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ARISTOTLE

PARTS OF ANIMALS

MOVEMENT OF ANIMALS

PROGRESSION OF ANIMALS
ARISTOTLE

PARTS OF ANIMALS

WITH AN ENGLISH TRANSLATION BY
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FELLOW OF CHRIST'S COLLEGE, CAMBRIDGE
AND UNIVERSITY LECTURER IN CLASSICS

AND A FOREWORD BY

MOVEMENT OF ANIMALS
PROGRESSION OF ANIMALS

WITH AN ENGLISH TRANSLATION BY
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CONTENTS

PARTS OF ANIMALS
Foreword . . . . . . . . . . . . 3
Introduction . . . . . . . . . 8
Text and Translation . . . . . 52

MOVEMENT OF ANIMALS
PROGRESSION OF ANIMALS
Introduction . . . . . . . . . . 436
Text and Translation . . . . . 440

Index to Parts of Animals . . . . . 543
Index to Movement and Progression of Animals . . . . . . . 552
From quotations which I had seen, I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere schoolboys to old Aristotle.

Charles Darwin to William Ogle, on the publication of his translation of *The Parts of Animals*, 1882.
PARTS OF ANIMALS
To
A. E. P. and L. A. P.
Aristotle refers to the *De partibus animalium* as an inquiry into the causes that in each case have determined the composition of animals. He does not, however, employ the category of causation in the manner normally adopted by men of science, since in this book causes are always considered in relation to ends or purposes, and design is regarded as having had a far larger share in the origin and development of living structures than that allotted to necessity.

In the *Historia animalium* the parts themselves are described, for although this work is to some extent physiological, its main object was to deal with the anatomy of the organism. The *De partibus animalium*, on the other hand, is almost exclusively physiological and teleological, and treats of the functions of the parts. But Aristotle's position was that of a teleologist only in a limited degree, for he appears to have taken that view of life which Bergson calls the doctrine of internal finality (that is to say, that each individual, or at any rate each species, is made for itself, that all its parts conspire for the greatest good of the whole, and are intelligently organized in view of that end but without regard for other organisms or kinds of organisms). Since every organ or part of the body was held to have its peculiar function, the existence of vestigial or rudimentary organs was
unrecognized. This was the doctrine of internal finality which was generally accepted until Darwin elaborated his theory of Natural Selection. The wider doctrine of external finality, according to which living beings are ordered in regard to one another, never gained acceptance among scientific philosophers, and the only indication that Aristotle ever adopted it is furnished by a passage in which he suggests that the mouth in Selachians is placed on the under surface so as to allow their prey to escape while the fish are turning on their backs before taking their food; but even this he qualified by the suggestion that the arrangement served a useful end for the fishes in question by preventing them from indulging in the harmful habit of gluttony.

The De partibus animalium opens with an introduction devoted to general considerations. This is followed by a discussion of the three degrees of composition, the first degree being composition of physical substances, the second degree, of homogeneous parts or tissues, and the third, of heterogeneous parts or organs. The tissues referred to are blood, fat, marrow, brain, flesh, and bone. After describing these, the organs are dealt with, and a consideration of their respective functions, first in sanguineous animals (i.e. in Vertebrates), and secondly in bloodless animals (i.e. Invertebrates), occupies the remainder of the book. The account given of the physiology of the blood is especially interesting, and it is noteworthy that Aristotle understood something of the nature of the process of absorption whereby the food becomes converted into nutriment which is carried by the blood to all parts of the body. He supposed, however, that the matter derived from the
gut passed first to the heart in the form of vapour or serum, and that it was there converted into true blood by a process of concoction. Aristotle knew nothing of the real nature of respiration, and he regarded the lungs as serving to temper the bodily heat by means of the inspired air. He was also entirely ignorant of the fact that the blood passes back to the heart and lungs after supplying the tissues and organs with nourishment. On the other hand, he fully appreciated the existence of excretory organs, the function of which was to remove from the body such substances as could not be utilized. In this category are included fluids such as bile, urine, and sweat. In the section on the gall-bladder, as in so many other passages in his works on natural history, it is truly remarkable how correct Aristotle is in his statements. He points out that the gall-bladder is not found either in the horse and ass or in the deer and roe, but is generally present in the sheep and goat. In the light of the knowledge that he possessed, therefore, Aristotle could scarcely have adopted a theory about this organ which has found expression in certain modern writings. According to this theory the gall-bladder is present in the sheep and ox because, these being ruminating animals, bile is only required at certain particular times when food passes into the intestine, whereas in the horse, which does not chew the cud, but yet is constantly eating, food is continually passing into the intestine and consequently a perpetual flow of bile is desirable. Since the gall-bladder is present in the non-ruminating pig but absent in the ruminating deer and roe, it is obvious that this theory cannot be consistently applied.
It is interesting to speculate about the school of research workers who must have contributed in providing material for this and the other works on natural science ascribed to Aristotle—who they were, the circumstances under which they lived, and what manner of facilities were available for their investigations—for it would seem certain that no man single-handed could possibly have acquired such a vast body of knowledge, hardly any of which could have been derived from earlier observers. Yet the work in its completed whole seems to show the mark of one master hand, and its uniform character and the clear line of teleological reasoning that runs through it have been well brought out in Dr. Peck’s translation. But putting aside its philosophical implications, the book consists of an attempt at a scientific record of all the apparently known facts relating to animal function. These are considered comparatively and as far as possible are brought into relation with one another. And thus, as the earliest text-book on animal physiology in the world’s history, this treatise will ever make its appeal, not only to the classical philosopher, but to all who are interested in the origin and growth of biological science.

F. H. A. M.
INTRODUCTION

Title. The traditional title of this treatise is not a very informative one. The subject of the work is, however, stated quite clearly by Aristotle at the beginning of the second Book in these words: "I have already described with considerable detail in my *Researches upon Animals* what and how many are the parts of which animals are composed. We must now leave on one side what was said there, as our present task is to consider what are the causes through which each animal is as I there described it" (646 a 7 foll.). The title ought therefore to be "Of the Causes of the Parts of Animals," and this is the title actually applied to it by Aristotle himself (at *De gen. an.* 782 a 21).a Even so, the word "parts" is misleading: it includes not only what we call parts, such as limbs and organs, but also constituents such as blood and marrow.b Perhaps, therefore, no harm is done by leaving the accepted (and convenient) Latin title untranslated.

The *De partibus*, as well as the other treatises contained in this volume, forms a portion of Aristotle’s zoological works. The foundation of these is the *Historia animalium*, or *Researches about Animals*, in nine books (the tenth is generally held to be

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a For the meaning of Cause see note below, p. 24.
b See note on "part" below, p. 28.
PARTS OF ANIMALS

spurious), in which observations are recorded, and consequent upon this are the treatises in which Aristotle puts forward theories founded upon these observations.

An animal is, according to Aristotle, a "concrete entity" made up of "matter" and "form." Hence, in the De partibus Aristotle treats of the causes on account of which the bodies—the "matter"—of animals are shaped and constructed as they are, in general; in the De incessu he deals specially with the parts that subserve locomotion. In the De anima he proceeds to consider Soul—the "form" of an animal. In the remaining treatises, of which De motu, included in this volume, is one, he deals with what he calls the functions "common to body and Soul," among which he includes sensation, memory, appetite, pleasure, pain, waking, sleeping, respiration, and so forth (see De sensu 436 a). The complete scheme is set out below:

I. Record of observations.
   Historia animalium. 10 (9) books.

II. Theory based upon observations.

\[
\begin{align*}
(a) \quad & \begin{cases} 
De \ partibus \\
\text{animalium} \\
\text{De incessu} \\
\text{animalium}
\end{cases} \\
\quad & \begin{cases} 
4 \text{ books} \\
1 \text{ book}
\end{cases} \end{align*}
\] treating of the way in which the "matter" of animals is arranged to subserve their various purposes.

\[
(b) \quad De \ anima \quad 3 \text{ books} \end{align*}
\] treating of the "form" of animals — the Soul.
ARISTOTLE

\[
\begin{align*}
\text{Parva naturalia} & \quad - \\
\text{De motu animalium} & \quad 1 \text{ book} \\
\text{De generatione animalium} & \quad 5 \text{ books}
\end{align*}
\]
treating of the functions "common to body and Soul," and in particular of some special departments of animal behaviour.

The section (b) is necessary to the completeness of the scheme, but as it has given rise to a whole department of study, it is usually treated apart from the rest. Thus the main bulk of the zoological and biological works may be taken to consist of the three great treatises, Historia animalium, De partibus animalium, and De generatione animalium. It was these which, through translations made from the Arabic, were restored to the West by those who revived scientific studies at the beginning of the thirteenth century.

The late D'Arcy W. Thompson, in the prefatory note to his translation of H.A., wrote: "I think it can be shown that Aristotle's natural history studies were carried on, or mainly carried on, in his middle age, between his two periods of residence at Athens," i.e. in the Troad, in Lesbos and in Macedonia, between the years 347 and 335: and this view has recently received convincing support from Mr. H. D. P. Lee, who bases his argument upon an examination of the place-names in H.A. This is opposed to the view which has been current for some years past, that the zoological works belong to a late period in Aristotle's life, and has important consequences for the reconstruction of Aristotle's philosophical develop-


b C.Q. xlii. (1948), 61 ff.

PARTS OF ANIMALS

ment, which cannot be dealt with here. It may, however, be remarked that, as Thompson said, it would follow that we might legitimately proceed to interpret Aristotle's more strictly philosophical work in the light of his work in natural history. But apart from these considerations, the great importance of the zoological works is that they represent the first attempt in Europe to observe and describe in a scientific way the individual living object.

Throughout the De partibus Aristotle endeavours to provide a Final Cause to explain the facts which he records—some purpose which they are supposed to answer; and Causes of this sort are by far the most common in his treatise. His outlook is therefore justly described as "teleological"; but it is important not to read too much into this description. Aristotle is never tired of telling us that Nature makes nothing and does nothing "without a purpose"; but if we ask what that purpose is we may find that the answer is not quite what we had expected. Plato's notion of the "form" tended to divert his attention from individuals through a hierarchy of successive "forms"; but for Aristotle "form" is not independent of matter: form must be embodied in some matter, that is, in individuals. Thus we find all through that Aristotle cannot long keep his eyes from the individual wherein the form is actually embodied, because it, after all, is the End, the crowning achievement of the efforts of the four Causes. This outlook controls the arrangement of Aristotle's treatise. Since all processes of production are determined by the nature of the product which is to result from them, it is the fully developed product which we must first make it our business to observe,

* The four Causes are dealt with in a separate note, p. 24.
and when we have discovered what are its actual characteristics we may then go on to work out its Causes and to examine the processes by which it was produced.

I give a brief synopsis and a contents-summary of the De partibus:

**BRIEF SYNOPSIS OF DE PARTIBUS**

Introduction: Methods.

Composition of Substances: Three modes:

1. The primary substances.
2. The "uniform" parts.
3. The "non-uniform" parts.

Consideration of:

1. Hot, cold, solid, fluid.
2. Uniform parts: (a) fluid, (b) solid.
3. Non-uniform parts, as follows:

- External parts of animals.
- Internal parts of blooded animals.
- Internal parts of bloodless animals.
- External parts of bloodless animals.
- External parts of blooded animals (resumed).
  - (a) Vivipara.
  - (b) Ovipara.

**SUMMARY**

Book I.

639 a 15 ch. 1  Introduction. On the Method of Natural Science.

Two questions propounded:

1. Are we to begin with the ultimate species and describe its characteristics, or with those that are common to many species?
(2) (Put in three ways):

(a) Are we to take first the phenomena, and then proceed to their Causes?
(b) Which is the primary Cause, the Final or the Efficient (Motive)?
   (Answered immediately: The Final; with a reference also to the influence of Necessity.)
(c) Are we to discuss first the processes by which the animal is formed, or the characteristics of it in its completed state?

*Answer to question (2).*

We must begin with the phenomena, then go on to the Causes, and the formative processes—or, in other words, the Final Cause concerns us first and foremost. This differs from the practice of the early philosophers, who concerned themselves with the Material Cause, though sometimes also with the Efficient (Motive) Cause. We must begin at the End, not at the beginning.

Thus we must consider not merely the primary substances, but the "uniform" parts, which are made out of them, and also the "non-uniform" parts. In doing this, we shall be paying attention to the Formal Cause, which is more important than the Material Cause: the animal as a finished whole is more significant than the substances out of which it was made.

But mere form or shape is not enough: "shaped matter" is not an animal. "Form" in its full and true sense involves "Soul": "Soul" somehow is the animal's Efficient and Final Cause. Actually, it is not Soul in its entirety, but
some “portion” of Soul which fulfils this office.

641 b 10 Thus the universe and the living objects in it are the products of something analogous to human art: they are controlled by a Final Cause.

642 a 1 But Necessity also has its place in the universe—

not (1) “absolute” necessity
nor (2) “coercive” necessity
but (3) “conditional” necessity.

These two Causes, the Final Cause and Necessity, set the stage for our piece.

642 b 5 ch. 2 Criticisms of dichotomy as a method of classification of animals.

644 a 11 ch. 4 The correct method of classification is by groups, such as Birds and Fishes.

644 a 23 Answer to question (1).
We must deal with groups, not species (e.g. Bird, not Crane), and where a species does not belong to a larger group, we must deal with species, not individuals (e.g. Man, not Socrates).

644 b 21 ch. 5 An Exhortation to the study of animals.

645 b 1 Final summary of the Method, combining answers to both the original questions:
(1) First we discuss the attributes common to a group;
(2) Then we give the explanation of them.

Book II.

646 a 8 ch. 1 Purpose and outline of the Treatise: Our subject is the causes of the parts of animals.
Three modes of composition:

(1) Out of the "elements" or dynameis (hot, cold, fluid, solid).
(2) The uniform parts (bone, flesh, etc.).
(3) The non-uniform parts (face, hand, etc.).

The relation of them to each other, and the way in which the Causes control this relation.

Parts may be divided into:

(a) Instrumental parts (non-uniform).
(b) Media of sensation (uniform).

The faculty of sensation has its seat in the heart, which is thus uniform; but it is also non-uniform, as it has to do with motion.

The uniform parts, generally. Variations occur in each of them, as is illustrated by the example of Blood.

Resumption of the Three modes of composition:

(1) The primary substances: meaning of "hot," "cold," "solid," "fluid," with special reference to Blood. This merges into a discussion of

(2) The Uniform parts.


Lard and Suet (forms of Blood).
Marrow (a form of Blood).
The Brain.

Flesh—the "part" par excellence—and its counterpart.

Bones, and their counterparts, and parts similar to Bone.

(3) The Non-uniform parts of animals.

(This occupies the rest of the work.)
ARISTOTLE

655 b 28 General statement of the three organs indispensable to animals.
656 a 14 Head: Brain. Sense-organs.
657 a 12 ch. 11 Ears.
657 a 25 ch. 13 Eyes, etc. (ch. 14: Eyelashes and digression on Hair).
658 b 27 ch. 16 Nostrils (esp. the Elephant's).
659 b 20 Lips.
660 a 14 ch. 17 Tongue.

Book III.
661 a 34 ch. 1 Teeth.
661 b 27 (Note on "the more and less.")
662 a 16 Mouth.
662 a 34 Beak.
662 b 23 ch. 2 Horns.
664 a 13 ch. 3 Neck: Oesophagus.
664 a 36 Larynx and windpipe.
664 b 20 Epiglottis.

665 a 27 ch. 4 Internal Parts of Blooded Animals: Viscera:
665 b 5 Heart.
667 b 15 ch. 5 Blood-vessels (Great Blood-vessel and Aorta, and generally).
668 b 33 ch. 6 Lung.
669 b 13 ch. 7 (Why viscera are double, and other remarks.) Liver and Spleen.
670 b 32 ch. 8 Bladder.
671 a 26 ch. 9 Kidneys.
672 b 8 ch. 10 Diaphragm.
673 b 4 ch. 11 Membranes.
673 b 12 ch. 12 Variations in the Viscera (Liver and Spleen).
674 a 9 ch. 14 Stomach and Intestines.
675 b 29 Jejunum.
676 a 7 ch. 15 Rennet.

Book IV.
676 a 23 ch. 1 General. Internal parts of Ovipara.
16
### Parts of Animals

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Part Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>676 b 16 ch. 2</td>
<td>Gall-bladder and Bile.</td>
</tr>
<tr>
<td>677 b 15 ch. 3</td>
<td>Omentum.</td>
</tr>
<tr>
<td>677 b 37 ch. 4</td>
<td>Mesentery.</td>
</tr>
<tr>
<td>678 a 27 ch. 5</td>
<td>Internal Parts of Bloodless Animals (Insects, Testacea, Crustacea, Cephalopods). With special reference to the Sepia’s “ink,” and the Sea-urchin’s “ova.”</td>
</tr>
<tr>
<td>681 a 10</td>
<td>Creatures intermediate between animals and plants.</td>
</tr>
<tr>
<td>682 a 30</td>
<td>External Parts of Bloodless Animals:</td>
</tr>
<tr>
<td>682 a 35 ch. 6</td>
<td>Of Insects.</td>
</tr>
<tr>
<td>683 b 4 ch. 7</td>
<td>Of Testacea.</td>
</tr>
<tr>
<td>683 b 25 ch. 8</td>
<td>Of Crustacea.</td>
</tr>
<tr>
<td>684 b 7 ch. 9</td>
<td>Of Cephalopods.</td>
</tr>
<tr>
<td>685 b 30 ch. 10</td>
<td>External Parts of Blooded Animals:</td>
</tr>
<tr>
<td></td>
<td>(a) Vivipara, (b) Ovipara.</td>
</tr>
<tr>
<td>686 a 6</td>
<td>Head and Neck.</td>
</tr>
<tr>
<td>686 a 24</td>
<td>Hands and Feet and relative proportion of limbs. Beginning from Man, whose position is upright, there is a gradation of declivity in the animals, continuing to the plants, which are upside-down.</td>
</tr>
<tr>
<td>687 a 2</td>
<td>Nature’s habit in assignment of organs. The structure of the human hand, etc.</td>
</tr>
<tr>
<td>688 a 12</td>
<td>Breast.</td>
</tr>
<tr>
<td>689 a 4</td>
<td>Excretory organs.</td>
</tr>
<tr>
<td>689 b 2</td>
<td>Rear parts.</td>
</tr>
<tr>
<td>690 a 5</td>
<td>Hoofs, hucklebones, etc.</td>
</tr>
<tr>
<td>690 b 12 (b) Ovipara:</td>
<td></td>
</tr>
<tr>
<td>690 b 18</td>
<td>(i) Serpents and Quadrupeds.</td>
</tr>
<tr>
<td>692 b 4</td>
<td>(ii) Birds.</td>
</tr>
<tr>
<td>695 b 2</td>
<td>(iii) Fishes.</td>
</tr>
</tbody>
</table>
Aristotle

697 a 15 (c) Intermediate Creatures:
Cetacea.
Seals and Bats.
Ostrich.

697 b 27 Conclusion.

A glance at the summary will show clearly the order of subjects which Aristotle lays down in the first book to be followed in a treatise such as the one in which he is engaged.

First, (A) to describe the parts of animals as they are observed to be; and then, (B) to give an account of their causes, and their formative processes.\(^a\)

Under (A) the order of preference is to be: first, the parts (1) common to all animals; (2) where necessary, those common to a group of animals only; and lastly, (3) in exceptional instances, those peculiar to a single species.

Also, it will be seen how Aristotle works out this scheme in the three books which follow. Before considering that, however, we should notice that Aristotle has a great deal to say about the correct classification of animals—or rather, against the incorrect classification of them. Chiefly, he inveighs against the method of dichotomy; and his chief objection to it is a simple and effective one—that it does not work. It forces us to assign to each species one distinguishing mark, and one only (642 b 21—643 a 24). And it cuts off kindred species from each other on the strength of some quite subordinate

\(^a\) *De partibus* is concerned chiefly with the causes and less with the processes.
PARTS OF ANIMALS

characteristic (642 b 10 foll.). The right method, says Aristotle, is to follow popular usage and divide the animals up into well-defined groups such as Birds and Fishes. And this leads him to distinguish two stages of difference:

(a) Cases in which the parts differ "by excess or defect"—as in different species of the same genus or group.

(b) Cases in which the resemblance is merely one of analogy—as in different genera.

Examples of (a): differences of colour and shape; many or few; large or small; smooth or rough; e.g. soft and firm flesh, long and short bill, many or few feathers.

(b) bone and fish-spine; nail and hoof; hand and claw; scale and feather.

(Reff. for the above, De part. an. 644 a 11–b 15; Hist. an. 486 a 15–b 21. See also Gen. An. (Loeb), Introd.)

The doctrine of differences of "excess and defect," "The more and less," or, as Aristotle also calls them, of "the more and less," may usefully be compared with that which underlies the modern theory of Transformations, and the comparison of related forms. Indeed, Professor D'Arcy Thompson asserts that "it is precisely ... this Aristotelian 'excess and defect' in the case of form which our co-ordinate method is especially adapted to analyse, and to reveal and demonstrate as the main cause of what (again in the Aristotelian sense) we term 'specific' differences" (Growth and

a And of course, into Blooded and Bloodless, though there are, as Aristotle points out, no popular names for these groups.
The co-ordinates to which he refers are those of the Cartesian method, on which is based the theory of Transformations. By means of them it is possible to exhibit, say, the cannon-bones of the ox, the sheep, and the giraffe as strictly proportionate and successive deformations of one and the same form. These deformations can be either simple elongations, as in the instance just cited, or they may occur according to an oblique or a radial system of co-ordinates, etc.\(^a\) In this way, differences of "excess and defect" are reduced to the terminology of mathematics; and it is especially interesting to notice this, as the phrase "excess and defect" itself had, in the Greek of Aristotle's time, a mathematical connexion. With it may be compared the well-known Platonic phrase, "the great and small." But this is not the place to enlarge upon such topics.\(^b\)

To return to Aristotle's classification. We find that he implements his preliminary outline in the following way:

I. First, he treats of the parts which are found in many different groups of animals, and also those which are to be considered counterparts of each other in different groups. This corresponds to A (1) above.

II. As he proceeds with this, he comes to the Viscera, which occur only in blooded animals.\(^c\) This provides a convenient point for embarking upon his second main division—corresponding

\(^a\) For details see D’Arcy Thompson, \textit{op. cit.} ch. xvii.

\(^b\) The reader is referred to A. E. Taylor, "Forms and Numbers," in \textit{Mind}, xxxv. 419 foll.; xxxvi. 12 foll.; D'Arcy Thompson, "Excess and Defect," in \textit{Mind}, xxxviii. 43 foll.

\(^c\) By "viscera" Ar. means the blood-like ones only.
PARTS OF ANIMALS

to A (2) above—the parts common to a group of animals, and we have first:
The Internal Parts of Blooded Animals.

III. This is followed by—
The Internal Parts of Bloodless Animals. Then,

IV. The External Parts of Bloodless Animals. Then,

V. The External Parts of Blooded Animals, which includes—

(a) Vivipara.
(b) Ovipara.
   (i) Serpents and Quadrupeds.
   (ii) Birds.
   (iii) Fishes.
(c) Intermediate Creatures.

References to exceptional instances, as to Man, corresponding to the division A (3) above, are of course to be found throughout the work.

Aristotle thus works out the main lines of his classification. And in each instance, where possible, he endeavours to assign the Cause, to name the purpose, which is responsible for the parts as he describes them. This corresponds to (B) above.

And here Aristotle is forced to admit an apparent necessity. Add tion to his scheme of Causes. The purpose, the good End, the final Cause, cannot always get a free hand. There is another Cause, Necessity. Aristotle takes great care to explain what is the nature of this Necessity (642 a 2 foll.). It is what he calls Necessity "ex hypothesi," or "conditional" Necessity, the sort of Necessity which is implied by any final Cause being what it is. If a piece of wood is to be split by an axe, the axe must ex hypothesi be hard and sharp, and that necessitates the use of bronze or
iron in the making of it. The same sort of Necessity applies in the works of Nature, for the living body itself is an instrument. It is thus the final Cause which necessitates the various stages of the process of formation and the use of such and such material.

Another kind of Necessity, however, makes its appearance in Natural objects, and that is “simple” Necessity. The mere presence of certain things in a living organism entails of necessity the presence of others (see 645 b 32, 677 a 17, b 22). Some results follow inevitably from the very nature of the material used. This “simple” Necessity can therefore be regarded as a reassertion of themselves by the motive and material Causes as against the final Cause. Sometimes, however, even in circumstances where “simple” Necessity operates, Nature is able to use the resulting products to subserve a final Cause (663 b 22, 32, 677 a 15; see also the note on Residues, p. 32). Cf. Gen. An. (Loeb), Introd. §§ 6-9.

The following table will show at a glance the scheme of Animals as treated of by Aristotle in the De partibus:

<table>
<thead>
<tr>
<th>A. BLEDDED ANIMALS</th>
<th>B. BLOODLESS ANIMALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man</td>
<td>Insects</td>
</tr>
<tr>
<td>Viviparous quadrupeds</td>
<td>Testacea</td>
</tr>
<tr>
<td>Oviparous quadrupeds</td>
<td>Crustacea</td>
</tr>
<tr>
<td>and footless animals</td>
<td>Cephalopods</td>
</tr>
<tr>
<td>(reptiles and amphibians)</td>
<td></td>
</tr>
<tr>
<td>Birds</td>
<td></td>
</tr>
<tr>
<td>Fishes</td>
<td></td>
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</tbody>
</table>

* See De gen. an. 778 b 1.
PARTS OF ANIMALS

<table>
<thead>
<tr>
<th>Intermediate between the above classes</th>
<th>Intermediate between animals and plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>between land and water animals</td>
<td>Ascidians</td>
</tr>
<tr>
<td>Cetacea</td>
<td>Sponges</td>
</tr>
<tr>
<td>Seals</td>
<td>Holothuria</td>
</tr>
<tr>
<td>between quadrupeds and birds</td>
<td>Acalephae</td>
</tr>
<tr>
<td>Bats</td>
<td></td>
</tr>
<tr>
<td>Ostrich</td>
<td></td>
</tr>
</tbody>
</table>

Note on the Four Classes of Bloodless Animals.— These, in order of increasing softness, as noted above, are the following (I give the Greek term, its literal translation, and the term which I have used to translate it in this volume):

<table>
<thead>
<tr>
<th>Greek Term</th>
<th>English Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>τὰ ἐντόμα</td>
<td>insected animals</td>
</tr>
<tr>
<td>τὰ ὀστρακόδερμα</td>
<td>shell-skinned animals</td>
</tr>
<tr>
<td>τὰ μαλακόστρακα</td>
<td>soft-shelled animals</td>
</tr>
<tr>
<td>τὰ μαλάκια</td>
<td>softies</td>
</tr>
</tbody>
</table>

In using "Testacea" to translate τὰ ὀστρακόδερμα ("the animals with earthenware skins"), I use it in the old-fashioned sense, so as to include a number of shelled invertebrates, comprising Gasteropods, Lamellibranchs, and some Echinoderms. It does not refer to the Testacea of modern zoologists, by whom the term is applied to the Foraminifera which are shelled Protozoa. The word "Ostracoderms" (a transliteration of Aristotle’s word) is now given by zoologists to a group of primitive fossil fishes.
The following notes on some of the more difficult and important of the technical terms used by Aristotle in the *De partibus* will, I hope, help to explain my translation and also to give some indication of the background of Aristotle's thought. (A fuller account will be found in *De Gen. An.*, Loeb edn.)

*Αἰτία*, "cause."

I retain the traditional translation "cause," although perhaps in some contexts "reason" may be a closer rendering, but a variation in the English term might well produce more confusion than clarity. To know, says Aristotle, is to know by means of Causes (see *Anal. post.* 91 a 20). A thing is explained when you know its Causes. And a Cause is that which is responsible, in any of four senses, for a thing's existence. The four Causes, of which two are mentioned very near the beginning of the first book (639 b 11), are:

1. The Final Cause, the End or Object towards which a formative process advances, and *for the sake of which* it advances—the *logos*, the rational purpose.

2. The Motive (or Efficient) Cause, the agent which is responsible for having set the process in motion; it is that *by which* the thing is made.

3. The Formal Cause, or Form, which is responsible for the *character* of the course which the process follows (this also is described as the *logos*, expressing *what* the thing is).

4. The Material Cause, or Matter, *out of which* the thing is made.
PARTS OF ANIMALS

It will be seen that the first three Causes tend naturally to coalesce under the aegis of the Formal Cause, in opposition to the fourth, the Material Cause, a contrast which is clearly put by Adam of St. Victor in one of his hymns:

effectiva vel formalis
causa Deus, et finalis,
sed numquam materia.

Hence, of course, comes the regular contrast of “form” and “matter,” in which, oddly enough, in modern usage the two terms have almost exchanged meanings. “Mere form,” “empty form,” in contrast with “the real matter,” are phrases which indicate a point of view very different from that of Aristotle. An equally drastic reversal of meaning has overtaken the term “substance,” as controversies on “transubstantiation,” and the existence of the word “unsubstantial” prove. “Cause” has certainly been more fortunate; but its meaning has been narrowed down, so that “cause” now usually suggests the “efficient” cause only. At the same time, we allow ourselves a wider variety of “efficient” causes than Aristotle, and are more ready to admit actions and events or even series of actions and events. We have, in fact, applied Aristotle’s precise terminology to the wider uses of everyday non-technical purposes. For Aristotle, the doctrine of the Four Causes provides an exhaustive and precise classification of the things which can be responsible for another thing’s existence, and by the naming of them the thing can be completely accounted for.

As an illustration the following will serve. Suppose the object to be explained is an oak. The
chronological order of the Causes is different from their logical one.

(i.) The Motive Cause: the parent oak which produced the acorn.

(ii.) The Material Cause: the acorn and its nourishment.

(iii.) The Formal Cause. The acorn as it grew into a tree followed a process of development which had the definite character proper to oaks.

(iv.) The Final Cause: the end towards which the process advanced, the perfected oak-tree.

Δόγος.

There are several places in the De partibus where, rather than represent λόγος by an inadequate or misleading word, I have transliterated it by logos. This serves the very useful purpose of reminding the reader that here is a term of very varied meanings, a term which brings into mind a number of correlated conceptions, of which one or another may be uppermost in a particular case. It is an assistance if we bear in mind that underlying the verb λέγειν, as it is most frequently used, is the conception of rational utterance or expression, and the same is to be found with λόγος, the noun derived from the same root. Δόγος can signify, simply, something spoken or uttered; or, with more prominence given to the rationality of the utterance, it can signify a rational explanation, expressive of a thing's nature, of the plan of it; and from this come the further meanings of principle, or law, and also of definition, or formula, as expressing
the structure or character of the object defined. (Note here the application of the term *logos* to the Final and Formal Causes, recorded in the foregoing note.) Another common meaning is seen especially in the use of the dative λόγῳ (cf. the verb λογίζομαι and its noun)—by reasoning, in thought, as opposed to fact or action. (See 640 a 32, Art is the λόγος τοῦ ἔργου ὁ ἀνευ τῆς ύλης; at 646 b 2 we read of the λόγος of a process of formation such as building, and the λόγος of the house which is built; at 678 a 35 of the λόγος which defines the essence of something, and at 695 b 19 of “the λόγος of the essence.” At 639 b 15 the “Cause for the sake of which”—the Final Cause—is described as being a λόγος.)

Γένεσις, “formation,” or “process of formation.”
Γέγνεσθαι, “to be formed,” “to go through a process of formation.”

These are the translations which I normally use, as more appropriate in a biological treatise than “coming into being,” and the like.

The process of formation is of course closely connected in Aristotle’s thought with the doctrine of the Four Causes.

Γένεσις is a process which, at any rate in biology, results in the production of an actual object, a living creature.

Γένεσις is also contrasted with οὐσία and φύσις: the order of things, we are told, in the process of formation is the reverse of the order in reality. For example, the bricks and mortar exist for the sake of the house

" Care should be taken not to regard φύσις as meaning "the process of φέσθαι."
which is to be built out of them, but they and not it come first in the order of time and fact. Aristotle sums this up by saying that what comes last in the process comes first in "nature" (646 a 25).

Mόριον, "part."

The term which occurs in the title of the treatise and is traditionally rendered "part" includes more than is normally included in the English "part of the body." For instance, this would not normally be applied to blood, but the term μόριον is applied by Aristotle to all the constituent substances of the body as well as to the limbs and organs. For him, blood is one of the ξύνων μόρια (648 a 2; see also 664 a 9, 690 a 8). A striking instance of the use of μόριον in this sense is the phrase τὰ ὀμοιομερῆ μόρια, which are the subject of the next following note.

Τὰ ὀμοιομερῆ μόρια, "the uniform parts."
Τὰ ἄνωμοιομερῆ μόρια, "the non-uniform parts."

Aristotle's application of the term μόριον to both these classes emphasizes the inclusiveness of its meaning. As examples of the "uniform" parts he mentions (647 b 10) blood, serum, lard, suet, marrow, semen, bile, milk, flesh—these are soft and fluid a ones; also bone, fish-spine, sinew, blood-vessel—these are hard and solid ones. Of "non-uniform" parts he gives as examples (640 b 20) face, hand, foot.

The relation of the "uniform" parts to the "non-uniform" he describes as follows (647 b 22 foll.):

a For the meaning of "fluid" and "solid" see below, p. 32.

28
PARTS OF ANIMALS

(a) some of the uniform are the material out of which the non-uniform are made (i.e. each instrumental part is made out of bones, sinews, flesh, etc.);
(b) some act as the nutriment of (a);
(c) some are the residue of (b)—faeces, urine.

It is not possible to equate the two classes with the later division into tissues and organs, since blood, for instance, though "uniform," is not a tissue; the term "organs," however, corresponds closely with Aristotle's own description—τὰ ὀργανικὰ μέρη (647 b 23), "instrumental parts."

The practical difference between the two classes is that each of the uniform parts has its own definite character as a substance (in the modern sense), while each of the non-uniform parts has its own definite character as a conformation or organ. The heart is the only part which belongs to both classes (647 a 25 foll.): it consists of one uniform part only, namely, flesh; but it also has essentially a definite configuration, and thus it is a non-uniform part.

Three stages or "degrees of composition," so far as biology is concerned, are enumerated by Aristotle (at 646 a 13 foll.). What Aristotle seems to mean, though he has not expressed himself quite clearly, is that there are three stages involved in the composition of compound bodies, namely,

(1) the δυνάμεις (see following note);
(2) the uniform parts;
(3) the non-uniform parts;

and finally, of course, out of the non-uniform parts
(4) the animal itself is composed.
We have thus:

(1) the simplest sorts of matter;
(2) the simplest organic substances compounded out of the foregoing (having no definite size, shape, or structure);
(3) the instrumental parts of the body constructed out of the foregoing (having definite size, shape, and structure); and
(4) the organism as a whole, assembled out of the foregoing.

Note.—For a description of the way in which the term τὰ δύναμεν has caused confusion in the accounts of Anaxagoras’s theories see Class. Qu., 1931, xxv. 34 following.

Δύναμις.

This is one of the most difficult terms to render in English.

The specialized meaning of δύναμις, “potentially,” as opposed to ἐνεργεῖα, “actually,” is so well known that there is no need to enlarge upon it here. Nor need I discuss the mathematical meaning of δύναμις. Other meanings need some comment.

(1) Δύναμις was the old technical term for what were later to be called στοιχεῖα (elements). It appears in the writings of the Hippocratic corpus and in Plato’s Timaeus. The best example of its use in De partibus is at the beginning of Book II. (646 a 15). The list of δύναμεις included the substances known as τὸ ύγρὸν, τὸ ἔγραφον, τὸ θερμοῦ, τὸ ψυχρόν, τὸ πυκνόν, τὸ γλυκύ, τὸ δρυμῆ, etc., etc. Only the first four of these were regarded by Aristotle as 30
the material of compound bodies: all the "other differences," he says, are consequent upon these.

The original meaning underlying this usage of the term seems to have been "strong substance of a particular character." This would be very appropriate to τὸ δριμὺν, τὸ πυκρόν, etc. (see Περὶ ἀρχαῖας ἱπτρυκῆς). There is no notion here of the substance having power in the sense of power to affect an external body in a particular way. (This meaning developed later.) If any effect did result, it would be described simply as the presence of the strong substance, and the remedy for it was to "concoct" the strong substance or otherwise to bring it into a harmless condition by "blending" it with other substances.

(2) As each of the substances known as δυνάμεις has its own peculiar character, sharply marked off from the others, the meaning of "peculiar and distinctive character" was naturally associated with the term. This seems to be its meaning in 655 b 12: ἐξ ἀνάγκης δὲ ταύτα πάντα γεώδη καὶ στερεῶν ἔχει τὴν φύσιν, ὅπλον γὰρ αὐτὴν δύναμιν. Indeed, in this meaning, δύναμις seems to be a slightly more emphatic version of φύσις, with which it is often used in conjunction (in Hippocrates, for instance), or in a parallel way as in the passage just cited. Compare also 651 b 21, where the marrow is asserted to be αἷματός τις φύσις, not, as some suppose, τῆς γονῆς σπερματικῆ δύναμις. Other instances of this use of δύναμις will be found in De partibus.

(3) From this usage it is not far to the idiomatic, pleonastic usage, e.g.:

678 a 13 ἡ τῶν ἐντέρων δύναμις almost = τὰ ἐντέρα.
682 b 15 ἡ τῶν πτερῶν δύναμις.

31
This is paralleled by a similar usage of φύσις:

663 a 34 ἡ τῶν κεράτων φύσις.
676 b 11 ἡ τῶν ἐντέρων φύσις.

(Other references for δύναμις: 640 a 24, 646 a 14, b 17, 650 a 5, 651 b 21, 652 b 8, 12, 653 a 2, 655 b 12, 658 b 34. See further Gen. An., Loeb edn., Introd. §§ 23 ff.).

Τὸ υγρόν καὶ τὸ ξηρόν, "fluid substance and solid substance," "the fluid and the solid."

These are two of the δυνάμεις.

Following Ogle, I use these renderings as being more in conformity with the definitions given by Aristotle than "the moist and the dry," which have often been used. Actually neither pair of English words quite expresses the Greek. Aristotle's definition of them (at De gen. et corr. 329 b 30) is this:

"υγρόν is that which is not limited by any limit of its own but can be readily limited, ξηρόν is that which is readily limited by a limit of its own but can with difficulty be limited"—i.e. of course by a limit imposed from without.

He discusses the various senses in which these terms are used at 649 b 9 following.

Περίττωμα, "residue."

This term I have translated throughout "residue,"
as being more literal and at the same time less misleading than "excrement." "Surplus" would have been even better if the word had been a little more manageable.

"Residue" is so called because it is that which is left over when the living organism, by acting upon the nutriment which it has taken, has provided itself with a sufficient supply for its upkeep. Some of the surplus will be useless material contained in the food from the outset, or else has been produced during the process of reducing the food into a condition suitable for its purposes in the body. The useless residues include the excrements. In order to appreciate the status of the useful residues the outlines of the processes through which the food passes must be kept clearly in mind. Briefly, then, the food is masticated in the mouth, then passed on to the stomach and then the heart, where it is concocted by means of heat—in other words, it is turned into blood, which is the "ultimate nourishment"; and this, when distributed into the blood-vessels, supplies the body with nutrition. Generally, however, more blood is produced than is necessary for the actual upkeep of the body, and this surplus undergoes a further stage of concoction, and is used by Nature in various ways. Marrow is a residue; so are semen, catamenia, milk. Sometimes, when nutrition is specially abundant, the surplus blood is concocted into fat (lard and suet). And some of the blood, reaching the extremities of the vessels in which it travels, makes its way out in the form of nails, claws, or hair. The Aristotelian doctrine of residues came down to Shakespeare, as is shown by the passage

*See page 34.*
ARISTOTLE

in Hamlet (iii. iv.) where the Queen says to Hamlet:

Your bedded haire, like life in excrements,
Start up, and stand an end.

This theory, as applied to hair, is expounded by Aristotle at 658 b 14 following, and modern biochemists have reason for believing that some pigmentation in animals, such as the black melanin of mammalian hair, or the yellow xanthopterine of the butterfly’s wing, is physiologically a form of excretion.

“Concoct,” “concoction.”

These terms, which have already appeared in these notes, are used to translate πέσσειν, πέψις. The Greek words are the same as those employed to denote the process of ripening or maturing of fruit, corn, and the like by means of heat—also that of baking and cooking.

Terms sometimes associated with these are μεταβολή and μεταβάλλειν. For example, at 650 a 5 we read that πέψις and μεταβολή take place διὰ τῆς τοῦ θερμοῦ δύναμεως; and at 651 b 26, as the creatures grow and get “matured,” the parts μεταβάλλει their colour, and so do the viscera.

Ψυχή, “Soul.”

The English word “Soul,” as will be seen, over-emphasizes, when compared with ψυχή, certain aspects of the Greek term, but it is by far the most convenient rendering, and I have used it in preference to “life” or “vital principle.”

It will be useful to have an outline of Aristotle’s general doctrine about Soul.

The different “parts” or “faculties” of Soul can
be arranged in a series in a definite order, so that the possession of any one of them implies the possession of all those which precede it in the list:

(1) nutritive Soul in all plants
(2) sentient Soul in all animals
(3) appetitive Soul in some animals
(4) locomotive Soul
(5) rational Soul in man only

At 641 a 23 Aristotle speaks of "parts" of the Soul, and though he often uses this phrase, the description he prefers is "faculties." In the passage which follows (641 a 33 foll.) all except appetitive Soul are mentioned. Sentient Soul is mentioned again at 650 b 24, 667 b 23, 672 b 16.

Aristotle raises the question whether it is the business of Natural science to deal with Soul in its entirety, and concludes that it is not necessary, since man is the only animal in which rational Soul is found. Thus it is only some part or parts of Soul, and not Soul in its entirety, which constitute animal nature.

In the passage 641 a 14 following, Aristotle takes for granted his doctrine about Soul, which is as follows (De anima, Book II.). Animate bodies, bodies "with Soul in them" (ἐν ψυχῇ), are "concrete substances" made up of matter and form. In this partnership, of course, the body is the matter and the Soul is the form. Thus Soul may be described as the "form" or "realization" (ἐν τελείω, "actuality") of the animal (cf. De part., loc. cit.).

This statement, however, is elsewhere made more precise. It is possible to distinguish two "realizations" of an animal; for an animal "has Soul in it"
even when it is asleep, but its full activity is not evident until it is awake and about its business. We must call Soul, then, the "first realization" of the animal, its waking life its "second realization." This distinction does not concern us in the *De partibus*. But an expansion of the definition is not irrelevant. Aristotle states that the Soul is the first realization of a body furnished with organs. The priority of Soul over body is emphasized in the passage just referred to (640 b 23—641 a 32), and in another interesting passage (687 a 8 foll.) Aristotle maintains that man has hands because he is the most intelligent animal, and not, as some have said, the most intelligent animal because he has hands.

With this is connected the question whether the Soul is independent of the body; though it is not raised in *De partibus*. As we have seen already, a ᾲγων is a single concrete entity made up of Soul and body, i.e. a certain form implanted in certain matter. The matter can exist, for it did exist, apart from the form; and as the form that is implanted in all the individuals of a species is one and the same form, clearly it can exist apart from any one individual’s matter—though of course its existence is not independent of all the individuals’ matter. Furthermore, the form—the Soul—requires matter of a particular kind: not any sort of matter will do. From these considerations two conclusions seem to follow: (1) that transmigration is impossible: a human Soul cannot function in a hyena’s body, any more than the carpenter’s art can be executed by means of musical instruments; (2) the Soul cannot function without a body at all; cannot, we may say, exist (414 a 19).
PARTS OF ANIMALS

So far, so good. But Aristotle is not satisfied. He feels the Soul is more than that. He finds a loophole. There may be some "part" of Soul (the rational part) which is not the "realization" of any body. The Soul, besides being the form, the formal Cause, of the body, is also its final Cause, and not only that, but the motive Cause too of all the changes originated in the body (De anima 415 b 7-28), for, as we saw (p. 25), the three non-material Causes tend to coalesce into one. This independent "part" of Soul "comes into the body from without" (see De gen. an. 736 b 25 foll.) and continues to exist after the death of the body (see De anima 413 a 6, b 24 foll., 430 a 22, etc.). All this, however, raises problems not touched upon in De partibus; indeed Aristotle himself offers no solution of them.

Ψυχή, κρᾶσις, ἀπόκρισις, σύντηξις.

I have indicated above, in the note on δύναμις, some of the older (Hippocratic) medical terminology of which traces are to be found in the De partibus. There is no room for an adequate discussion of such terms and theories, and the following bare references must suffice.

In the Hippocratic treatise Περὶ διαίτης the theory is put forward that the human organism, body and Soul alike, is composed of fire and water (which really consist of "the hot," "the solid," "the cold," and "the fluid")—the function of fire being to cause motion, of water to provide nourishment. In ch. 35 we have a list of the different varieties of Blend (κρῆσις, σύγκρησις) of fire and water which may be
ARISTOTLE

found in the Soul in different individuals, and upon the Blend its health and sensitivity \(^a\) depend.

With these statements may be compared the following passages in *De partibus*:

652 b 8 Some, says Aristotle, maintain that the Soul *is* fine; but it is better to say that it subsists in some such material. "The hot" is indeed the most serviceable material for the functions which the Soul has to perform, and these include nourishing and causing motion.

647 b 30 foll. Here is a reference to the different varieties of blood, and Aristotle tells us which sort of blood is *αισθητικότερον* and which animals are on that account *φρονιμότερα* (cf. 650 b 24 and 686 b 28). The phrase *αἷματος κρασίς* is actually used at 686 a 9. (Cf. also 650 b 29, the *κρασίς* in the heart; 652 b 35, the parts in the head are colder than the *σύμμετρος κρασίς*; 669 a 11, the *κρασίς* of the body; 673 b 26, its *εὐκρασία*.)

The term *σύντηξις*, which occurs frequently in the *Περὶ διαίτης*, is found only once in the *De partibus* at 677 a 14—bile is said to be a residue or *σύντηξις*. Properly speaking, *σύντηξις* is the term applicable to the "colliquescence" or decay of the parts of the body themselves. (Cf. *σύντηγμα* at *De gen. an.* 724 b 26 foll.; also *σύντηξις*, 456 b 34; cf. also Platt's note at the end of his translation of *De gen. an.*, on 724 b 27.) The effect of the colliquescence is to produce an

\(^a\) The adjective used is *φρόνιμος*. 

38
unhealthy ἀπόκρισις (absecession)—a very common term in Περὶ διαίτης (see chh. 58 foll. throughout). It occurs twice in De partibus. In both places it is used of a περίττωμα. At 690 a 9 the surplus earthy matter ἀπόκρισις λαμβάνει, and forms a continuous nail or hoof. At 681 b 35 Aristotle speaks of the place where the σπερματική or the περιττωματική ἀπόκρισις is effected; and here ἀπόκρισις seems to mean simply “act of excretion.” The meaning of the term seems both here and in Hippocrates to be specially associated with περιττώματα, either useful ones, or useless and even harmful ones. A great deal of Περὶ διαίτης is taken up with suggestions for getting rid of harmful ἀποκρίσεως.

The meaning of ἀπόκρισις is therefore wider than “excretion” or “secretion,” as used in their present usual sense, though these are included among its meanings.

Τὸ μᾶλλον καὶ ἵπτον, “the more and less,” see above, p. 19, and Gen. An. (Loeb), Introd. §§ 70 ff.

Translators of Aristotle’s Zoology

The history of the translation of Aristotle’s works begins with the Nestorian Christians of Asia Minor, who were familiar with the Greek language as their service-books were written in it, and before the coming of the Arabs they had translated some of the works of Aristotle and Galen into Syriac. Before
435, Ibas, who in that year was made Bishop of Edessa, had translated into Syriac the commentaries of Theodore on the works of Aristotle. Jacob, one of Ibas’s successors at Edessa (d. 708), translated the Categories into Syriac, but a much earlier version had been made by Sergios of Resh 'Ainâ (d. 536), who had studied Greek at Alexandria. In 765 the Nestorian physician Georgios was summoned to Bagdad by the Caliph, and translated numerous Greek words into Arabic for him. By the beginning of the ninth century, translation was in full swing at Bagdad, under the Caliphate of al-Mamun (813–833), son of Harun-al-Rashid. The first leader of this school of translators was the physician Ibn al-Batriq, who translated the Historia animalium, the De partibus animalium, and the De generatione animalium into Arabic.

But it was through southern Italy, Sicily and Spain that the transmission of Aristotle’s works from the Arabic into Latin was effected. Messina had been recovered from the Saracens by 1060, and the whole of Sicily was freed by 1091. Under the Norman kings, Greeks, Saracens and Latins lived together in one community, and the court was the meeting-ground for eminent persons of all nations and languages. The reconquest of Spain had begun in the eighth century, so that here also an opportunity offered for making the works of Greek science available in Latin. Archbishop Raymond of Toledo (1126–1151) and Bishop Michael of Tarazona (1119–1151) were the patrons of the translators, who made Toledo the centre of their activity. One of these was Michael Scot.

There is in existence an Arabic translation of
the zoological works, of which there is a ms. in the British Museum. It is probable that this is the translation made by Ibn al-Batriq, and that this Arabic version is the original from which Michael Scot made his Latin translation at Toledo. Michael was, among his other accomplishments, astrologer to Frederick II., King of Sicily, at his court at Palermo, and before 1217 he had reached Toledo and was at work there on his translations from the Arabic. His De animalibus (a translation of the zoological works in nineteen books) is one of his earliest works, and two mss. of it contain a note which gives a later limit of 1220 for the work. Other evidence establishes that it was certainly finished before 1217, and it may even be placed in the first decade of the century. It is probable that Michael had as collaborator one Andrew, canon of Palencia, formerly a Jew. One of the earliest to make use of Michael’s translations was Robert Grosseteste, Bishop of Lincoln (d. 1253), one of the leading Aristotelian scholars of the time, who quotes from Michael’s version of

\[a\] B.M.Add. 7511 (13th–14th century). This is the ms. referred to by Steinschneider, Die arabischen Übersetzungen p. 64, as B.M. 437. I have seen this ms.

\[b\] Judging from the passages which Dr. R. Levy kindly read for me in the Arabic ms., the Latin version is a close translation from it. Also, the contents-preface which is found prefixed to Michael Scot’s translation corresponds exactly with the preface which precedes the Arabic version in this ms. (see the B.M. catalogue, Catalogus codicum manuscriptorum orientalium, p. 215).

\[c\] One of them is ms. Caius 109, in the library of Gonville and Caius College, Cambridge. It is of the thirteenth century.

\[d\] See S. D. Wingate, The Medieval Latin Versions, p. 75.

\[e\] Born at Stradbroke, Suffolk. A Franciscan.
De generatione.\textsuperscript{a} The De animalibus also formed the basis of a commentary in twenty-six books by Albertus Magnus.\textsuperscript{b} This was probably written soon after the middle of the thirteenth century. Except for the portions which appear in Albertus's commentary, and the earlier part of the first chapter,\textsuperscript{c} Michael's version has never been printed \textit{in extenso}. Michael died in or before 1235, and is reputed to have been buried, as he was born, in the lowlands of Scotland.

About the same time, at the request of a pupil of Albertus, St. Thomas Aquinas (1227–1274), who required more accurate versions for his commentaries on the works of Aristotle, new translations, direct from the Greek, were being undertaken by William of Moerbeke.\textsuperscript{d} William was born about 1215. He became a Dominican, was confessor to Popes Clement IV. and Gregory X., and was Archbishop of Corinth. He acted as Greek secretary at the Council of Lyons in 1274. He died in 1286. The earliest dated translation made by him is one of the \textit{De partibus animalium}. The date 1260 occurs in a ms. of it at Florence (Faesulani 168), which also contains \textit{Hist. an.}, \textit{De progressu an.}, and \textit{De gen. an.} This translation was made at Thebes.

Among later Latin translators of the zoological

\begin{itemize}
\item \textsuperscript{a} According to Roger Bacon, Michael appeared at Oxford in 1230, bringing with him the works of Aristotle in natural history and mathematics.
\item \textsuperscript{b} \textit{Ed. princeps}, Rome, 1478; latest ed., H. Stadler, 1916–1921.
\item \textsuperscript{c} 639 a 1—640 a 20, printed by G. Furlani in \textit{Rivista degli Studi Orientali}, ix. (1922), pp. 246–249.
\item \textsuperscript{d} A small town south of Ghent on the borders of Flanders and Brabant.
\end{itemize}
works the names of two Greeks must be mentioned. George of Trebizond (Trapezuntius), who was born in Crete in 1395, visited Italy between 1430 and 1438, and was secretary to the humanist Pope Nicholas V., an ardent Aristotelian. George’s work, however, was hurried and not over-exact, and he, together with his predecessors, was superseded by his contemporary Theodore of Gaza, who was born in Thessalonica about 1400, and was professor of Greek at Ferrara in 1447. In 1450 Theodore was invited by the Pope to go to Rome to make Latin versions of Aristotle and other Greek authors. His translation of the zoological works, a dedicated to the Pope, Sixtus IV., soon became the standard version, and it is printed in the Berlin edition of Aristotle.

Translations of the De gen. were made by Augustinus Niphus, of the University of Padua (1473–1546), and of the De gen. and De incessu by Peter Alcyonius (Venice, 1487–1527). The De gen. was also translated by Andronicus Calliustus of Byzantium (d. 1478). With the later Latin versions we need not here concern ourselves, but something must be said of the scientific workers who were inspired by Aristotle, and of the translations into modern languages.

The Renaissance biologists show unmistakably the difference in quality which there is between Aristotle’s physics and his biology. Hieronimo Fabrizio of Acquapendente (1537–1619) knew and admired Aristotle’s work on embryology, and what is more, himself carried out further important observations on the same subject. His brilliant successor, William Harvey (1578–1657), was a student of Aristotle, and

a In eighteen books, excluding the spurious tenth book of the Historia animalium.
ARISTOTLE

much of his inspiration came from that source. William Harvey was the first to make any substantial advance in embryology since Aristotle himself. But this is more appropriate to the De generatione than to the De partibus. In other departments of study, however, during the seventeenth century, the authority of Aristotle and the scholastic doctrine with which he was identified were being combated in the name of freedom, and thus it came about that the zoological works also, which had been brought to light by the dark ages, were allowed to pass back into oblivion by the age of enlightenment. They were not rediscovered until the end of the eighteenth century by Cuvier (1769-1832) and Saint-Hilaire (1805-1895) in the nineteenth.

MODERN EDITIONS


TRANSLATIONS WITHOUT TEXT

PARTS OF ANIMALS


Langkavel reproduces almost verbatim the Berlin text, together with Bekker’s apparatus, to which a great deal of other matter has been added, including some of Bekker’s ms. notes in his copy of Erasmus’s edition, and some corrected reports of the readings of the ms. E, which Langkavel himself inspected. Also, there are some emendations proposed by Bonitz.

Any English translator must stand very much indebted to the work of William Ogle, whose translation, originally published in 1882, was revised by its author and republished in the Oxford series of translations of Aristotle in 1911. It is not possible to overrate the care and exactness with which this piece of work was executed. I should like here to acknowledge my own indebtedness to it, and I have had its accuracy as a model before me. With regard to style, it will be seen that I have aimed at producing something rather different from Ogle’s version.
ARISTOTLE

The Text

The manuscript authorities cited by Bekker for the *De partibus* will be found on p. 50.

The dates of some of the mss. as given by different scholars vary considerably: for details I refer the reader to the various catalogues, and also to L. Dittmeyer's edition of Hist. an. (Leipzig, 1907) and W. W. Jaeger's edition of *De an. motu*, etc. (Leipzig, 1913).

I have relied upon the *apparatus* of Bekker and Langkavel for the readings of the Greek mss., except for those of Z, the oldest parts of which I have collated from photostats; and at several places I have inspected the ms. itself. In some places (e.g. 663 b 17, 685 a 2, 16) I found the reading had been defectively reported. It is clear that a more reliable collation of the chief mss. of *De partibus* is clearly needed. From a different source I have attempted to restore intelligibility to several corrupt passages with the aid of the Arabic version and the Latin version of Michael Scot, which represent an earlier stage of the Aristotelian text than our Greek mss. Among the passages dealt with in this way are the passage at 654 b 14 following, which has been dislocated by glosses and phrases imported from elsewhere, and the remarkable passage about the structure of the Cephalopods at 684 b 22 following, where considerable havoc has been done to the text by references to a diagram which were inserted at some period between the date of the ms. from which the Arabic version was made and that of the archetype of all our present Greek mss. I have been able to restore this passage, though not always the actual Greek words, by reference to the Arabic version and Michael Scot's Latin

\[a\] See additional note on p. 434.
translation made from it. Dr. Reuben Levy has most kindly read this passage for me in the 13th-14th century Arabic ms. in the British Museum, Add. 7511.

For these two passages, and for a good many other suspected places, I have consulted all the known mss. of Michael Scot’s version which are to be found in this country. They are (excluding mss. which contain merely abridgements or extracts):

Cambridge, Gonville and Caius College 109
  ,, University Library li. 3. 16
  ,, Dd. 4. 30
Oxford, Merton College 278
  ,, Balliol College 252
London, British Museum Royal 12. C. XV
  ,, Harl. 4970

All these are of the thirteenth or fourteenth century.

I have inspected at test places the following three mss. of William of Moerbeke’s version:

Oxford, Merton College 270
  ,, 271
  ,, Balliol College 250

William’s translation was made from a ms. or mss. which had already been infected by the corruptions found in the Greek mss. which exist to-day.

I should like here to express my thanks to the Librarians who so kindly made arrangements for me to inspect the mss. under their care.

Where I have accepted the reading of the Berlin Scope of edition, I have not given any record of the ms. variants. These are to be found in the apparatus criticus of that edition and of Langkavel’s edition.

* So far as I know, this ms. has not been mentioned in any of the published lists of mss. of Michael Scot’s De animalibus.
I have endeavoured, except in the passage 691 b 28 to 695 a 22 in the fourth Book, to record all places where I have departed from the text of the Berlin edition, and I have given the source of the reading which I have adopted. Where Bekker himself introduced a reading different from that of the mss., this is attributed to him by name.

I have not recorded all of the many passages in which I have corrected the punctuation. The text has been reparagraphed throughout.

Reference
The following list includes authorities for statements made in the Introduction, and books which the student of the Aristotelian zoological works and their history will find useful:


M. Steinschneider, *Die arabischen Übersetzungen aus dem Griechischen* (Beihet XII. zum Centralblatt für Bibliothekswesen), Leipzig, 1893.


PARTS OF ANIMALS


Acknowledgements

It is a great pleasure to acknowledge here the help which I have received from many friends at Cambridge, not only by way of reading typescript and proof and by discussion, but also by the interest which they have shown in the work and by their continuous encouragement. The following have read the translation either in whole or in part: Prof. F. M. Cornford, Professor of Ancient Philosophy; Dr. F. H. A. Marshall, Reader in Agricultural Physiology (who has also kindly written the Foreword to this volume), and Dr. Joseph Needham, Reader in Biochemistry. I am under a particular obligation to my colleague Mr. H. Rackham, who has read the whole translation both in typescript and in proof. I am indebted to Dr. Sydney Smith and a number of other friends for their kindness in discussing various points and for reading certain passages. Dr. Reuben Levy, Professor of Persian, has kindly read for me some passages in the Arabic translation of the zoological works. To all of these gentlemen, without whose aid the work could not have been carried through, I record my sincerest thanks.

The present (third) edition has again been revised.

A. L. P.

July 11th 1952

49
Sigla

E  Parisinus regius 1853 (see p. 434)
Y  Vaticanus graecus 261
Z  Oxoniensis Coll. Corp. Chr. W.A. 2. 7 (see p. 434)
U  Vaticanus 260
P  Vaticanus graecus 1339
S  Laurentianus Mediceus 81. 1
Q  Marcianus 200
b  Parisinus 1859
m  Parisinus 1921
Σ  Michael Scot’s Latin version, from my own transcription.
vulg.  The usual reading, as in the Berlin edition.
Langkavel  Emendations proposed by Langkavel in his edition.
Ogle  Emendations proposed by William Ogle in footnotes to his translation.
Platt  Emendations proposed by Arthur Platt, either (a) in "Notes on Aristotle," in *Journal of Philology*, 1913, xxxii. 292 following, or (b) recorded by Ogle in footnotes to his translation.
Cornford  Suggestions in private communications to me from Professor Cornford and Mr. Rackham.
Rackham  Th(urot)  Ch. Thuot, in *Rev. Arch.*, 1867.ª
Peck  Emendations proposed by myself.

ª Of over 100 textual points, many being of minor importance, raised by Th., about a third had been dealt with in my first edition (before Th.’s work came to my notice), some of them more fully, by other scholars or myself. Some of Th.’s other suggestions have been adopted in this edition.
The maister Cooke was called *Concoction*.
Spenser, *Faerie Queen*
ΑΡΙΣΤΟΤΕΛΟΤΣ
ΠΕΡΙ ΖΩΙΩΝ ΜΟΡΙΩΝ

Α

639 a  Περὶ πᾶσαν θεωρίαν τε καὶ μέθοδον, ὅμως ταπεινοτέραν τε καὶ τιμιωτέραν, δύο φαίνονται τρόποι τῆς ἔξεσις εἶναι, ὡν τὴν μὲν ἐπιστήμην τοῦ πράγματος καλῶς ἔχει προσαγορεῦειν, τὴν δ' οἷον παιδείαν τινὰ. πεπαιδευμένου γάρ ἐστὶ κατὰ τρόπον τὸ δύνασθαι κρίναι εὐστόχως τι καλῶς ἢ μὴ καλῶς ἀποδίδωσιν ὁ λέγων. τοιούτον γὰρ δὴ τινὰ καὶ τὸν ὅλως πεπαιδευμένον οἴόμεθ' εἶναι, καὶ τὸ πεπαιδεῦσθαι τὸ δύνασθαι ποιεῖν τὸ εἰρημένον. πλὴν τούτον μὲν περὶ πάντων ὡς εἰπεῖν κριτικόν τινὰ νομίζομεν εἶναι ἐνα τὸν ἀριθμὸν ὀντα, τὸν δὲ περὶ τινὸς φύσεως ἀφωρισμένης· εἰ δὲ γὰρ ἂν τις ἑτέρος τὸν αὐτὸν τρόπον τῷ εἰρημένῳ διακείμενος περὶ μόριον. ὅστε δὴ λοι ὅτι καὶ τῆς περὶ φύσιν ἱστορίας δεῖ τινὰς ὑπάρχειν ὅρους τοιούτους πρὸς οὓς ἀναφέρων ἀποδείκται τὸν τρόπον τῶν δεικνυ-
There are, as it seems, two ways in which a person may be competent in respect of any study or investigation, whether it be a noble one or a humble: he may have either what can rightly be called a scientific knowledge of the subject; or he may have what is roughly described as an educated person's competence, and therefore be able to judge correctly which parts of an exposition are satisfactory and which are not. That, in fact, is the sort of person we take the "man of general education" to be; his "education" consists in the ability to do this. In this case, however, we expect to find in the one individual the ability to judge of almost all subjects, whereas in the other case the ability is confined to some special science; for of course it is possible to possess this ability for a limited field only. Hence it is clear that in the investigation of Nature, or Natural science, as in every other, there must first of all be certain defined rules by which the acceptability of the method of exposition may be tested, apart from whether the statements made
μένων, χωρὶς τοῦ πῶς ἔχει τάληθες, εἴτε οὖτως εἴτε ἄλλως. λέγω δ’ οἶνον πότερον δεῖ λαμβάνοντας μίαν ἐκάστην οὐσίαν περὶ ταύτης διωρίζειν καθ’ αὐτὴν, οἶνον περὶ ἀνθρώπου φύσεως ἥ λέοντος ἢ βοῶς ἢ καὶ τίνος ἄλλου καθ’ ἐκαστον προχειρίζο-
μένους, ἢ τὰ κοινὴ συμβεβηκότα πάσι κατὰ τι κοινὸν ὑποθεμένους—πολλὰ γὰρ ὑπάρχει ταῦτα 
pολλοῖς γένεσιν ἐτέροις οὕσων ἄλληλων, οἶνον ὕπνους, ἀναπνοῆ, αὐξήσις, φθίσις, θάνατος, καὶ πρὸς τού-
tοις ὁ σα τουαῦτα τῶν λειτομένων παθῶν τε καὶ 
διαθέσεων· ἀδηλὸν γὰρ καὶ ἀδιόριστὸν ἐστὶ λέγειν 
vν ἐν περὶ τούτων φανερὸν δ’ ὅτι καὶ κατὰ μέρος 
μὲν λέγοντες περὶ πολλῶν ἐρωτεύειν πολλάκις ταὐτά· 
καὶ γὰρ ἤπιους καὶ κυσί καὶ ἀνθρώποις ὑπάρχει 
tῶν εἰρημένων ἐκαστον, ὡστε ἐὰν καθ’ ἐκαστον τὰ 
συμβεβηκότα λέγη τις, πολλάκις ἀναγκασθῆσεται 
περὶ τῶν αὐτῶν λέγειν, ὁ σα ταῦτα μὲν ὑπάρχει τοῖς 
eἰδεί διαφέρουσι τῶν ζῶν, αὐτὰ δὲ μηδεμίαν ἔχει 
διαφοράν. ἔτερα δ’ ὑσως ἐστὶν ὁ σα συμβαίνει τὴν 
μὲν κατηγορίαν ἔχειν τὴν αὐτὴν διαφέρειν δὲ τῇ 
κατ’ εἰδος διαφορᾶ, οἶνον ἢ τῶν ζῶν πορείᾳ· οὐ 
γὰρ φαίνεται μία τῷ εἰδεί· διαφέρει γὰρ πτήσις καὶ 
νεύσις καὶ βάδισις καὶ ἔρψις.

Διὸ δεῖ μὴ διαλεληθέναι πῶς ἐπισκεπτέων, λέγω 
δὲ πότερον κοινὴ κατὰ γένος πρῶτον, εἴθ’ ὅστερον

1 τὰ συμβεβηκότα Ogle: τῶν συμβεβηκότων vulg.
represent the truth or do not. I mean, for instance, should we take each single species severally by turn (such as Man, or Lion, or Ox, or whatever it may be), and define what we have to say about it, in and by itself; or should we first establish as our basis the attributes that are common to all of them because of some common character which they possess?—there being many attributes which are identical though they occur in many groups which differ among themselves, e.g. sleep, respiration, growth, decay, death, together with those other remaining affections and conditions which are of a similar kind. I raise this, for at present discussion of these matters is an obscure business, lacking any definite scheme. However, thus much is plain, that even if we discuss them species by species, we shall be giving the same descriptions many times over for many different animals, since every one of the attributes I mentioned occurs in horses and dogs and human beings alike. Thus, if our description proceeds by taking the attributes for every species, we shall be obliged to describe the same ones many times over, namely, those which although they occur in different species of animals are themselves identical and present no difference whatever. Very likely, too, there are other attributes, which, though they come under the same general head, exhibit specific differences;—for example, the locomotion of animals: of which there are plainly more species than one—e.g. flight, swimming, walking, creeping.

Therefore we must make up our minds about the method of our investigation and decide whether we will consider first what the whole group has in
perί των ἰδίων θεωρητέον, ἢ καθ’ ἐκαστὸν εὐθὺς. νῦν γὰρ οὐ διωρισταὶ περὶ αὐτοῦ, οὔδε γε τὸ νῦν ῥήθησόμενον, οἶνον πότερον καθάπερ οἱ μαθηματικοὶ τὰ περὶ τὴν ἀστρολογίαν δεικνύοντο, οὔτω δεῖ καὶ τὸν φυσικὸν τὰ φαινόμενα πρῶτον τὰ περὶ τὰ ζῶα
10 θεωρήσαντα καὶ τὰ μέρη τὰ περὶ ἐκαστὸν, ἐπειδ’ οὔτω λέγειν τὸ διὰ τὶ καὶ τὰς αἰτίας, ἡ ἄλλως πως. πρὸς δὲ τοὺς, ἐπεὶ πλεῖον ὅρῶμεν αἰτίας περὶ τὴν γένεσιν τὴν φυσικὴν, οἶνον τὴν θ’ οὐ ἔνεκα καὶ τὴν ὀθέν ἢ ἀρχὴ τῆς κινήσεως, διοριστέον καὶ περὶ τούτων, ποία πρῶτη καὶ δευτέρα πέφυκεν.
15 φαίνεται δὲ πρώτη ἡν λέγομεν ἐνεκά τινος· λόγος γὰρ οὕτως, ἀρχὴ δ’ ὁ λόγος ὁμοίως ἐν τε τοῖς κατὰ τέχνην καὶ ἐν τοῖς φύσει συνεστηκόσιν. ἡ γὰρ τῇ διανοίᾳ ἢ τῇ αἰσθήσει ὁρισμένοις ὁ μὲν ἱατρὸς τὴν υγίειαν ὁ δ’ οἰκοδόμος τὴν οἰκίαν, ἀποδιδόσι τοὺς λόγους καὶ τὰς αἰτίας οὐ ποιοῦσιν ἐκάστου, καὶ διότι ποιητέον οὕτως. μᾶλλον δ’ ἐστὶ τὸ οὗ ἔνεκα καὶ τὸ καλὸν ἐν τοῖς τῆς φύσεως ἔργοις ἢ ἐν τοῖς τῆς τέχνης. τὸ δ’ ἐξ ἀνάγκης οὐ πάσων ὑπάρχει τοῖς κατὰ φύσιν ὁμοίως, εἰς

This point is resumed and decided below, 644 a 23 ff., 645 b 2 ff.
"Formation." See Introduction, pp. 27 f.
i.e. the "final" cause.
i.e. the "motive" or "efficient" cause.
See Introduction, pp. 26 f.
Cf. 645 a 24.
PARTS OF ANIMALS, I. i.

common, and afterwards the specific peculiarities; or begin straightway with the particular species.\(^a\) Hitherto this has not been definitely settled. And there is a further point which has not yet been decided: should the student of Nature follow the same sort of procedure as the mathematician follows in his astronomical expositions—that is to say, should he consider first of all the phenomena which occur in animals, and the parts of each of them, and having done that go on to state the reasons and the causes; or should he follow some other procedure? Furthermore, we see that there are more causes\(^b\) than one concerned in the formation\(^c\) of natural things: there is the Cause for the sake of which the thing is formed,\(^d\) and the Cause to which the beginning of the motion is due.\(^e\) Therefore another point for us to decide is which of these two Causes stands first and which comes second. Clearly the first is that which we call the "Final" Cause—that for the sake of which the thing is formed—since that is the logos\(^f\) of the thing—its rational ground, and the logos is always the beginning for products of Nature as well as for those of Art. The physician or the builder sets before himself something quite definite—the one, health, apprehensible by the mind, the other, a house, apprehensible by the senses; and once he has got this, each of them can tell you the causes and the rational grounds for everything he does, and why it must be done as he does it. Yet the Final Cause (purpose) and the Good (Beautiful)\(^g\) is more fully present in the works of Nature than in the works of Art. And moreover the factor of Necessity is not present in all the works of Nature in a similar sense. Almost all
ARISTOTLE

639 b

δ' πειρώνται πάντες σχεδὸν τοὺς λόγους ἀνάγειν, οὐ διελόμενοι ποσαχῶς λέγεται τὸ ἀναγκαῖον. ὕπάρχει δὲ τὸ μὲν ἀπλῶς τοὺς ἁίδοις, τὸ δ' ἐξ ὑποθέσεως καὶ τοῖς ἐν γενέσει πάσιν ὁσπερ ἐν τοῖς τεχναστοῖς, οἶον οἰκία καὶ τῶν ἄλλων ὀτιων τῶν τοιούτων. ἀνάγκη δὲ τοιάνδε τὴν ὤλην ὑπ- ἀρξαι εἰ ἔσται οἰκία ἢ ἄλλο τι τέλος· καὶ γενέσθαι τε καὶ κινηθῆναι δεὶ τὸδε πρῶτον, εἰτα τόδε, καὶ τούτον δὴ τὸν τρόπον ἐφεξῆς μέχρι τοῦ τέλους καὶ 30 οὗ ἕνεκα γίνεται ἕκαστον καὶ ἔστιν. ὡσαύτως δὲ

640 a καὶ ἐν τοῖς φύσει γινομένοις. ἀλλ' δ' τρόπος τῆς ἀποδείξεως καὶ τῆς ἀνάγκης ἐτεροσ ἐπὶ τε τῆς φυσικῆς καὶ τῶν θεωρητικῶν ἐπιστημῶν. (εἰρηται δ' ἐν ἐτεροῖς περὶ τούτων.) ἢ γὰρ ἀρχὴ τοῖς μὲν τὸ ὄν, τοῖς δὲ τὸ ἐσόμενον· ἐπεὶ γὰρ τοιών'd' ἐστὶν ἢ

6 ὑγίεια ἢ ό ἄνθρωπος, ἀνάγκη τὸδ' εἶναι ἢ γενέσθαι, ἀλλ' οὐκ ἐπεὶ τὸδ' ἐστὶν ἢ γέγονεν, ἐκεῖνο εὖ

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a "Absolute," i.e. simple or unconditional necessity, belongs to the "eternal things," such as the heavenly bodies or the eternal truths of mathematics. For further details see De gen. et corr. 337 b 14 ff.

b At Met. 1025 b ff. Aristotle makes a threefold classification of the sciences into (a) theoretical (contemplative), (b) practical, (c) productive. The result of (a) is knowledge only, of (b) knowledge and action, of (c) knowledge, action, and some article or product. The three "theoretical" sciences are theology (i.e. metaphysics), mathematics, and physics (natural science). In the present passage, however, Aristotle contrasts natural science with the "theoretical" sciences. This is because he is considering Nature as a craftsman whose craft or science belongs to the third class—the "productive" sciences. Our study of Nature's science 58
philosophers endeavour to carry back their explanations to Necessity; but they omit to distinguish the various meanings of Necessity. There is "absolute" Necessity, which belongs to the eternal things; and there is "conditional" Necessity, which has to do with everything that is formed by the processes of Nature, as well as with the products of Art, such as houses and so forth. If a house, or any other End, is to be realized, it is necessary that such and such material shall be available; one thing must first be formed, and set in motion, and then another thing; and so on continually in the same manner up to the End, which is the Final Cause, for the sake of which every one of those things is formed and for which it exists. The things which are formed in Nature are in like case. Howbeit, the method of reasoning in Natural science and also the mode of Necessity itself is not the same as in the Theoretical sciences. (I have spoken of this matter in another treatise.) They differ in the following way. In the Theoretical sciences, we begin with what already is; but in Natural science with what is going to be: thus, we say, Because that which is going to be—health, perhaps, or man—has a certain character, therefore of necessity some particular thing, P, must be, or must be formed; not, Because P is now, or has been formed, therefore the other thing (health, or man) of necessity is now may be a "theoretical" science, but Nature's science itself is "productive."

c The reasoning process in a "theoretical" science, e.g. mathematics, begins, say, with A, and then deduces from it the consequences B, C, D. In a "productive" science, e.g. building, it begins with the house which is to be built, D, and works backwards through the preliminary stages which must be realized in order to produce the house, C, B, A. Cf. below, 640 a 16 ff.
ANCIENT GREEK

ARISTOTLE

640 a

άνάγκης ἐστὶν ἢ ἐσται. οὐδ' ἐστιν εἰς ἀῤῥητὴν τὴς τοιαύτης ἀποδείξεως τὴν ἀνάγκην,
ὡστ' εἰπεῖν, ἐπεὶ τόδ' ἐστίν, ὅτι τόδ' ἐστίν. δι'-
ωρισται δὲ καὶ περὶ τούτων ἐν ἐτέροις, καὶ ποιοῖς
ὑπάρχει καὶ ποῖα ἀντιστρέφει καὶ διὰ τιν' αἰτίαιν.

10 Δεὶ δὲ μὴ λεληθεῖαι καὶ πότερον προσήκει λέγειν,
ὡσπερ οἱ πρότερον ἐποιοῦντο τὴν θεωρίαν, πῶς
ἐκαστὸν γίνεσθαι πέφυκε μᾶλλον ἢ πῶς ἐστίν.
οὐ γὰρ τι μικρὸν διαφέρει τούτῳ ἐκείνῳ. έοικε
δ' ἐπετεύθεν ἀρκτέον εἶναι (καθάπερ καὶ πρότερον
ἐπιμεν, ὅτι πρώτον τὰ φαινόμενα ληπτεόν περὶ
ἐκαστὸν γένος, εἴθ' οὔτω τὰς αἰτίας τούτων
λεκτέον) καὶ περὶ γενέσεως μᾶλλον γὰρ τάδε
συμβαίνει καὶ περὶ τὴν οἰκοδόμησιν ἐπεὶ τοιόνδ' ἐστὶ τὸ εἴδος τῆς οἰκίας, ἡ τοιόνδ' ἐστίν ἡ οἰκία ὅτι
γίνεται οὔτως. ἡ γὰρ γένεσις ένεκα τῆς οὐσίας
ἐστίν, ἀλλ' οὐχ ἡ οὐσία ένεκα τῆς γενέσεως. διόπερ

15 Ἐμπεδοκλῆς οὖκ ὀρθῶς εἰρήκει λέγων ύπάρχειν
πολλὰ τοῖς ζῷοις διὰ τὸ συμβήναι οὔτως ἐν τῇ
γενέσει, οἷον καὶ τὴν ράχιν τοιαύτην ἐχειν ὅτι
στραφέντος καταχθῆναι συνέβη, ἀγνοῶν πρῶτον μὲν
ὅτι δεὶ τὸ στέρμα τὸ συνιστάν' ύπάρχειν τοιαύτην

1 συνιστάν Platt: συνιστάν vulg.

a Though of course this Necessity has its place in natural
 science (see 642 a 31 ff.). It is, however, not the only sort
 of Necessity in Natural science, and not the paramount one.

b See De gen. et corr. 337 b 25 ff. An example of a non-
 convertible proposition is: Foundations are necessary for a
 house to be built. You cannot say, "If foundations are laid
 a house must of necessity be built," because it is not "ab-
 solutely" and always necessary that a house should be built.

c Cf. Plato, Philebus 54 a-c.
or will be in the future." Nor, in a process of reasoning of this kind, is it possible to trace back the links of Necessity to eternity, so as to say, *Because* $A$ is, therefore $Z$ is. I have, however, discussed these matters in another work, and I there stated where either kind of Necessity applies, which propositions involving Necessity are convertible, and the reasons why.

We must also decide whether we are to discuss the processes by which each animal comes to be formed—which is what the earlier philosophers studied—or rather the animal as it actually is. Obviously there is a considerable difference between the two methods. I said earlier that we ought first to take the phenomena that are observed in each group, and then go on to state their causes. This applies just as much to the subject of the process of formation: here too we ought surely to begin with things as they are actually observed to be when completed. Even in building the fact is that the particular stages of the process come about because the Form of the house is such and such, rather than that the house is such and such because the process of its formation follows a particular course: the process is for the sake of the actual thing, the thing is not for the sake of the process." So Empedocles was wrong when he said that many of the characteristics which animals have are due to some accident in the process of their formation, as when he accounts for the vertebrae of the backbone by saying "the fetus gets twisted and so the backbone is broken into pieces": he was unaware (a) that the seed which gives rise to the animal must to

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4 Emped. frag. 97 (Diels, *Fragmente* 5, 31 b 97).
Aristotle

640 a

ἐξων δύναμιν, εἰθ' ὅτι τὸ ποιησαν πρότερον ὑπήρχεν
25 οὐ μόνον τῷ λόγῳ ἄλλα καὶ τῷ χρόνῳ: γεννᾷ γὰρ ὁ ἀνθρώπος ἀνθρώπων, ὥστε διὰ τὸ ἐκείνου τοιοῦτο εἶναι ἡ γένεσις τοιαδή συμβαίνει τωδέ. [ὁμοίως δὲ καὶ ἐπὶ τῶν αὐτομάτων δοκούστων γίνεσθαι καθάπερ καὶ ἐπὶ τῶν τεχναστῶν ἔνια γὰρ καὶ ἀπὸ ταυτομάτου γίνεται ταῦτα τοῖς ἀπὸ τέχνης, οἴον
30 υγίεια. ὁν κὲν οὐν προὐπάρχει τὸ ποιητικὸν [ὁμοίων], οἴον ἡ ἄνθρωποτοποιητική, οὐ [γὰρ] γίνεται αὐτομάτον. ἡ δὲ τέχνη λόγου τῶν ἐργού ὅ ἁνευ τῆς υλῆς ἐστίν. καὶ τοῖς ἀπὸ τύχης ὁμοίως· ὡς γὰρ ἡ τέχνη ἐχει, οὔτω γίνεται.]6 διὸ μάλιστα μὲν λεκτέον ὡς ἐπειδὴ τοῦτο ἦν τὸ ἀνθρώπῳ εἶναι,
35 διὰ τούτῳ ταῦτ' ἐχει· οὐ γὰρ ἐνδέχεται εἶναι ἄνευ τῶν μορίων τούτων. εἰ δὲ μή, ὅ τι ἐγχύτατα τοῦτον, καὶ ἡ ὅτι ὅλως ἀδύνατον ἄλλως, ἡ καλὸς

640 b γε οὔτως. ταῦτα δ' ἐπεται ἐπεὶ δ' ἐστὶ τοιοῦτον, τὴν γένεσιν ὡδὲ καὶ τοιαύτην συμβαίνειν ἀναγκαῖον· διὸ γίνεται πρῶτον τῶν μορίων τόδε, εἶτα τόδε. καὶ τούτον ἡ τον τρόπον ὁμοίως ἐπὶ πάντων τῶν φύσει συνισταμένων.

5 Οἱ μὲν οὖν ἀρχαίοι καὶ πρῶτοι φιλοσοφήσαντες

1 ἐνα γὰρ om. Z¹.
2 ὁν Z: τῶν vulg.
3 om. Z¹.
4 ἡ Z: om. vulg.
5 om. Z.
6 ὁμοίως (l. 27) ... γίνεταi, ex Met. 1032-1034 exorta, olim ut vid. in marg. 640 b 4 adscripta; inepta seclusi.
7 ὅτι ὅλως Z¹: ὅλως ὅτι ἀ. ἀ. vulg.

a i.e. the same character as the animal which it is to produce. For dynamis see Introduction, pp. 30 ff.
b No doubt a marginal note appended to 640 b 4.
PARTS OF ANIMALS, I. i.

begin with have the appropriate specific character a; and (b) that the producing agent was pre-existent: it was chronologically earlier as well as logically earlier: in other words, men are begotten by men, and therefore the process of the child's formation is what it is because its parent was a man. [Similarly too with those that appear to be formed spontaneously, just as with those produced by the arts; for some that are formed spontaneously are identical with those produced by art, e.g. health. As for those things whose producing agent is pre-existent, e.g. the art of statuary, no spontaneous formation occurs. Art is the logos of the article without the matter. And similarly with the products of chance: they are formed by the same process that art would employ.] b So the best way of putting the matter would be to say that because the essence of man is what it is, therefore a man has such and such parts, since there cannot be a man without them. If we may not say this, then the nearest to it must do, viz. that there cannot be a man at all otherwise than with them, or, that it is well that a man should have them. And upon this these considerations follow: Because man is such and such, therefore the process of his formation must of necessity be such and such and take place in such a manner; which is why first this part is formed, then that. And thus similarly with all the things that are constructed by Nature.

Now those who were the first to study Nature in
As Empedocles and Anaxagoras, whose attempts to discover the "material" and the "efficient" causes are mentioned a few lines below. See also Met. 983 b 6 ff.

"Material" cause: see Introduction, pp. 24 ff.

"Residue": lit. "surplus"; see Introduction, pp. 32 ff.

Cf. Hippocrates, Περὶ διαίτης, i. 9.

"Parts": see Introduction, pp. 28 ff.
the early days spent their time in trying to discover what the material principle or the material Cause was, and what it was like; they tried to find out how the Universe is formed out of it; what set the process going (Strife, it might be, or Friendship, Mind, or Spontaneity); assuming throughout that the underlying material had, by necessity, some definite nature: e.g. that the nature of Fire was hot, and light; of Earth, cold, and heavy. At any rate, that is how they actually explain the formation of the world-order. In a like manner they describe the formation of animals and plants, saying (e.g.) that the stomach and every kind of receptacle for food and for residue is formed by the water flowing in the body, and the nostril openings are forcibly made by the passage of the breath. Air and water, of course, according to them, are the material of which the body is made: they all say that Nature is composed of substances of this sort. Yet if man and the animals and their parts are products of Nature, then account must be taken of flesh, bone, blood, in fact of all the "uniform parts," and indeed of the "non-uniform parts" too, viz. face, hand, foot; and it must be explained how it comes to pass that each of these is characterized as it is, and by what force this is effected. It is not enough to state simply the substances out of which they are made, as "Out of fire," or "Out of earth." If we were describing a bed or any other like article, we should endeavour to describe the form of it rather than the matter (bronze, or wood)—or, at

1 "Uniform" and "non-uniform"; see Introduction, pp. 28 ff. The distinction between "uniform" and "non-uniform" parts is, historically, the predecessor of the distinction between "tissues" and "organs."
640 b

η τὸ ξύλον, εἰ δὲ μή, τὴν γε τοῦ συνόλου· κλίνη γὰρ τὸ δὲ ἐν τῷ δὲ ἤ τὸ δὲ τουόντε, ὥστε κἀ̃ γερ τοῦ σχῆματος εἰ τῇ λεκτέου, καὶ ποῖων τὴν ἰδέαν· Ἦ γὰρ κατὰ τὴν μορφὴν φύσις κυριωτέρα τῆς ὑλικῆς φύσεως.

30 Ἐὰν μὲν οὖν τῷ σχῆματι καὶ τῷ χρώματι ἐκαστόν ἐστὶ τῶν τε λογίων καὶ τῶν μορίων, ἄρθως ἄν Δημόκριτος λέγω· φαίνεται γὰρ οὕτως ὑπολαβεῖν. φησὶ γὰρ τὸν παντὶ δῆλον εἶναι οἷον τῇ τὴν μορφὴν ἐστὶν ὁ ἀνθρώπος, ὡς οὐντος αὐτοῦ τῷ το σχῆματι καὶ τῷ χρώματι γνωρίμου. καίτοι καὶ ὁ τεθνεῶς ἐξεὶ τῆν αὐτὴν τοῦ σχῆματος μορφὴν, ἀλλὰ ὠμός οὐκ ἐστὶν ἀνθρώπος. ἔτι δὲ ἀδύνατον εἶναι χείρα ὁμωσών διακειμένην, οἷον χαλκῆν ἡ ἠλάνην, πλὴν ὁμωνύμως, ὡσπερ τῶν γεγραμμένον ἰατρῶν. οὐ γὰρ δυνήσεται ποιεῖν τὸ ἑαυτῆς ἔργον, ὡσπερ οὐδ᾿ αὐλοὶ λίθνοι τὸ ἑαυτῶν ἔργον, οὐδ᾿ ὁ γεγραμμένος ἰατρός. ὁμοίως δὲ τούτου οὐδὲ τῶν τοῦ τεθηκότος μοιρῶν οὐδὲν ἐτι τῶν τοιούτων ἐστὶ, λέγω δὲ οἰον ὀψηλιμός, χείρ. λίαν οὖν ἀπλῶς εἰρηται, καὶ τὸν αὐτὸν τρόπον ὡσπερ ἀν εἰ τέκτων λέγων περὶ χειρὸς ἠλάνης. οὕτως γὰρ καὶ οἱ φυσιολογοὶ τὰς γενέσεις καὶ τὰς αἰτίας τοῦ σχῆματος λέγουσιν. ὑπὸ τίνων γὰρ ἐδημουργήθησαν δυνάμεως; ἀλλὰ ῥητὸς δὲ μὲν τέκτων ἐρεῖ πέλεκυν ἢ τρύπανον, δ δ᾿ ἀέρα καὶ γῆν,

a See Diels, Fragmenta, 68 v 165.

b i.e. the early writers on “Nature.”
PARTS OF ANIMALS, I. i.

any rate, the matter, if described, would be described as belonging to the concrete whole. For example, "a bed" is a certain form in certain matter, or, alternatively, certain matter that has a certain form; so we should have to include its shape and the manner of its form in our description of it—because the "formal" nature is of more fundamental importance than the "material" nature.

If, then, each animal and each of its parts is what it is in virtue of its shape and its colour, what Democritus says will be correct, since that was apparently his view, if one understands him aright when he says that it is evident to everyone what "man" is like as touching his shape, for it is by his shape and his colour that a man may be told. Now a corpse has the same shape and fashion as a living body; and yet it is not a man. Again, a hand constituted in any and every manner, e.g., a bronze or wooden one, is not a hand except in name; and the same applies to a physician depicted on canvas, or a flute carved in stone. None of these can perform the functions appropriate to the things that bear those names. Likewise, the eye or the hand (or any other part) of a corpse is not really an eye or a hand. Democritus's statement, therefore, needs to be qualified, or a carpenter might as well claim that a hand made of wood really was a hand. The physiologers, however, when they describe the formation and the causes of the shape of animal bodies, talk in this selfsame vein. Suppose we ask the carver "By what agency was this hand fashioned?" Perhaps his answer will be "By my axe" or "By my auger," just as if we ask the physiologer "By what agency was this body fashioned?" he will say "By air" and
πλὴν βέλτιον ὁ τέκτων· οὐ γὰρ ἵκανὸν ἔσται αὐτῷ τὸ τοσοῦτον εἴπειν, ὅτι ἐμπεσόντος τοῦ ὀργάνου τὸ μὲν κοίλον ἐγένετο τὸ δὲ ἐπίπεδον, ἀλλὰ διότι τὴν πληγὴν ἐποιήσατο τοιαύτην, καὶ τίνος ἑνεκα, ἐρεῖ τὴν αἰτίαν, ὅπως τοιόυδε ἡ τοιόνδε ποτὲ τὴν μορφὴν γένηται.

15 Δήλον τούνων ὅτι οὐκ ὀρθῶς λέγουσι, καὶ ὅτι λεκτέον ὡς τοιοῦτον τὸ ζῷον, καὶ περὶ ἐκείνου καὶ τί καὶ τοίνυν τι καὶ τῶν μορίων ἐκάστουν, ὅσπερ καὶ περὶ τοῦ εἰδους τῆς κλήυσ.

Εἰ δὴ τούτῳ ἐστι ψυχή ν ἡ ψυχής μέρος ἡ μὴ ἄνευ ψυχῆς (ἀπελθοῦσας γοῦν οὐκέτι ζῷον ἔστων, οὐδὲ τῶν μορίων οὐδέν τὸ αὐτὸ λείπεται, πλὴν τῷ σχήματι μόνον, καθάπερ τὰ μυθευόμενα λιθοῦσθαι), εἰ δὴ ταῦτα οὕτως, τοῦ φυσικοῦ περὶ ψυχῆς ἄν εἰη λέγειν καὶ εἰδέναι, καὶ εἰ μὴ πάσης, κατ’ αὐτὸ τοῦτο καθ’ ὅ τοιοῦτο τὸ ζῷον, καὶ τί ἐστιν ἡ ψυχῆ, ἡ αὐτὸ τοῦτο τὸ μόριον, καὶ περὶ τῶν συμβεβηκτὸν κόσων κατὰ τὴν τοιαύτην αὐτῆς οὐσίαν, ἀλλος τε καὶ τῆς φύσεως διχῶς λεγομένης καὶ οὐσίας, τῆς μὲν ὡς ὥλης, τῆς δ’ ὡς οὐσίας· καὶ ἔστιν αὐτή καὶ ὡς ἡ κινοῦσα καὶ ὡς τὸ τέλος· τοιοῦτον δὲ τοῦ ζῴου

1 ἐκάστου Peck: ἐκαστον vulg.

*a Or, "reason"; see Introduction, p. 24.
*b See above, 640 b 26.
*c "Soul": see Introduction, pp. 34 ff.
*d Or "motive."
"By earth." But of the two the craftsman will give a better answer, because he will not feel it is sufficient to say merely that a cavity was created here, or a level surface there, by a blow from his tool. He will state the cause on account of which, and the purpose for the sake of which, he made the strokes he did; and that will be, in order that the wood might finally be formed into this or that shape.

It must now be evident that the statements of the physiologers are unsatisfactory. We have to state how the animal is characterized, i.e., what is the essence and character of the animal itself, as well as describing each of its parts; just as with the bed we have to state its Form.

Now it may be that the Form of any living creature is Soul, or some part of Soul, or something that involves Soul. At any rate, when its Soul is gone, it is no longer a living creature, and none of its parts remains the same, except only in shape, just like the animals in the story that were turned into stone. If, then, this is really so, it is the business of the student of Natural science to inform himself concerning Soul, and to treat of it in his exposition; not, perhaps, in its entirety, but of that special part of it which causes the living creature to be such as it is. He must say what Soul, or that special part of Soul, is; and when he has said what its essence is, he must treat of the attributes which are attached to an essence of that character. This is especially necessary, because the term "nature" is used—rightly—in two senses: (a) meaning "matter," and (b) meaning "essence" (the latter including both the "Efficient" Cause and the "End"). It is, of course, in this latter sense that the entire Soul or
641 a ἐποίησε τὸν ψυχὴν ἤ μέρος τι αὐτῆς. ὡστε καὶ 
οὕτως ἂν λεκτέον εἰς τῷ περὶ φύσεως θεωρητικῷ 
περὶ ψυχῆς μᾶλλον ἢ περὶ τῆς ὕλης, ὡστε μᾶλλον ἢ 
ὕλη δι᾽ ἐκείνην φύσις ἡ ἀνάπαλιν καὶ γὰρ 
κλίνῃ καὶ τρῖτος τὸ ἐν τοῖς ἑστίν, ὅτι δυνάμει ταῦτά 
ἐστιν.

Ἀπορήσειε δ’ ἂν τις εἰς τὸ νῦν λεχθὲν ἐπιβλέψας, 
πότερον περὶ πάσης ψυχῆς τῆς φυσικῆς ἐστὶ τὸ 
εἰπεῖν ἢ περὶ τινος.εἰ γὰρ περὶ πάσης, οὐδεμία 
λείπεται παρὰ τῆς φυσικῆς ἐπιστήμης φιλοσοφία.

641 b ὃ γὰρ νοῦς τῶν νοητῶν, ὡστε περὶ πάντων ἢ 
φυσικῆ γνώσις ἂν εἰη τῆς γὰρ αὐτῆς περὶ νοῦ καὶ 
τοῦ νοητοῦ θεωρήσαι, εἰπερ πρὸς ἀληθεία, καὶ ἢ 
αὐτὴ θεωρία τῶν πρὸς ἀληθεία πάντων, καθάπερ 
καὶ περὶ αἰσθήσεως καὶ τῶν αἰσθητῶν. ἢ οὐκ ἐστὶ 
πάσα ἡ ψυχὴ κινήσεως ἀρχή, οὐδὲ τὰ μόρια ἄπαντα, 
ἀλλ’ αὐξήσεως μὲν ὅπερ καὶ ἐν τοῖς φυτοῖς, ἀλλ’ 
λοιώσεως δὲ τοῦ αἰσθητικοῦ, φορᾶς δ’ ἐτερόν τι καὶ 
οὐ τὸ νοητικὸν· ὑπάρχει γὰρ ἡ φορὰ καὶ ἐν ἑτέροις 
τῶν ζωῆς, διάνοια δ’ οὐδενί. δῆλον οὖν ὥς οὖ 

1 τινος (μορίου) Rackham.

a i.e. qualitative change, which is the “motion” proper 
to this part of the Soul.

70
some part of it is the "nature" of a living creature. Hence on this score especially it should be the duty of the student of Natural science to deal with Soul in preference to matter, inasmuch as it is the Soul that enables the matter to "be the nature" of an animal (that is, potentially, in the same way as a piece of wood "is" a bed or a stool) rather than the matter which enables the Soul to do so.

In view of what we have just said, one may well ask whether it is the business of Natural science to treat of Soul in its entirety or of some part of it only; since if it must treat of Soul in its entirety (i.e. including intellect) there will be no room left for any other study beside Natural science—it will include even the objects that the intellect apprehends. For consider: wherever there is a pair of interrelated things, such as sensation and the objects of sensation, it is the business of one science, and one only, to study them both. Now intellect and the objects of the intellect are such a pair; hence, the same science will study both of them, which means that there will be nothing whatever left outside the purview of Natural science. All the same, it may be that it is neither Soul in its entirety that is the source of motion, nor yet all its parts taken together; it may be that one part of Soul, (a), viz. that which plants have, is the source of growth; another part, (b), the "sensory" part, is the source of change; and yet another part, (c), the source of locomotion. That even this last cannot be the intellectual part is proved, because animals other than man have the power of locomotion, although none of them has intellect. I take it, then, as evident
perí pásis ψυχῆς λεκτέον· οὐδὲ γὰρ πᾶσα ψυχή
10 φύσις, ἀλλὰ τι μόριον αὐτῆς ἐν ἦ καὶ πλεῖω.

"Ετὶ δὲ τῶν ἔξ ἀφαιρέσεως οὐδενὸς ὁτὸν τῷ εἶναι
tὴν φυσικὴν θεωρητικὴν, ἐπειδὴ ἡ φύσις ἑνεκά τοῦ
ποιεῖ πάντα· φαίνεται γὰρ, ὡσπερ ἐν τοῖς τεχνα-
στοῖς ἐστὶν ἡ τέχνη, οὕτως ἐν αὐτοῖς τοῖς πράγ-
μασιν ἄλλη τις ἀρχὴ καὶ αὐτία τοιαύτη, ἢν ἔχωμεν
15 καθάπερ τὸ θερμὸν καὶ τὸ ψυχρὸν ἐκ τοῦ παντός.
dιὸ μᾶλλον εἰκὸς τὸν οὐρανὸν γεγενησθαι ὑπὸ
tοιαύτης αἰτίας, εἰ γέγονε, καὶ εἶναι διὰ τοιαύτην
αἰτίαν μᾶλλον ἢ τὰ ζῶα τὰ θνητά· τὸ γοῦν τεταγ-
μένον καὶ τὸ ὅρισμένον πολὺ μᾶλλον φαίνεται ἐν
20 τοῖς οὐρανοῖς ἢ περὶ ἡμᾶς, τὸ δὲ ἄλλοτ' ἄλλως καὶ
ὡς ἔτυχε περὶ τὰ θνητὰ μᾶλλον. οἱ δὲ τῶν μὲν
ζῷων ἐκαστὸν φύσει φασίν εἶναι καὶ γενέσθαι, τὸν
d' οὐρανὸν ἀπὸ τύχης καὶ τοῦ αὐτομάτου τοιοῦτον
συστήναι, ἐν ὃ ἀπὸ τύχης καὶ ἀταξίας οὐδ' ὀτιοῦν
φαίνεται. πανταχοῦ δὲ λέγομεν τόδε τοῦτ' ἔνεκα,
25 ὅπου ἂν φαίνηται τέλος τῷ πρὸς δὴ κύνησις περαίνει
μηδενὸς ἐμποδίζοντος. ὡστε εἶναι φανερὸν ὅτι ἔστι
τι τοιοῦτον, δὴ καὶ καλοῦμεν φύσιν· οὐ γὰρ δὴ
δὲ τι ἑτυχεν εἷς ἐκαστὸν γίνεται σπέρματος, ἀλλα
tόδε ἐκ τοῦτο, οὐδὲ σπέρμα τὸ τυχὸν ἐκ τοῦ τυ-

a With this passage cf. Plato, Philebus 29-30.
b Cf. Samuel Butler, Life and Habit, p. 134, "A hen is
only an egg's way of making another egg."
PARTS OF ANIMALS, I. i.

that we need not concern ourselves with Soul in its entirety; because it is not Soul in its entirety that is an animal’s "nature," but some part or parts of it.

Further, no abstraction can be studied by Natural science, because whatever Nature makes she makes to serve some purpose; for it is evident that, even as art is present in the objects produced by art, so in things themselves there is some principle or cause of a like sort, which came to us from the universe around us, just as our material constituents (the hot, the cold, etc.) did. Wherefore there is better reason for holding that the Heaven was brought into being by some such cause—if we may assume that it came into being at all—and that through that cause it continues to be, than for holding the same about the mortal things it contains—the animals; at any rate, there is much clearer evidence of definite ordering in the heavenly bodies than there is in us; for what is mortal bears the marks of change and chance. Nevertheless, there are those who affirm that, while every living creature has been brought into being by Nature and remains in being thereby, the heaven in all its glory was constructed by mere chance and came to be spontaneously, although there is no evidence of chance or disorder in it. And whenever there is evidently an End towards which a motion goes forward unless something stands in its way, then we always assert that the motion has the End for its purpose. From this it is evident that something of the kind really exists—that, in fact, which we call "Nature," because in fact we do not find any chance creature being formed from a particular seed, but $A$ comes from $a$, and $B$ from $b$; nor does any chance seed come from any chance individual. Therefore
ARISTOTLE

641 b

χόντος σώματος. ἀρχὴ ᾧρα καὶ ποιητικὸν τοῦ ἐξ
30 αὐτοῦ τὸ ἐξ οὗ τὸΙ σπέρμα. φύσει γάρ ταύτα.
φύτει γοῦν ἐκ τούτου. ἀλλὰ μὴν ἐτί τοῦτον
πρότερον τὸ οὗ τὸ σπέρμα· γένεσις μὲν γὰρ τὸ
σπέρμα, οὐσία δὲ τὸ τέλος. ἀμφοῖν δὲ ἐτί πρό-
τερον, ἀφ' οὗ ἐστὶ τὸ σπέρμα. ἐστὶ γάρ τὸ
σπέρμα διχῶς, ἐξ οὗ τε καὶ οὗ· καὶ γάρ ἀφ' οὗ
35 ἀπῆλθεν, τοῦτον σπέρμα, οὗν ἵππου, καὶ τοῦτον
δ' ἐστι αἷ αὐτοῦ, οἷον ὅρεως, τρόπον δ' οὗ τὸν
αὐτόν, ἀλλ' ἐκατέρου τὸν εἰρημένον. ἔτι δὲ δυνάμει
642 a τὸ σπέρμα· δύναμις δ' ὥς ἔχει πρὸς ἐντελεχείαν
ίσμεν.

Εἰσὶν ἀρα δυ' αἰτία αἰταὶ, τὸ Θ' οὗ ἐνεκα καὶ
tὸ ἐξ ἀνάγκης· πολλὰ γὰρ γίνεται, ὅτι ἀνάγκη.
ίσως δ' ἂν τις ἀπορήσειει ποιαν λέγουσιν ἀνάγκην
5 οἱ λέγοντες ἐξ ἀνάγκης· τῶν μὲν γὰρ δύο τρόπων
οὐδέτερον οἴον Θ' ὑπάρχειν τῶν διωρισμένων ἐν τοῖς
κατὰ φιλοσοφίαν. ἐστὶ δ' ἐν γε τοῖς ἔχουσι γένεσιν
η τρίτη· λέγομεν γὰρ τὴν τροφὴν ἀναγκαῖον τὶ κατ'
oὐδέτερον τούτων τῶν τρόπων, ἀλλ' ὅτι οὐχ οἷον τ'
ἀνευ ταύτης εἶναι. τοῦτο δ' ἐστὶν ὦσπερ ἐξ ὑπο-
10 θέσεως· ὦσπερ γὰρ ἐπεὶ δεὶ σχίζειν τῷ πελέκει,
ἀνάγκη σκληρὸν εἶναι, εἰ δὲ σκληρόν, χαλκοῦν ἦ

1 ἐξ οὗ τὸ supplevi, Σ secutus.

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a There is a reference here, which is not apparent in the English version, to the etymological connexion between φύσις (nature) and φύεσθαι (to grow). Cf. Met. 1014 b 16 ff.

b Viz. actuality is prior to potentiality.

c These treatises are referred to again in the Politics (1282 b 19) and in the Eudemian Ethics (1217 b 23). The two modes of necessity seem to be (1) "absolute" necessity (mentioned here), and (2) "coercive" necessity (see Met. 74.
the individual from which the seed comes is the source and the efficient agent of that which comes out of the seed. The reason is, that these things are so arranged by Nature; at any rate, the offspring grows out of the seed. Nevertheless, logically prior to the seed stands that of which it is the seed, because the End is an actual thing, and the seed is but a formative process. But further, prior to both of them stands the creature out of which the seed comes. (Note that a seed is the seed "of" something in two senses—two quite distinct senses: it is the seed "of" that out of which it came—e.g. a horse—as well as "of" that which will arise out of itself—e.g. a mule). Again, the seed is something by potentiality, and we know what is the relation of potentiality to actuality. We have, then, these two causes before us, to wit, the "Final" cause, and also Necessity, for many things come into being owing to Necessity. Perhaps one might ask which "Necessity" is meant when it is specified as a cause, since here it can be neither of the two modes which are defined in the treatises written in the philosophical manner. There is, however, a third mode of Necessity: it is seen in the things that pass through a process of formation; as when we say that nourishment is necessary, we mean "necessary" in neither of the former two modes, but we mean that without nourishment no animal can be. This is, practically, "conditional" Necessity. Take an illustration: A hatchet, in order to split wood, must, of necessity, be hard; if so, then it must, of necessity, be made of 1015 a 20 ff.). The third he has referred to already at 639 b 25, viz. "conditional" necessity. See pp. 21 f.
Aristotle, Cret.

αὐτὶς ἢ μὴ, πειρᾶσθαί γε ποιεῖν τοῦτο, δῆλον, καὶ οὗτε πάντες οἱ τοῦτο μὴ λέγοντες οὐδὲν ὡς εἰπεῖν περὶ φύσεως λέγουσιν: ἀρχὴ γὰρ ἡ φύσις μᾶλλον τῆς ὑλῆς. (ἐνιαχοῦ δὲ ποι ἀυτῆ καὶ Ἐμπεδοκλῆς περιπίπτει, ἀγόμενος ὅπ' αὐτῆς τῆς ἀληθείας, καὶ τὴν οὕσιαν καὶ τὴν φύσιν ἀναγκάζεται φάναι τὸν λόγον εἶναι, οἷον ὅστοιν ἀποδίδουσι τί ἐστιν: οὔτε γὰρ ἐν τι τῶν στοιχείων λέγει αὐτὸ οὔτε δύο ἢ τρία οὔτε πάντα, ἀλλὰ λόγον τῆς μίξεως αὐτῶν. δῆλον τοίνυν ὅτι καὶ ἡ σάρξ τὸν αὐτὸν τρόπον ἐστι, καὶ τῶν ἄλλων τῶν τοιούτων μορίων ἐκαστον. αὐτικὸν δὲ τοῦ μὴ ἐλθεῖν τοὺς προγενεστέρους ἐπὶ τὸν τρόπον τοῦτον, ὅτι τὸ τί ἢν εἶναι καὶ τὸ ὀρίσασθαι τὴν οὕσιαν οὐκ ἢν, ἀλλ' ἢματο μὲν Δημόκριτος πρῶτος, ὡς οὐκ ἀναγκαίον δὲ τῇ φυσικῇ θεωρίᾳ, ἀλλ' ἐκφερόμενος ὅπ' αὐτοῦ τοῦ πράγματος· ἐπὶ Σωκράτους δὲ τοῦτο μὲν ηὐξῆθη, τὸ δὲ ξητεῖν τὰ περὶ φύσεως ἐληξε,

1 sic Ogle: ei de μη, δῆλον γε πειρᾶσθαυ ποιεῖν vulg.

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a See Diels, Fragmenta 5, 31 a 78.
b "Element": this term is normally used to denote the four substances, earth, water, air, fire.
c This is probably a reference to Democritus's opposition to the theories of Protagoras, who held that "what appears
PARTS OF ANIMALS, I. 1.

bronze or of iron. Now the body, like the hatchet, is an instrument; as well the whole body as each of its parts has a purpose, for the sake of which it is; the body must therefore, of necessity, be such and such, and made of such and such materials, if that purpose is to be realized.

It is, therefore, evident that of Causation there are two modes; and that in our treatise both of them must be described, or at least an attempt must be made to describe them; and that those who fail herein tell us practically nothing of any value about "Nature," for a thing's "nature" is much more a first principle (or "Cause") than it is matter. (Indeed, in some places even Empedocles, being led and guided by Truth herself, stumbles upon this, and is forced to assert that it is the logos which is a thing's essence or nature.) For instance, when he is explaining what Bone is, he says not that it is any one of the Elements, or any two, or three, or even all of them, but that it is "the logos of the mixture" of the Elements. And it is clear that he would explain in the same way what Flesh and each of such parts is. Now the reason why earlier thinkers did not arrive at this method of procedure was that in their time there was no notion of "essence" and no way of defining "being." The first to touch upon it was Democritus; and he did so, not because he thought it necessary for the study of Nature, but because he was carried away by the subject in hand and could not avoid it. In Socrates' time an advance was made so far as the method was concerned; but at that time philosophers gave up the study of Nature to be to you, is for you." Protagoras had emphasized the validity of sense-data; Democritus denied it.
Aristotle

30 πρὸς δὲ τὴν χρήσιμον ἀρετὴν καὶ τὴν πολιτικὴν ἀπέκλιναν οἱ φιλοσοφοῦντες. 

Δευκτεόν δ’ οὕτως, οἶνον ὅτι ἐστὶ μὲν ἡ ἀναπνοὴ τοῦδε χάρυν, τούτο δὲ γίνεται διὰ τάδε εἴς ἀνάγκης. ἡ δ’ ἀνάγκη ὅτε μὲν σημαινεῖ ὅτι εἴ έκείνο ἐσται τὸ οὖ ἑνεκα, ταῦτα ἀνάγκη ἐστὶν ὑμεῖς, ὅτε δ’ ὅτι ἐστιν οὕτως ἔχοντα καὶ πεφυκότα τὸ θερμὸν γὰρ ἀναγκαῖον ἐξεῖναι καὶ πάλιν εἰσεῖναι ἀντικροῦν, τὸν δ’ ἀέρα εἰσρεῖν τοῦτο δ’ ἤδη 642 b ἀναγκαῖον ἐστιν, τοῦ ἐντὸς δὲ θερμοῦ ἀντικόπτοντος εὖ τῆς ψυξάς τοῦ θύραθεν ἀέρος ἢ εἴσοδος καὶ ἢ ἐξόδος. ὅ μὲν οὖν τρόπος οὕτως ἢ τῆς μεθόδου, καὶ περὶ δὲν ὑπὲρ λαβεῖν τὰς αἰτίας, ταῦτα καὶ τοιαύτα ἐστιν.

II. Λαμβάνουσι δ’ ἐνιοῦ τὸ καθ’ ἐκαστὸν, διαιρούμενοι τὸ γένος εἰς δύο διαφοράς. τούτο δ’ ἐστὶ τῇ μὲν οὐράδιον, τῇ δὲ ἀδύνατον. ἐνίων γὰρ ἐσται

1 οὕτως supplevi.
2 ἢ εἴσοδος om. pr. E.

“Goodness,” or “virtue,” is one of the chief topics discussed by Socrates in the Platonic dialogues. Cf. Aristotle, Met. 987 b 1, “Socrates busied himself about moral matters, but did not concern himself at all with Nature as a whole.”

b I have not attempted, except by one insertion, to straighten out the text of this confused account, which looks like a displaced note intended for the paragraph above (ending “realized,” p. 77). If it is to remain in the text, it would follow at that place (after 642 a 13) least awkwardly. For a more lucid account of the process of Respiration see De resp. 480 a 16–b 5.

c This is usually held to include Plato, on the ground that
and turned to the practical subject of "goodness," and to political science.)

Here is an example of the method of exposition. We point out that although Respiration takes place for such and such a purpose, any one stage of the process follows upon the others by necessity. Necessity means sometimes (a) that if this or that is to be the final Cause and purpose, then such and such things must be so; but sometimes it means (b) that things are as they are owing to their very nature, as the following shows: It is necessary that the hot substance should go out and come in again as it offers resistance, and that the air should flow in—that is obviously necessary. And the hot substance within, as the cooling is produced, offers resistance, and this brings about the entrance of the air from without and also its exit. This example shows how the method works and also illustrates the sort of things whose causes we have to discover.

II. Now some writers endeavour to arrive at the ultimate and particular species by the process of dividing the group (genus) into two differentiae. This is a method which is in some respects difficult and in other respects impossible. For example:

the method of dichotomy is used in the Sophist and Politicus. But the method can hardly be said to be seriously applied to the classification of animals in the Politicus, and in the Sophist it is introduced partly in a humorous way, partly to lead up to the explanation of ῥό μὴ ὅν (not-being). Either Aristotle has mistaken the purpose of the method (as he has at An. Pr. 46 a 31 ff.) or (much more probably) he is referring to some other writer's detailed application of it. See e.g. Stenzel in Pauly-Wissowa, s.v. Speusippus.

d Each stage of the division gives two differentiae, which are treated as "genera" for the next stage of the division, and so on.
ARISTOTLE

\[642 b\]

diafora mia monh, ta \( \delta' \) alla perierga, oion upo-
pou, dipou, schizopou\(1\). authe gar monh kuria.
10 ei de mhi, tauoton pollakis anagkaion legein. eti
de prosekei mhi diaspain ekaston genos, oion touis
oritheas tous men en t\( \tilde{h} \)de tous \( \delta' \) en allh diairesei,
khathaper exousin ai gegrammenai diaireseis. ekei
gar tous men meta tvon einoudwv symvaivei di-

e

\[15\]" omiosti ti \( \beta \)rvma keita, etera \( \beta' \) 
axhvs. allai
\( \delta' \) eisin \( \alpha \)nuvnuoi, oion to \( \epsilon \)naimon kai to \( \alpha \)naimov.

\[17\] e\( \epsilon \)per
\[18\] o\( \nu \)n m\( \eta \)dev tvon omoget\( \nu \)v diaaspastov, 
\[19\] eti eis du

diaireseis m\( \alpha \)taios \( \alpha \)n e\( \iota \) o\( \nu \)tv gar diairoinov
anagkaion xwrioein kai diaspain. tvon polupodov

\[20\] gar esti tva men en tois pezois tv \( \delta' \) en tois

einoudwv.

III. "Eti steperhei men anagkaion diairein kai
diairoinov oi dichostomounves. ouk esti de diafora

\[1\] apouw post schizopou vulg., del. Ogle; fortassse [apereon]
scrinendum (cf. An. Post. 92 a 1, Met. 1037 b 34).

\[a\] Other groups will get broken up under several lines of
division, as Aristotle goes on to say, and he repeats this at
643 b 14, where he adds that "contrary" groups will get
lumped together under a single line (and "contrariety is
maximum 'difference,' " see Met. 1055 a 5 ff., cf. 1018 a 30).

\[b\] Aristotle holds that one is not enough; see 643 b 9 ff.
and 29 ff.
(a) Some groups will get only one \textit{differentia}, the rest of the terms being superfluous extras, as in the example: footed, two-footed, cloven-footed—since this last one is the only independently valid \textit{differentia}. Otherwise the same thing must of necessity be repeated many times over.

(b) Again, it is a mistake to break up a group, as for instance the group Birds, by putting some birds in one division and some in another, as has been done in the divisions made by certain writers: in these some birds are put in with the water-creatures, and others in another class. (These two groups, each possessing its own set of characteristics, happen to have regular names—Birds, Fishes—but there are other groups which have not, e.g. the "blooded" and "bloodless" groups: there is no one regular name for either of these.) If, then, it is a mistake to break up any group of kindred creatures, the method of division into two will be pointless, because those who so divide are compelled to separate them and break them up, some of the many-footed animals being among the land-animals and others among the water-animals.

III. (c) Again, this method of twofold division makes it necessary to introduce privative terms, and those who adopt it actually do this. But a privation, as

c \textit{i.e.} all terms except the final one can be dispensed with, because none of them constitutes an independent (\textit{kupia}) \textit{differentia}; one line of division yields one valid \textit{differentia} and no more (cf. 644 a 2-10).

d Cf. 644 a 5 and \textit{Met.} 1038 a 32.

e In this case, "-footed" (cf. \textit{Met.} 1038 a 19 ff.). But Aristotle does not explain how \textit{di}που is "superfluous."
ARISTOTLE

642 b

στερήσεως ἦ στέρησις· ἀδύνατον γὰρ εἴδη εἶναι τού μὴ ὄντος, ὅτι τῆς ἀποδίας ἦ τοῦ ἀπτέρου ὠστερ πτερώσεως καὶ ποδῶν· δεὶ δὲ τῆς καθόλου δια-

25 φορᾶς εἴδη εἶναι· εἰ γὰρ μὴ ἔσται, διὰ τί ἂν εἴη τῶν καθόλου καὶ οὐ τῶν καθ' ἐκαστοῦ; τῶν δὲ διαφορῶν αἱ μὲν καθόλου εἰσι καὶ ἔχουσιν εἴδη, οἰον πτερότης· τὸ μὲν γὰρ ἄσχιστον τὸ δ' ἐσχι-

30 σμένον ἐστὶ πτερόν. καὶ ποδότης ὁσαύτως ἢ μὲν πολυσχιδῆς, ἢ δὲ δισχιδῆς, οἰον τὰ δίχαλα, ἢ δ' ἀσχιδῆς καὶ ἀδιαφρετος, οἰον τὰ μώνυχα. χαλεπὸν μὲν οὐν διαλαβεῖν καὶ εἰς τουαύτας διαφορὰς ὁν ἔστιν εἴδη, ὄσθ' ὁτιοῦν ζῷον ἐν ταυταῖς ὑπάρχειν καὶ μὴ ἐν πλείοσι ταύτον (οἰον πτερωτοῦ καὶ ἀπτεροῦ· ἐστὶ γὰρ ἄμφω ταύτον, οἰον μύρμηξ καὶ λαμπυρῖς καὶ ἐπερά τινα), πάντων δὲ χαλεπώτατον ἦ ἀδύνατον εἰς τὰς ἀντικειμένας. 

35 ἀναγκαῖον γὰρ τῶν καθ' ἐκαστοῦ ὑπάρχειν τινὶ τῶν διαφορῶν ἀκάστην, ὃστε καὶ τὴν ἀντικειμένην. εἰ δὲ μὴ ἐνδέχεται τοὺς εἴδει διαφέρουσιν ὑπάρχειν εἴδος τι τῆς οὐσίας ἄτομον καὶ ἐν, ἀλλ' ἂι διαφορὰν ἔξει (οἰον ὥρις ἀνθρώπου—ἡ διποδία γὰρ ἀλλη καὶ διάφορος· καὶ εἰ ἐναιμα, τὸ αἷμα διάφορον, ἡ ούδὲν τῆς οὐσίας τὸ αἷμα θετέον)—εἰ δ' οὕτως ἔστιν, ἢ

643 a


2 ll. 3-6 interpunctionem correcxi.

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a I have not attempted to keep a consistent translation for πτερόν, as Aristotle applies this term to “feathers” and to “wings” (of insects).
privation, can admit no differentiation; there cannot be species of what is not there at all, *e.g.* of "footless" or "featherless," as there can be of "footed" and "feathered"; and a generic *differentia* must contain species, else it is specific not generic. However, some of the *differentiae* are truly generic and contain species, for instance "feathered" (some feathers are barbed, some unbarbed); and likewise "footed" (some feet are "many-cloven," some "twy-cloven," as in the animals with bifid hoofs, and some "uncloven" or "undivided," as in the animals with solid hoofs). Now it is difficult enough to arrange the various animals under such lines of differentiation as these, which after all do contain species, in such a way that every animal is included in them, but not the same animal in more than one of them (*e.g.* when an animal is both winged and wingless, as ants, glow-worms, and some other creatures are); but it is excessively difficult and in fact impossible to arrange them under the opposite lines of differentiation. Every *differentia* must, of course, belong to some species; and this statement will apply to the negative *differentiae* as well as to the positive. Now it is impossible for any essential characteristic to belong to animals that are specifically different and at the same time to be itself one and indivisible: it will always admit of differentiation. (For example, Man and Bird are both two-footed, but this essential characteristic is not the same in both: it is differentiated. And if they are both "blooded," the blood must be different, or else it cannot be reckoned as part of their essence.) If that is so, then, the one

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b As the privative characteristic would have to be.

* See below, 693 b 2 ff.
Because it cannot fulfill the condition of admitting differentiation. At whatever stage of the division it comes (unless at the very end), the privative term will cover at least two species, and therefore at the next stage the dichotomists will have to divide it—illegitimately, as Aristotle maintains.
**PARTS OF ANIMALS, I. III.**

differentia will belong to two species. And if so, it is clear that a privative cannot be a valid differentia.a

(d) Now assuming that each species is indivisible: if each differentia also is indivisible, and none is common to more species than one, then the number of differentiae will be equal to the number of species. (Supposing it were possible to have a differentia which though indivisible was common; clearly, in that case, animals which differed in species would be in the same division in virtue of that common differentia. Therefore, if the differentiae under which the indivisible and ultimate species fall are to be proper and private to each one, it is necessary that no differentia be common; otherwise, species which are actually different will come under one and the selfsame differentia.) And we may not place one and the same indivisible species under two or three of the lines of differentiation given by the divisions; nor may we include different species under one and the same line of differentiation. Yet each species must be placed under the lines of differentiation available. It is evident from this that it is impossible to arrive at the indivisible species either of animals or of any other group by the method of twofold division as these people practise it, for even on their showing the number of ultimate differentiae must of necessity be equal to the total number of indivisible species of animals. Thus, suppose we have some particular group of creatures whose prime differentiae are "pale" and "not pale"; by that method these two will each give two other differentiae, and so forth, until in the end the indivisible differentiae are reached: these last ones will be either four in
πλήθος τῶν ἀφ' ἐνὸς διπλασιαζομένων· τοσατά δὲ καὶ τὰ εἰδη.

("Εστὶ δ' ἡ διαφορὰ ἐν τῇ ὕλῃ τὸ εἴδος. σοτε 25 γὰρ ἄνευ ὕλης οὐδὲν ξύον μόριον, οὔτε μόνη ἡ ὕλη· οὐ γὰρ πάντως ἔχον σῶμα ἐσται ξύον, οὐδὲ τῶν μορίων οὐδέν, ὡσπερ πολλάκις εἴρηται.

"Ετι διαιρεῖν χρή τοῖς ἐν τῇ ὑσίᾳ καὶ μὴ τοῖς συμβεβηκόσι καθ' αὐτό, οἷοι εἰ τις τὰ σχήματα διαιροῖ, οὗ τὰ μὲν δυσὶν ὀρθαὶς ἵσαι ἔχει τὰς 30 γωνίας, τὰ δὲ πλείοσιν· συμβεβηκός γὰρ τι τῷ τριγώνῳ τὸ δυσὶν ὀρθαὶς ἵσαι ἔχειν τὰς γωνίας.

"Ετι τοῖς ἀντικειμένοις διαιρεῖν (dei), διάφορα γὰρ ἄλληλοις πάντικείμενα, οἷον λευκότης καὶ μελανία καὶ εὐθύτης καὶ καμπυλότης. έϊν οἷον θάτερα διάφορα ἡ, τῷ ἀντικειμένῳ διαιρετέον, καὶ μὴ τοῖ 35 μὲν νεύσει τὸ δὲ χρώματι. πρὸς δὲ τούτοις, τὰ γ' ἐμψυχα τοῖς κοινοῖς ἔργοις τοῦ σώματος καὶ τῆς

643 b ψυχῆς, οἷον καὶ ἐν ταῖς ῥηθείσαις νῦν πορευτικὰ καὶ πτηνὰ—ἔστιν γὰρ τινα γένη οἷς ἁμφό ὑπάρχει καὶ ἔστι πτηνὰ καὶ ἄπτερα, καθάπερ τὸ τῶν μυρμήκων

1 sic Y : τὸ εἴδος ἐν τῇ ὕλῃ vulg.
2 (dei) supplevi.
PARTS OF ANIMALS, I. iii.

number, or some higher value of $2^n$; and there will be an identical number of species.a

(The species is the *differentia* in the Matter. There is no animal part which exists without matter; nor on the other hand is there any which is matter only, for body in any and every condition cannot make an animal or any part of an animal, as I have often pointed out.b)

(e) Again, the division ought to be made according to points that belong to the Essence of a thing and not according to its essential (inseparable) attributes. For instance, in making divisions of geometrical figures, it would be wrong to divide them into those whose angles are together equal to two right angles and those whose angles are together greater than two right angles; because it is only an attribute of the triangle that its angles are together equal to two right angles.c

(f) Again, division should be by "opposites," opposites being mutually "different," e.g. pale and dark, straight and curved. Therefore, provided the two terms are truly "different," division should be by means of opposites, and should not characterize one side by ability to swim and the other side by some colour. And besides this, division of living creatures, at any rate, by the functions which are common functions of body and soul,d such as we actually find done in the divisions mentioned above, where animals are divided into "walkers" and "fliers"—for there are some groups, such as that of the Ants, which have both attributes, being both locomotive, and thought (see *De an*. 414 a 28 ff.). His point is that the correct way to divide and classify animals is rather by bodily characteristics, which is what he himself does.
γένος—καὶ τῷ ἄγριῷ καὶ ἡμέρῳ (<οὐ δεῖ>² διαφέρον οὐσαύτως γὰρ ἂν δόξεις ταῦτα εἰδὴ διαφέρων. 5 πάντα γὰρ, ὡς εἰπεῖν, ὁσα ἡμέρα καὶ ἄγρια τυγχάνει ὃντα, οἴον ἀνθρωποι, ἵπποι, βόσκε, κύνες ἐν τῇ Ἰνδικῇ, ὑς, αἴγες, πρόβατα. ὃν ἐκαστὸν, εἰ μὲν ὄμωνυμον, οὐ διήρηται χωρίς, εἰ δὲ ταῦτα ἐν εἴδει, οὐχ οἶον τ' εἶναι διαφορὰν τὸ ἄγριον καὶ τὸ ἡμερόν.

"Ὅλως δ' ὑποικοῦν διαφορὰς³ μᾶ διαφοροῦν τὸ τοῦτο συμβαίνειν ἀναγκαῖον. ἀλλὰ δεῖ πειράσθαι λαμβάνειν κατὰ γένη τὰ ζώα, ὡς υφήγηνθ' οἱ πολλοὶ διορίσαντες ὁρινόθι γένος καὶ ἱχθύος. τούτων δ' ἐκαστὸν πολλαῖς ὄριοι διαφοραῖς, οὐ κατὰ τὴν διχοτομίαν. οὔτω μὲν γὰρ ἦτοι τὸ παράπαν οὐκ ἔστι λαβεῖν (τὸ αὐτὸ γὰρ εἰς πλεῖον ἐμπίπτει διαμερίσεις καὶ τὰ ἐναντία εἰς τὴν αὐτήν), ἤ μᾶν μόνον διαφορὰ ἔσται, καὶ αὐτὴ ἦτοι ἀπλή ἤ ἐκ συμπλοκῆς τὸ τελευταίον ἔσται εἰδὸς. ἐὰν δὲ μὴ διαφοράς λαμβάνῃ τις διαφορὰν,⁴ ἀναγκαίον, ὅσπερ συνδέσμω τὸν λόγον ἐνα ποιοῦτας, οὔτω καὶ τὴν διαμερίσειν συνεχὴ ποιεῖν. λέγω δ' οἶον συμβαίνει τοῖς διαφορομένοις τὸ μὲν ἀπτερον τὸ δὲ πτερωτόν, πτερωτοῦ δὲ τὸ μὲν ἡμερόν τὸ δ' ἄγριον, ἡ τὸ μὲν

¹ καὶ EY: καὶ τῷ vulg.
² supplevi.
³ ὑποικοῦν διαφορὰν alii: ὑποικοῦν Y: διαφορὰ vel διαφορά ESY.

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⁵ Cf. Plato, Politicus, 264 a 1.
⁶ On this see Platt, C.Q., 1909, iii. 241.
⁷ For διαφορά in the sense of "bifurcation" cf. Met. 1048 b 4, where he speaks of the two "parts" of a διαφορά.
⁸ i.e. with the preceding terms. See below, 644 a 5.
"winged" and "wingless"—and by "wild" and "tame," a is not permissible, for this similarly would appear to divide up species that are the same, since practically all the tame animals are also found as wild ones: e.g. Man, the horse, the ox, the dog (in India b), swine, the goat, the sheep; and if, in each of these groups, the wild and the tame bear the same name, as they do, there is no division between them, while if each group is specifically a unit, then it follows that "wild" and "tame" cannot make a valid differentiation.

And generally, the same thing inevitably happens whatever one single line of differentiation is taken for the division. The proper course is to endeavour to take the animals according to their groups, following the lead of the bulk of mankind, who have marked off the group of Birds and the group of Fishes. Each of these groups is marked off by many differentiae, not by means of dichotomy. By dichotomy (a) either these groups cannot be arrived at at all (because the same group falls under several divisions and contrary groups under the same division) or else there will be one differentia only, and this either singly or in combination d will constitute the ultimate species. e But (b) if they do not take the differentia of the differentia, they are forced to follow the example of those people who try to give unity to their prose by a free use of conjunctions: there is as little continuity about their division. Here is an example to show what happens. Suppose they make the division into "wingless" and "winged," and then divide "winged" into "tame" and "wild" or into

 And this will never completely represent any actual group or species. See below, 644 a 6 ff.
λευκὸν τὸ δὲ μέλαν· οὐ γὰρ διαφορὰ τοῦ πτερωτοῦ τὸ ἡμερον οὐδὲ τὸ λευκὸν, ἀλλὰ ἐτέρας ἀρχὴ δια-
φορᾶς· ἐκεῖ δὲ κατὰ συμβεβηκός. διὸ πολλαῖς τὸ ἐν εὐθέως διαιρετέον, ὡσπερ λέγομεν. καὶ γὰρ
25 οὐτως μὲν αἱ στερήσεις ποιήσουσι διαφοράν, ἐν δὲ τῇ διχοτομίᾳ οὐ ποιήσουσιν.

"Ωτι δ’ οὐκ ἐνδέχεται τῶν καθ’ ἐκαστόν εἰδῶν λαμβάνειν οὐδὲν διαιροῦσι δίχα τὸ γένος, ὡσπερ τινὲς ώθησαν, καὶ ἐκ τῶνδε φανερον.

'Αδύνατον γὰρ μίαν ὑπάρχειν διαφορὰν τῶν
30 καθ’ ἐκαστόν διαιρετῶν, εάν θ’ ἀπλὰ λαμβάνῃ τις
εάν τε συμπεπλεγμένα. [λέγω δὲ ἀπλὰ μὲν, εάν μὴ
ἐχθι διαφοράν, οἶον τὴν σχιζόποδιαν, συμπεπλεγ-
μένα δὲ, εάν ἔχη, οἶον τὸ πολυσχίδες πρὸς τὸ
σχιζόπουν':]3] τούτο γὰρ ἡ σύνεχεια βούλεται τῶν
ἔπο τοῦ γένους κατὰ τὴν διαίρεσιν διαφορὰν ὡς ἐν
35 τὶ τὸ πάν ὄν, ἀλλὰ παρὰ τὴν λέξιν συμβαίνει δοκεῖν
τὴν τελευταίαν μόνην εἶναι διαφορὰν [οἶον τὸ πολυ-
644 a σχίδες ἢ τὸ δίπουν, τὸ δ’ υπόπουν καὶ πολὺπουν
περίεργα].4 ὅτι δ’ ἀδύνατον πλείους εἶναι τοιαῦτας,
δῆλον· αἰε γὰρ βαδίζων ἐπὶ τὴν ἐσχάτην διαφορὰν
ἀφικνεῖται [ἀλλ’ οὐκ ἐπὶ τὴν τελευταίαν καὶ τὸ
εἴδος].5 αὕτη δ’ ἐστὶν ἢ τὸ σχιζόπουν μόνον, ἢ
5 πάσα ἡ σύμπλεξις, εάν διαιρήται ἄνθρωπος,6 οἶον
εἰ τὶς συνθεῖται υπόπουν, δίπουν, σχιζόπουν. εἰ δ’
ἡν δ’ ἄνθρωπος σχιζόπουν μόνον, οὕτως εὐγίνετ’ ἀν
αὕτη ἢ’ μία διαφορά. νῦν δ’ ἐπειδὴ οὐκ ἔστιν,

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1 τὶς Υ: om. vulg.  
2 πρὸς τῷ Platt.  
3 seclusi. codices varia, ut videtur; sic Bekker.  
4 οἶον . . . περίεργα seclusi.  
5 ἀλλ’ . . . εἴδος seclusi.  
6 ἄνθρωπον vulg.  
7 ἢ’ Ogle.
"pale" and "dark": neither "tame" nor "pale" is a differentiation of "winged," but the beginning of another line of differentiation, and can come in here only by accident. Therefore, as I say, in dividing we must distinguish the one original group forthwith by numerous differentiae; and then too the privative terms will make valid differentiae, which they will never do in the system of dichotomy.

Here are further considerations to show that it is impossible to come at any of the particular species by the method of dividing the group into two, as some people have imagined.

Obviously it is impossible that one single differentia is adequate for each of the particular species covered by the division, whether you adopt as your differentia the isolated term or the combination of terms for this is intended by the continuity of the series of differentiae throughout the division from the original group, to indicate that the whole is a unity; but, in consequence of the form of the expression, the last one comes to be considered as the sole differentia). And it is evident that there cannot be more than one such differentia; for the division proceeds steadily until it reaches the ultimate differentia, and—supposing the division is aiming at "Man"—this is either "cloven-footed" alone, or else the whole combination, e.g. if one combined "footed," "two-footed," "cloven-footed." If Man were merely a cloven-footed animal, then this would be the one differentia, arrived at by the right method. But as he is not merely

\[a\] i.e. the last term of any series, or all its terms together, as he goes on to say. Cf. 643 b 15 f.

\[b\] This definition appears also in Met. 1037-1038.
ARISTOTLE

644 a

ἀνάγκη πολλὰς εἶναι μὴ ὑπὸ μίαν διαίρεσιν. ἀλλὰ μὴν πλείους γε τοῦ αὐτοῦ οὐκ ἔστιν ὑπὸ μίαν
dιχοτομίαν εἶναι, ἀλλὰ μίαν κατὰ μίαν τελευταίαν.
ὡστε ἀδύνατον ὅτι οὖν λαβεῖν τῶν καθ' ἐκαστὸν
ξώμων δίχα διαιρομένους.

IV. Ἀπορήσεις δ' ἂν τις διὰ τὸ οὐκ ἀνωθεν ἐνὶ
ὁνόματι ἐμπεριλαβῶντες ἀμα ἐν γένος ἀμφω προσ-
ηγόρευσαν οἱ ἄνθρωποι, ὁ περιέχει τὰ τε ἐνυδρα
cαι τὰ πτηνὰ τῶν ξώμων: ἐστὶ γὰρ ἐνα πάθη
κοινὰ καὶ τοῦτος [καὶ τοῖς ἄλλοις ξώοις ἀπασιν].

1 ἀλλ' ὀμως ὀρθῶς διώρισται τοῦτον τὸν τρόπον.
ὁσα μὲν γὰρ διαφέρει τῶν γενῶν καθ' ὑπεροχὴν καὶ
tῶ μᾶλλον καὶ ἤττον,2 ταῦτα ὑπέξευκται ἐν γένει,
ὅσα δ' ἔχει τὸ ἀνάλογον, χωρίς· λέγω δ' οἶον ὄρνις
20 ὀρνιθὸς διαφέρει τῷ μᾶλλον ἦ καθ' ὑπεροχὴν (τὸ
μὲν γὰρ μακρόπτερον τὸ δὲ βραχύπτερον), ἱχθυῖες
δ' ὀρνιθὸς τῷ ἀνάλογον (ὁ γὰρ ἐκείνω πτερόν, θα-
tέρῳ λεπίς). τοῦτο δὲ ποιεῖν ἐπὶ πᾶσιν οὐ δύδων
tὰ γὰρ πολλὰ ξώα ἀνάλογον ταῦτα πέπονθεν.

Ἐπεὶ δ' ουσία μὲν εἰς τὰ ἐσχάτα εἴδη, κατὰ
25 δὲ ταῦτα τὰ3 τὸ εἴδος ἀδιάφορα (οίνων Σωκράτης,
Κορίσκος), ἀναγκαῖον ἦ τὰ καθόλου ὑπάρχοντα

1 seclusi Ogle docente.
2 sic Rackham: τοῦ μᾶλλον καὶ τὸ (τὸ om. Υ) ἤττον vulg.
3 κατὰ δὲ ταῦτα τὰ Peck: ταῦτα δὲ κατὰ vulg.

a This paragraph has been corrupted by confusing interpola-

2 On this point see D'Arcy W. Thompson, Growth and Form, esp. ch. 17, and the same author's paper Excess and Defect: or The Little More and the Little Less, in Mind, xxxviii. (N.S.) 149, pp. 43-55. See also infra,

92
that, it is necessary that there should be many *differentiae*, not under one line of division. And yet there cannot be more than one *differentia* for the same thing under one line of dichotomy: one line must end in one *differentia*. So it is impossible for those who follow the method of twofold division to arrive at any of the particular animals.\(^a\)

IV. Some may find it puzzling that general usage has not combined the water-animals and the feathered animals into one higher group, and adopted one name to cover both, seeing that in fact these two groups have certain features in common. The answer is that in spite of this the present grouping is the right one; because while groups that differ only "by excess" (that is, "by the more and less"\(^b\)) are placed together in one group, those which differ so much that their characteristics can merely be called analogous are placed in separate groups. As an illustration: (a) one bird differs from another bird "by the more," or "by excess": one bird's feathers are long, another's are short; whereas (b) the difference between a Bird and a Fish is greater, and their correspondence is only by analogy: a fish has no feathers at all, but scales, which correspond to them. It is not easy to do this in all cases, for the corresponding analogous parts of most groups of animals are identical.

Now since the ultimate species are "real things,"\(^c\) while within them are individuals which do not differ in species (as *e.g.* Socrates and Coriscus),\(^d\) we shall have to choose (as I have pointed out)\(^e\) between

\(^a\) Lit. "substances."

\(^b\) *i.e.* within the species "man."

\(^c\) Above, at 639 a, b, etc.
644 a  
πρότερον εἰπεῖν ἡ πολλάκις ταύτων λέγειν, καθάπερ εἴρηται. (τὰ δὲ καθόλου κοινά· τὰ γὰρ πλείοσιν ὑπάρχοντα καθόλου λέγομεν.) ἀπορίαν δὲ ἔχει περὶ πότερα δεὶ πραγματεύεσθαι. ἥ μὲν γὰρ οὐσία τὸ 80 τῷ εἴδει ἀτόμον, κράτιστον, εἰ τις δύναυτο, περὶ τῶν καθ’ ἐκαστὸν καὶ ἀτόμων τῷ εἴδει θεωρεῖν χωρίς, ὡσπερ περὶ ἄνθρωπον, οὕτω καὶ 1 περὶ ὀρνιθὸς, (καὶ μὴ περὶ ὄτουον ὀρνιθὸς) (ἔχει γὰρ εἴδη τὸ γένος τούτο), ἄλλα περὶ τῶν ἀτόμων. 3 οἶον ἡ στρογγὸς ἡ γέρανος ἢ τι τοιούτων. ἥ δὲ συμβηκεται λέγειν 35 πολλάκις περὶ τοῦ αὐτοῦ πάθους διὰ τὸ κοινῇ πλείοσιν ὑπάρχειν, ταύτη δ’ ἐστὶν ὑπάτοπον καὶ 644 b μακρὸν τὸ περὶ ἐκάστου λέγειν χωρίς. ὅσως μὲν οὐν ὀρθῶς ἔχει τὰ μὲν κατὰ γένη κοινῇ λέγειν, ὡσα λέγεται καλῶς ὀρισμένων τῶν ἀνθρώπων, καὶ ἔχει τε μίαν φύσιν κοινὴν καὶ εἴδη ἐν αὐτοῖς 3 μὴ 5 πολὺ διείστωτα, ὀρνις καὶ ἱχθύς, καὶ εἰ τι ἄλλο ἐστὶν ἀνώνυμον μὲν, τῷ γένει δ’ ὀμοῖα 4 περιέχει τὰ ἐν αὐτῷ 5 εἴδη· ὅσα δὲ μὴ τοιαῦτα, καθ’ ἐκαστὸν, οἶον περὶ ἄνθρωπον καὶ εἰ τι τοιούτων ἐτερόν ἐστὶν.

Σχεδὸν δὲ τοῖς σχῆμασι τῶν μορίων καὶ τοῦ σώματος ὁλο, ἐὰν ὀμοιότητα ἔχωσιν, ὀρισται τὰ γένη, οἶον τὸ τῶν ὀρνίθων γένος πρὸς αὐτὸ 6 πέ-  

1 καὶ] μὴ Bonitz.  
2 hunc locum correxī, Σ secutus; ἔχει γὰρ εἴδη τὸ γένος τούτο· ἄλλα περὶ ὄτουον ὀρνιθὸς τῶν ἀτόμων, οἶον κτλ. vulg.  
3 αὐτοῖς vulg.: correxī.  
4 ὀμοῖως vulg.: correxī.  
5 αὐτῷ vulg.: correxī.  
6 αὐτῷ Platt, fortasse Z1: αὐτῷ Y: αὐτὰ Z2, vulg.
PARTS OF ANIMALS, I. iv.

describing first of all the general attributes of many species, and repeating the same thing many times over. (By "general" attributes I intend the "common" ones. That which belongs to many we call "general." ) One may well hesitate whether of the two courses to follow. For, in so far as it is the specifically indivisible which is the "real thing," it would be best, if one could do it, to study separately the particular and specifically indivisible sorts, in the same way as one studies "Man," to do this with "Bird" too, that is. to study not just "Bird" in the mass, but—since "Bird" is a group which contains species—the indivisible species of it, e.g. Ostrich, Crane, and so on. Yet, on the other hand, this course is somewhat unreasonable and long-winded, because it makes us describe the same attributes time and again, as they happen to be common attributes of many species. So perhaps after all the right procedure is this: (a) So far as concerns the attributes of those groups which have been correctly marked off by popular usage—groups which possess one common nature apiece and contain in themselves species not far removed from one another, I mean Birds and Fishes and any other such group which though it may lack a popular name yet contains species generically similar—to describe the common attributes of each group all together; and (b) with regard to those animals which are not covered by this, to describe the attributes of each of these by itself—e.g. those of Man, and of any other such species there may be.

Now it is practically by resemblance of the shapes of their parts, or of their whole body, that the groups are marked off from each other: as e.g. the groups
ARISTOTLE

644 b

10 πονθε καὶ τὸ τῶν ἰχθύων καὶ τὰ μαλάκια τε καὶ τὰ ὀστρεία. τὰ γὰρ μόρια διαφέρουν τοῦτων οὐ τῇ ἁνάλογου ὁμοιότητι, οἷον ἐν ἄνθρωπῳ καὶ ἰχθύι πέπονθεν ὅστοιν πρὸς ἀκανθαν, ἀλλὰ μᾶλλον τοῖς σωματικοῖς πάθεσιν, οἷον μεγέθει μικρότητι, μαλα-
15 κότητι σκληρότητι, λειώτητι τραχύτητι καὶ τοῖς τοιούτοις, ὅλως δέ τῷ μᾶλλον καὶ ἡττον.

Πῶς μὲν ἀποδέχεσθαι δεῖ τὴν περὶ φύσεως μέθοδον, καὶ τίνα τρόπον γίνοιτ' ἂν ἡ θεωρία περὶ αὐτῶν ὅδω καὶ ράστα, ἐτ' ἰδίᾳ διαφέρεσιν, τίνα τρόπον ἐνδέχεται μετιούσι λαμβάνειν χρησίμως, καὶ
20 διότι τὸ διχοτομεῖν τῇ μὲν ἀδύνατον τῇ δὲ κενόν, εὐρηταί. διωρισμένων δὲ τοῦτων περὶ τῶν ἐφεξῆς λέγομεν, ἄρχειν τὴνδε ποιησάμενοι.

V. Τῶν οὖσιῶν ὅσαι φύσει συνεστάσι, τὰς μὲν λέγομεν ἀγενήτους καὶ ἀφθάρτους εἶναι τῶν ἀπαντά αἰῶνα, τὰς δὲ μετέχειν γενέσεως καὶ
25 ψευδώς. συμβέβηκε δὲ περὶ μὲν ἐκεῖνας τιμίας οὖσας καὶ θείας ἐλάττους ἡμῖν ὑπάρχειν θεωρίας (καὶ γὰρ ἐξ ὧν ἂν τις σκέψασθαί περὶ αὐτῶν, καὶ περὶ ὧν εἰδέναι ποθοῦμεν, παντελῶς ἐστὶν ὁλίγα τὰ φανερά κατὰ τὴν αἰσθησιν), περὶ δὲ τῶν φθαρτῶν φυτῶν τε καὶ ζώων εὐποροῦμεν μᾶλλον πρὸς τὴν
30 γνώσιν διὰ τὸ σύντροφον: πολλὰ γὰρ περὶ ἐκαστον γένους λάβοι τῖς ἂν τῶν ἑπαρχοῦντος βουλόμενος διαπονεῖν ικανώς. ἔχει δ' ἐκάτερα χάρων. τῶν μὲν γὰρ εἰ καὶ κατὰ μικρὸν ἐφαπτόμεθα, ὅμως διὰ τὴν

1 λέγομεν Peck.

Lit., “softies.” The group includes, roughly, the cephalopod mollusca.

Lit., “oysters” (bivalves).

96
PARTS OF ANIMALS, I. iv.–v.

Birds, Fishes, Cephalopods, Testacea. Within each of these groups, the parts do not differ so far that they correspond only by analogy (as a man’s bone and a fish’s spine); that is, they differ not structurally, but only in respect of bodily qualities, e.g. by being larger or smaller, softer or harder, smoother or rougher, and so forth, or, to put it generally, they differ “by the more and less.”

We have now shown:

(1) how to test a method of Natural science;
(2) what is the most systematic and easiest way of studying Natural science;
(3) what is the most useful mode of Division for our present purpose;
(4) why dichotomy is in one respect impossible and in another futile.

Now that we have made this beginning, and clearly distinguished these points, we may proceed.

V. Of the works of Nature there are, we hold, two kinds: those which are brought into being and perish, and those which are free from these processes throughout all ages. The latter are of the highest worth and are divine, but our opportunities for the study of them are somewhat scanty, since there is but little evidence available to our senses to enable us to consider them and all the things that we long to know about. We have better means of information, however, concerning the things that perish, that is to say, plants and animals, because we live among them; and anyone who will but take enough trouble can learn much concerning every one of their kinds. Yet each of the two groups has its attractiveness. For although our grasp of the eternal things is but slight, nevertheless the joy which it brings is, by
This passage, 645 a 6-15, is quoted by R. Boyle (Of the Usefulness of Naturall Philosophy, 1663) both in Gaza’s Latin version and in an English translation, and he introduces it thus: “And, methinks, Aristotle discourses very Philosophically in that place, where passing from the consideration of the sublimist productions of Nature, to justifie his diligence in recording the more homely Circumstances of the History of Animals, he thus discourses.” He also quotes
reason of their excellence and worth, greater than that of knowing all things that are here below; just as the joy of a fleeting and partial glimpse of those whom we love is greater than that of an accurate view of other things, no matter how numerous or how great they are. But inasmuch as it is possible for us to obtain more and better information about things here on the earth, our knowledge of them has the advantage over the other; and moreover, because they are nearer to us and more akin to our Nature, they are able to make up some of their leeway as against the philosophy which contemplates the things that are divine. Of "things divine" we have already treated and have set down our views concerning them; so it now remains to speak of animals and their Nature. a So far as in us lies, we will not leave out any one of them, be it never so mean; for though there are animals which have no attractiveness for the senses, yet for the eye of science, for the student who is naturally of a philosophic spirit and can discern the causes of things, Nature which fashioned them provides joys which cannot be measured. If we study mere likenesses of these things and take pleasure in so doing, because then we are contemplating the painter's or the carver's Art which fashioned them, and yet fail to delight much more in studying the works of Nature themselves, though we have the ability to discern the actual causes—that would be a strange absurdity indeed. Wherefore we must not betake ourselves to the consideration of the meaner animals with a bad grace, as though we were children; since in all natural things there is somewhat of the mar-

the following passage, a 15-23, describing it as "that Judicious reasoning of Aristotle."

D 2

99
**ARISTOTLE**

645 a

τι θαυμαστών· καὶ καθάπερ Ἡράκλειτος λέγεται
20 πρὸς τοὺς ξένους εἰπεῖν τοὺς θεολογοῦντες ἐντυχεῖν αὐτῷ, οὐ ἐπειδὴ προσιόντες εἰδον αὐτὸν θερόμενον πρὸς τῷ ὕπνῳ ἔστησαν (ἐκελέει γὰρ αὐτοὺς εἰσέναι βαρροῦντας· εἶναι γὰρ καὶ ἐνταῦθα θεοῦ), οὕτω καὶ πρὸς τὴν ζήτησιν περὶ ἐκάστου τῶν ξύων προσιέναι δεῖ μὴ δυσωποῦμεν, ὡς ἐν ἀπασίν ὄντος τινὸς φυσικοῦ καὶ καλοῦ.

Τὸ γὰρ μὴ τυχόντως ἀλλ' ἕνεκά τινος ἐν τοῖς τῆς
25 φύσεως ἔργοις ἐστὶ καὶ μάλιστα· οὐ δ' ἑνεκα συνέστηκεν ἢ γέγονεν τέλους, τὴν τοῦ καλοῦ χώραν εἰληφεν. εἰ δὲ τις τὴν περὶ τῶν ἄλλων ξύων θεωρίαν ἀτμον εἶναι νεόμικο, τὸν αὐτὸν τρόπον οἴεσθαι χρή καὶ περὶ αὐτοῦ· οὐκ ἐστὶ γὰρ ἄνευ πολλῆς δυσχερείας ἱδεῖν εξ ὧν συνέστηκε τὸ τῶν
30 ἀνθρώπων γένος, οἶδον αἷμα, σάρκες, ὄστα, φλέβες καὶ τὰ τοιαύτα μόρια. ὅμοιως τε δει νομίζειν τὸν περὶ οὕτως οὖν τῶν μορίων ἢ τῶν σκευῶν διαλεγόμενον μὴ περὶ τῆς ὦλης ποιεῖσθαι τὴν μνήμην, μηδὲ ταύτης χάριν, ἀλλὰ τῆς ὦλης μορφῆς, οἶδον καὶ περὶ οἰκίας, ἀλλὰ μὴ πλίνθων καὶ πηλοῦ καὶ ἔξωλν·
35 καὶ τὸν περὶ φύσεως περὶ τῆς συνθέσεως καὶ τῆς ὦλης οὐσίας, ἀλλὰ μὴ περὶ τούτων ἀ μὴ συμβαίνει χωριζόμενα ποτὲ τῆς οὐσίας αὐτῶν.

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*a* Or, with reference to another use of οὐσία, “which gives them their being.” Independent approaches to the position that components are non-significant in isolation had been made, *e.g.* by Anaxagoras, as a physical philosopher (see my article in *C.Q.* xxv. 27 ff., 112 ff.), who held that “the things (*i.e.* the constituent elements) in this world are not separate one from another” (frag. 8, Diels, *Fragmente* 5, 100
vellous. There is a story which tells how some visitors once wished to meet Heracleitus, and when they entered and saw him in the kitchen, warming himself at the stove, they hesitated; but Heracleitus said, "Come in; don't be afraid; there are gods even here." In like manner, we ought not to hesitate nor to be abashed, but boldly to enter upon our researches concerning animals of every sort and kind, knowing that in not one of them is Nature or Beauty lacking.

I add "Beauty," because in the works of Nature purpose and not accident is predominant; and the purpose or end for the sake of which those works have been constructed or formed has its place among what is beautiful. If, however, there is anyone who holds that the study of the animals is an unworthy pursuit, he ought to go further and hold the same opinion about the study of himself, for it is not possible without considerable disgust to look upon the blood, flesh, bones, blood-vessels, and suchlike parts of which the human body is constructed. In the same way, when the discussion turns upon any one of the parts or structures, we must not suppose that the lecturer is speaking of the material of them in itself and for its own sake; he is speaking of the whole conformation. Just as in discussing a house, it is the whole figure and form of the house which concerns us, not merely the bricks and mortar and timber; so in Natural science, it is the composite thing, the thing as a whole, which primarily concerns us, not the materials of it, which are not found apart from the thing itself whose materials they are.\(^a\)

\(^{59}\text{b}^{8})\); also from the logical point of view, as seen in Plato, \textit{Theaetetus}, 201 \textit{e} ff.
645 b  Ἀναγκαῖον δὲ πρῶτον τὰ συμβεβηκότα διελείψειν 
περὶ ἐκαστον γένος, ὡσα καθ’ αὐτὰ πάσιν ὑπάρχει
toῖς ζώοις, μετὰ δὲ ταῦτα τὰς αἰτίας αὐτῶν πειρά-
σθαι διελείψειν. εἰρθηαῖ μὲν οὖν καὶ πρότερον στὶ
pολλὰ κοινὰ πολλοῖς ὑπάρχει τῶν ζώων, τὰ μὲν
ἀπλῶς (οἷον πόδες, πτερά, λεπίδες, καὶ πάθη δή
tῶν αὐτῶν τρόπον τούτοις), τὰ δ’ ἀνάλογον (λέγω δ’
ἀνάλογον, ὧτι τοῖς μὲν ὑπάρχει πλεύμων, τοῖς δὲ
πλεύμων μὲν οὐ, δ’ δὲ τοῖς ἔχουσι πλεύμωνα, ἐκεί-
νοις ἐτερον ἀντὶ τοῦτον. καὶ τοῖς μὲν αἴμα, τοῖς δὲ
τὸ ἀνάλογον τῆν αὐτὴν ἔχον δύναμιν ἢπερ τοῖς
ἐναίμοις τὸ αἷμα). τὸ δὲ λέγειν χωρὶς περὶ ἐκαστῶν
tῶν καθ’ ἐκαστα, καὶ ἐμπροσθεν εἰπομεν ὧτι
πολλάκις συμβῆσται ταῦτα λέγειν, ἐπειδὰν λέ-
γωμεν περὶ πάντων τῶν ὑπαρχόντων ὑπάρχει δὲ
πολλοῖς ταῦτα. ταῦτα μὲν οὖν ταύτη διωρίσθω.

15 Ἑπεὶ δὲ τὸ μὲν ὄργανον πᾶν ἕνεκα του, τῶν δὲ
τοῦ σώματος μορίων ἐκαστον ἕνεκα του, τὸ δ’ οὖ
ἔνεκα πράξεις τις, φανερὸν ὧτι καὶ τὸ σύνολον σώμα
συνέστηκε πράξεως τινος ἕνεκα πολυμεροῦς. 1 οὐ
γάρ ἢ πρίσις τοῦ πρίσιον χάριν γέγονεν, ἀλλ’ ὃ
πρίνω τῆς πρίσισις. χρήσις γάρ τις ἢ πρίσις ἐστίν.
ὅστε καὶ τὸ σώμα πως τῆς ψυχῆς ἐνεκεν, καὶ τὰ
20 μόρια τῶν ἔργων πρὸς ἅ πέφυκεν ἐκαστον.

Δεκτέον ἄρα πρῶτον τὰς πράξεις τὰς τε κοινὰς 2

1 πολυμεροῦς P: πλήρους vulg.: fortasse polymorphon, cf. 646 b 15.
2 πάντων post κοινὰς vulg.: delevi.

a Almost always used in the singular by Aristotle.
b By "blood" Aristotle means red blood only. "Blooded" and "bloodless" animals do not quite coincide with vertebrates and invertebrates; for there are some invertebrates which have red blood, e.g. molluscs (Planorbis), insect.
First of all, our business must be to describe the attributes found in each group; I mean those "essential" attributes which belong to all the animals, and after that to endeavour to describe the causes of them. It will be remembered that I have said already that there are many attributes which are common to many animals, either identically the same (e.g. organs like feet, feathers, and scales, and affections similarly), or else common by analogy only (i.e. some animals have a lung, others have no lung but something else to correspond instead of it; again, some animals have blood, while others have its counterpart, which in them has the same value as blood in the former). And I have pointed out above that to treat separately of all the particular species would mean continual repetition of the same things, if we are going to deal with all their attributes, as the same attributes are common to many animals. Such, then, are my views on this matter.

Now, as each of the parts of the body, like every other instrument, is for the sake of some purpose, viz. some action, it is evident that the body as a whole must exist for the sake of some complex action. Just as the saw is there for the sake of sawing and not sawing for the sake of the saw, because sawing is the using of the instrument, so in some way the body exists for the sake of the soul, and the parts of the body for the sake of those functions to which they are naturally adapted.

So first of all we must describe the actions (a) larvae (Chironomus), worms ( Arenicola). In other invertebrates the blood may be blue (Crustacea) or green (Sabellid worms), or there may be no respiratory pigment at all (most insects).
καὶ τὰς κατὰ γένος καὶ τὰς κατ᾽ εἰδοὺς. λέγω δὲ κοινὰς μὲν αἱ πάσιν ὑπάρχουσι τοῖς ζῴοις, κατὰ γένος δὲ ὁσῶν παρ᾽ ἄλληλα τὰς διαφορὰς ὀρῶμεν καθ᾽ ὑπεροχὴν οὕσας, οἷον ὄρνιθα λέγω κατὰ γένος, ἀνθρωπον δὲ κατ᾽ εἰδοὺς, καὶ πάν ὦ κατά τὸν καθὸλου λόγον μηδεμίαν ἔχει διαφοράν. τὰ μὲν γὰρ ἔχουσι τὸ κοινὸν κατ᾽ ἀναλογίαν, τὰ δὲ κατὰ γένος, τὰ δὲ κατ᾽ εἰδοὺς.

"Οσαί μὲν οὖν πράξεις ἄλλων ἐνεκα, δῆλον ὅτι καὶ ὃν αἱ πράξεις τὸν αὐτὸν τρόπον διεστᾶσιν ὑπερ αἱ πράξεις. ὁμοίως δὲ κἂν εἰ τινὲς πρότεραι καὶ τέλος ἐτέρων πράξεων τυγχάνουσιν οὕσας, τὸν αὐτὸν ἐξει τρόπον καὶ τῶν μορίων ἐκαστὸν ὃν αἱ πράξεις αἱ τοιαῦται· καὶ τρίτον, ἃ τινῶν ἄναγκαιον ὑπάρχειν. (λέγω δὲ πάθη καὶ πράξεις γένεσιν, αὐξήσειν, ὁχεῖαν, ἐγρήγορον, ὑπὸν, πορείαν, καὶ ὁπόσ᾽ ἄλλα τοιαῦτα τοῖς ζῴοις ὑπάρχειν μόρια δὲ λέγω ἱνα, ὀφθαλμὸν καὶ τὸ σύνολον πρόσωπον, ὃν ἐκαστον καλεῖται μέλος. ὁμοίως δὲ καὶ περὶ τῶν ἄλλων.)

Καὶ περὶ μὲν τοῦ τρόπου τῆς μεθόδου τοσαῦτ᾽ ἡμῖν εἰρήσωμεν· τὰς δὲ αἰτίας πειραθῶμεν εἴπειν περὶ τε τῶν κοινῶν καὶ τῶν ἰδίων, ἀρξάμενοι, καθάπερ διωρίσαμεν, πρῶτον ἀπὸ τῶν πρῶτων.

1 ἃ τινῶν Peck, cf. 677 a 18: ὃν vulg.: ἃ τούτων Ogle.

See above, note on 644 a 17.

Examples will occur during the course of the treatise.
which are common, and those which belong (b) to a group, or (c) to a species. By “common” I mean those that are present in all animals; by “those which belong to a group” I mean those of animals whose differences we see to be differences “of excess” in relation to one another: an example of this is the group Birds. Man is an example of a species; so is every class which admits no differentiation of its general definition. These three sorts of common attributes are, respectively, (1) analogous, (2) generic, (3) specific.

Now it is evident that when one action is for the sake of another action, then the instruments which perform the two actions differ exactly as the two actions differ: and if one action is “prior” to another and is the “end” of that other action, then the part of the body to which it belongs will be “prior” to the part to which the other action belongs. There is also a third possibility, viz. that the action and its organ are there simply because the presence of others necessarily involves them. (By affections and actions I mean Generation, Growth, Copulation, Waking, Sleep, Locomotion, and the other similar ones that are found in animals. Examples of parts are: Nose, Eye, Face; each of these is named a “limb” or “member.” And the same holds for the rest too.)

Let this suffice concerning the method of our inquiry, and let us now endeavour to describe the causes of all these things, particular as well as common; and, according to the principles laid down, we will begin with the first ones first.
For the threefold series cf. De gen. an. 714 a 9 ff. This first "composition" seems to be intended to cover non-organic compounds.

Dynamis here is clearly the pre-Aristotelian technical term. See Introduction, p. 30. See De gen. et corr. chh. 2, 8.

In some contexts, "fluid" and "solid" seem more...
BOOK II

I have already described with considerable detail in my *Researches upon Animals* what and how many are the parts of which the various animals are composed. We must now leave on one side what was said there, as our present task is to consider what are the *causes* through which each animal is as I there described it.

Three sorts of composition can be distinguished. (1) First of all we may put composition out of the *Elements* (as some call them), viz. Earth, Air, Water, Fire; or perhaps it is better to say *dynamis* instead of Elements—some of the *dynamis*, that is, not all, as I have stated previously elsewhere. It is just these four, the fluid substance, the solid, the hot, and the cold, which are the matter of composite bodies; and the other differences and qualities—such as heaviness lightness, firmness looseness, roughness smoothness, etc.—which composite bodies present are subsequent upon these. (2) The second sort of composition is the composition of the "uniform" substances found in animals (such as bone, flesh, etc.). These also are composed out of the primary appropriate; in others, "moist" and "dry" (the traditional renderings). Aristotle defines them at *De gen. and corr.* 329 b 30. See also below, 649 b 9. I have normally translated them "fluid" and "solid" throughout.

* "Uniform," "non-uniform"; see Introduction, p. 28.
ARISTOTLE

646 a

τρίτη δὲ καὶ τελευταία κατ’ ἀριθμὸν ἢ τῶν ἀν-ομοιομερῶν, οἷον προσώπου καὶ χειρὸς καὶ τῶν τοιούτων μορίων.

25 Ἠσθέν 

646 a

τρίτη δὲ καὶ τελευταία κατ’ ἀριθμὸν ἢ τῶν ἀν-
ομοιομερῶν, οἷον προσώπου καὶ χειρὸς καὶ τῶν τοιούτων μορίων.

25 Ἠσθέν δ’ ἑναντίως ἐπὶ τῆς γενέσεως ἔχει καὶ τῆς
οὐσίας—τὰ γὰρ ὑστερα τῇ γενέσει πρότερα τὴν
φύσιν ἐστὶ, καὶ πρῶτον τὸ τῇ γενέσει τελευταῖον
(οὐ γὰρ οἰκία πλίνθων ἐνεκέν ἐστὶ καὶ λίθων, ἀλλὰ
ταῦτα τῆς οἰκίας· ὁμοίως δὲ τούτ’ ἔχει καὶ περὶ τῆν
ἀλλὴν ὕλην· οὐ μόνον δὲ φανερὸν ὅτι τοῦτον ἔχει τὸν

646 b

τρόπον ἐκ τῆς ἐπαγωγῆς, ἀλλὰ καὶ κατὰ τὸν λόγον·
pῶν γὰρ τὸ γινόμενον ἐκ τινος καὶ εἰς τι ποιεῖται
τῇ γένεσιν, καὶ ἂν ἄρχης ἐπ’ ἄρχην, ἀπὸ τῆς
πρώτης κινούσης καὶ ἐχούσης ἤδη τινὰ φύσιν ἐπὶ
tινὰ μορφὴν ἢ τοιούτον ἄλλο τέλος· ἀνθρωπος γὰρ
ἀνθρωπὸν καὶ φυτὸν γεννᾷ φυτὸν ἐκ τῆς περὶ

35 ἐκαστὸν ὑποκειμένης ὕλης)—τῷ μὲν οὖν χρόνῳ

646 b

προτέραν τὴν ὕλην ἀναγκαῖον εἶναι καὶ τὴν γένεσιν,
tῶν λόγω δὲ τῆν οὐσίαν καὶ τὴν ἐκάστου μορφῆν.
δὴ λογος δ’ ἄν λέγῃ τις τὸν λόγον τῆς γενέσεως· ὁ μὲν
γὰρ τῆς οἰκοδομήσεως λόγος ἔχει τὸν τῆς οἰκίας,
ὅ δὲ τῆς οἰκίας οὐκ ἔχει τὸν τῆς οἰκοδομήσεως.

5 ὁμοίως δὲ τούτο συμβέβηκε καὶ ἐπὶ τῶν ἀλλων.
ὡς τῇ μὲν τῶν στοιχείων ὕλην ἀναγκαῖον εἶναι
tῶν ὁμοιομερῶν ἐνεκέν· ὑστερα γὰρ ἕκεινον ταῦτα

a Or, “efficient.”

b Or, “in thought,” “in conception.”

c Almost represented here by “definition.”
substances. (3) The third and last is the composition of the "non-uniform" parts of the body, such as face, hand, and the like.

Now the order of things in the process of formation is the reverse of their real and essential order; I mean that the later a thing comes in the formative process the earlier it comes in the order of Nature, and that which comes at the end of the process is at the beginning in the order of Nature. Just so bricks and stone come chronologically before the house, although the house is the purpose which they subserve, and not vice versa. And the same applies to materials of every kind. Thus the truth of my statement can be shown by induction; but it can also be demonstrated logically, as follows. Everything which is in process of formation is in passage from one thing towards another thing, i.e. from one Cause towards another Cause; in other words, it proceeds from a primary motive a Cause which to begin with possesses a definite nature, towards a Form or another such End. For example, a man begets a man and a plant begets a plant. These new individuals are made out of the substrate matter appropriate in each case. Thus, matter and the process of formation must come first in time, but logically b the real essence and the Form of the thing comes first. This is clear if we state the logos c of such a process. For example, the logos of the process of building includes the logos of a house, but that of a house does not include that of the process of building. And this holds good in all such cases. Hence we see that the matter, viz. the Elements, must exist for the sake of the uniform substances, because these come later in the process of formation than
ΑΡΙΣΤΟΤΕΛΗΣ

646 b

τῇ γενέσει, τούτων δὲ τὰ ἀνομοιομερή. ταῦτα γὰρ

ηοθή τὸ τέλος ἔχει καὶ τὸ πέρας, ἐπὶ τοῦ τρίτου

λαβόντα τὴν σύστασιν ἀριθμοῦ, καθάπερ ἐπὶ πολλῶν

10 συμβαίνει τελειοθεία τὰς γενέσεις.

'Εξ ἀμφοτέρων μὲν οὖν τὰ ζῶα συνεστηκε τῶν

μορίων τούτων, ἀλλὰ τὰ ὁμοιομερή τῶν ἀνομοιο-

μερῶν ἐνεκέν ἔστω· ἐκεῖνων γὰρ ἔργα καὶ πράξεις

εἰσίν, οίνον ὀφθαλμοῦ καὶ μυκτήρου καὶ τοῦ προσ-

ώπου παντὸς καὶ δακτύλου καὶ χειρὸς καὶ παντὸς

15 τοῦ βραχίωνος. πολυμόρφων δὲ τῶν πράξεων καὶ

τῶν κυνήσεων ὑπαρχουσῶν τοῖς ζώοις ὀλοίς τε καὶ

τοῖς μορίοις τοῖς τοιούτοις, ἀναγκαῖον εἰς ὃν σύγ-

κεινται τὰς δυνάμεις ἀνομοίας ἔχειν· πρὸς μὲν γὰρ

τινὰ μαλακότης χρήσιμος πρὸς τὴν σκληρότητα,

καὶ τὰ μὲν τάσιν ἔχειν δεῖ τὰ δὲ κάμψιν.

20 Τὰ μὲν οὖν ὁμοιομερὴ κατὰ μέρος διείληφε τὰς

dυνάμεις τὰς τοιαύτας (τὸ μὲν γὰρ αὐτῶν ἐστὶ

μαλακὸν τὸ δὲ σκληροῦν, καὶ τὸ μὲν ὑγρὸν τὸ δὲ

ἐξηρόν, καὶ τὸ μὲν' γλύσχρον τὸ δὲ κραυρὸν), τὰ

Δ' ἀνομοιομερὴ κατὰ πολλὰς καὶ συγκεκμένας

ἀλλήλως· ἔτερα γὰρ πρὸς τὸ πεύσαι τῇ χειρὶ χρή-

25 σιμοῖς δύναμις καὶ πρὸς τὸ λαβεῖν. διόσπερ εἰς

ὀστῶν καὶ νεύρων καὶ σαρκὸς καὶ τῶν ἄλλων τῶν

τοιούτων συνεστήκασι τὰ ὀργανικὰ τῶν μορίων,

ἀλλ' οὔκ ἔκεινα ἐκ τούτων.

'Ως μὲν οὖν ἐνεκά τινος διὰ ταύτην τὴν αἰτίαν

ἔχει περὶ τούτων τὸν εἰρημένον τρόπον, ἐπεὶ δὲ

ξητεῖται καὶ πῶς ἀναγκαῖον ἔχειν οὗτω, φανεροῦ ὅτι

30 προὔπηρχεν οὗτός πρός ἄλληλα ἔχοντα εἰς ἀνάγκης

1 τὸ μὲν PZ: om. vulg.
PARTS OF ANIMALS, II. i.

the Elements; just so the non-uniform parts come later than the uniform. The non-uniform parts, indeed, whose manner of composition is that of the third sort, have reached the goal and End of the whole process; and we often find that processes of formation reach their completion at this point.

Now animals are composed out of both of these two sorts of parts, uniform and non-uniform; the former, however, are for the sake of the latter, as it is to the latter that actions and operations belong (e.g. eye, nose, the face as a whole, finger, hand, the arm as a whole). And inasmuch as the actions and movements both of an animal as a whole and of its parts are manifold, the substances out of which these are composed must of necessity possess divers dynameis. Softness is useful for some purposes, hardness for others; some parts must be able to stretch, some to bend.

In the uniform parts, then, such dynameis are found apportioned out separately: one of the parts, for instance, will be soft, another hard, while one is fluid, another solid; one viscous, another brittle. In the non-uniform parts, on the other hand, these dynameis are found in combination, not singly. For example, the hand needs one dynamis for the action of compressing and another for that of grasping. Hence it is that the instrumental parts of the body are composed of bones, sinews, flesh, and the rest of them, and not the other way round.

The Cause which I have just stated as controlling the relation between them is, of course, a Final Cause; but when we go on to inquire in what sense it is necessary that they should be related as they are, it becomes clear that they must of necessity have been thus related to each other from the beginning.
The translation “sense-organ” must not be taken to imply that the part through which the sense functions is an
It is possible for the non-uniform parts to be constructed out of the uniform substances, either out of many of them, or out of one only. (Examples of the latter are furnished by certain of the viscera, which, although they are of manifold shapes and forms, yet for all practical purposes may be said to consist of one only of the uniform substances.) But it is impossible for the uniform substances to be constructed out of the non-uniform parts: for then we should have an uniform substance consisting of several non-uniform parts, which is absurd.

These, then, are the Causes owing to which some of the parts of animals are simple and uniform; while others are composite and non-uniform.

Now the parts can also be divided up into (a) instrumental parts and (b) sense-organs. And we may say that each of the instrumental parts of the body, as I have stated earlier, is always non-uniform, while sensation in all cases takes place in parts that are uniform. The reasons why this is so are the following: The function of each of the senses is concerned with a single kind of sensible objects; and the sense-organ in each case must be such as can apprehend those objects. Now when one thing affects another, the thing which is affected must be potentially what the other is actually; so both are the same in kind, and therefore if the affecting thing is single, the affected one is single too. Hence we find that while with regard to the parts of the body such as hand, or face, none of the physiologers attempts to say that one of them is earth, and another water, and another fire; yet they do conjoin

"organ" in the stricter meaning of the word. "Organs" are normally "non-uniform," sense-organs are "uniform."
πρὸς ἕκαστον ἐπιξευγνύουσι τῶν στοιχείων, τὸ μὲν ἀέρα φάσκοντες εἶναι, τὸ δὲ πῦρ.

Οὕσης δὲ τῆς αἰσθήσεως ἐν τοῖς ἀπλοῖς μέρεσι 15 εὐλόγως μάλιστα συμβαίνει τὴν ἀφήν ἐν ὀμοιομερεῖ 
μὲν ἐκιστα δ’ ἀπλῶ τῶν αἰσθητηρίων ἐγγίνεσθαι: 
μάλιστα γὰρ αὕτη δοκεῖ πλειόνων εἶναι γενῶν, καὶ 
πολλὰς ἔχειν ἐναντίωσεις τὸ ὑπὸ ταύτην αἰσθητόν, 
θερμὸν ψυχρόν, ἐρυθὸν ὑγρὸν καὶ ἐπὶ τὸ ἄλλο τοιούτον·
καὶ τὸ τούτων αἰσθητήριον, ἡ σάρξ καὶ τὸ ταύτη 
ἀνάλογον, σωματωδέστατόν ἐστὶ τῶν αἰσθητηρίων. 
ἐπεὶ δ’ ἀδύνατον εἶναι ζώον ἄνευ αἰσθήσεως, καὶ 
διὰ τούτο ἂν εἴη ἀναγκαῖον ἔχειν τοῖς ζώοις ἕνα 
μόρια ὀμοιομερῆ· ἡ μὲν γὰρ αἰσθησις ἐν τούτοις, 
αἱ δὲ πράξεις διὰ τῶν ἀνομοιομερῶν ὑπάρχουσιν 
αὐτοῖς.

25 Τῆς δ’ αἰσθητικῆς δυνάμεως καὶ τῆς κινούσης 
τὸ ζώον καὶ τῆς θρεπτικῆς ἐν ταύτῳ μορίῳ τοῦ 
σώματος οὐσίας, καθάπερ ἐν ἔτεροις εἰρήται πρό-
τερον, ἀναγκαῖον τὸ ἔχον πρῶτον μόριον τὸς 
τουαύτας ἀρχὰς, ἢ μὲν ἐστὶ δεκτικὸν πάντων τῶν 
αἰσθητῶν, τῶν ἀπλῶν εἶναι μορίων, ἢ δὲ κυνητικὸν 
καὶ πρακτικὸν, τῶν ἀνομοιομερῶν. διότερ ἐν μὲν 
τοῖς ἀναίμοις ζώοις τὸ ἀνάλογον, ἐν δὲ τοῖς ἑναῖμοι 
ἡ καρδία τοιούτων ἐστίν· διαφερεῖται μὲν γὰρ εἰς 
ὀμοιομερῆ καθάπερ τῶν ἄλλων σπλάγχνων ἐκαστον, 
διὰ δὲ τὴν τοῦ σχήματος μορφῆ ἄνομοιομερῆς 
ἐστίν. ταύτῃ δ’ ἡκολούθηκε καὶ τῶν ἄλλων τῶν

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a See De somno, 455 b 34 ff.
each of the sense-organs with one of the elementary substances, and they assert that this sense-organ is air, this one fire.

Sensation thus takes place in the simple parts of the body. The organ in which touch takes place is, however, as we should expect, the least simple of all the sense-organs, though of course like the others it is uniform. This is evidently because the sense of touch deals with more kinds of sense-objects than one: and these objects may have several sorts of oppositions in them, e.g. hot and cold, solid and fluid, and the like. So the sense-organ which deals with these—viz. the flesh, or its counterpart—is the most corporeal of all the sense-organs. Another reason we might adduce why animals must of necessity possess some uniform parts at any rate, is that there cannot be such a thing as an animal with no power of sensation, and the seat of sensation is the uniform parts. (The non-uniform parts supply the means for the various activities, not for sensation.)

Further, since the faculties of sensation and of motion and of nutrition are situated in one and the same part of the body, as I stated in an earlier work, that part, which is the primary seat of these principles, must of necessity be included not only among the simple parts but also among the non-uniform parts—the former in virtue of receiving all that is perceived through the senses, the latter because it has to do with motion and action. In blooded animals this part is the heart, in bloodless animals the counterpart of the heart, for the heart, like every one of the other viseera, can be divided up into uniform pieces; but on the other hand it is non-uniform owing to its shape and formation. Every one of the other so-
647 a
35 καλομένων σπλάγχνων ἐκαστον· ἐκ τῆς αὐτῆς
647 b γὰρ ὅλης συνεστάσιν· αἰματικῆ γὰρ ἡ φύσις πάντων
αὐτῶν διὰ τὸ τὴν θέσιν ἔχειν ἐπὶ πόροις φλεβικοῖς
καὶ διαλήψεως. καθάπερ οὖν ἡσυχασμένος ἦσας,
tάλλα σπλάγχνα τῆς διὰ τῶν φλεβῶν ρύσεως τοῦ
αἵματος οἶνον προχεῖματα ἐστίν· ἢ δὲ καρδία, διὰ
5 τὸ τῶν φλεβῶν ἀρχὴ εἶναι καὶ ἔχειν ἐν αὐτῇ τὴν
δύναμιν τὴν δημιουργοῦσαν τὸ ἄιμα πρώτην, εὐ-
λογον ἢς οἴας ἄρχεται ¹ τροφῆς ἐκ τοιαύτης συν-
εστάναι καὶ αὐτῆς.

Διότι μὲν οὖν αἰματικὰ τῆς μορφῆς τὰ σπλάγχνα
ἔστιν εἰρηται, καὶ διότι τῇ μὲν ὁμοιομερῇ τῇ δ’
ἀνομοιομερῇ.

10 Π. Τῶν δ’ ὁμοιομερῶν μορίων ἐν τοῖς ζῴους ἐστὶ
τὰ μὲν μαλακὰ καὶ υγρά, τὰ δὲ σκληρά καὶ στερεά,
ὕγρα μὲν ἡ ὅλως ἢ ἐως ἄν ἢ ἐν τῇ φύσει, οἴον
ἀιμα, ἵχώρ, πιμελή, στέαρ, μυελός, γονή, χολή,
γάλα ἐν τοῖς ἔχουσι, σάρξ, καὶ τὰ τούτως ἀνάλογον.

15 οὐ γὰρ ἀπαντά τά ζῷα τούτων τῶν μορίων τέ-
teveχεν, ἀλλ’ ἐνα τῶν ἀνάλογον τούτων τισίν. τὰ
δὲ ἥγρα καὶ στερεά τῶν ὁμοιομερῶν ἐστίν, οἴον
ὀστοῦν, ἄκανθα, νεύρον, φλέψ. καὶ γὰρ τῶν ὁμο-
μερῶν ἢ διαίρεσις ἔχει διαφοράν· ἐστὶ γὰρ ὡς ἐνίων
τὸ μέρος ὁμώνυμον τῶ ὅλω, οἴον φλεβῶς φλέψ, ἐστι
20 δ’ ὡς οἷς ὁμώνυμον, ἀλλὰ προσώπων πρόσωπον
οὐδαμῶς.

¹ οἴας corr. in loco plurium litterarum Y: οἳ as Z (as Z² in
rasura). ἄρχεται (vel ἀρχὴ ἐστὶ) Peck, cf. 666 a 7, b 1, etc.:
dέχεται vulg.

116
called viscera follows suit. They are all composed of the same material, as they all have a sanguineous character, and this is because they are situated upon the channels of the blood-vessels and on the points of ramification. All these viscera (excluding the heart) may be compared to the mud which a running stream deposits; they are as it were deposits left by the current of blood in the blood-vessels. As for the heart itself, since it is the starting-point of the blood-vessels and contains the substance (dynamis) by which the blood is first fashioned, it is only to be expected that it will itself be composed out of that form of nutriment which it originates.

We have now stated why the viscera are sanguineous in formation, and why in one aspect they are uniform and in another non-uniform.

II. Of the uniform parts in animals, some are soft and fluid, some hard and firm. Some are permanently fluid, some are fluid only so long as they are in the living organism—e.g. blood, serum, lard, suet, marrow, semen, bile, milk (in the lactiferous species), flesh. (As these parts are of course not to be found in all animals, add to this list their counterparts.) Other of the uniform parts are solid and firm: examples are bone, fish-spine, sinew, blood-vessel. This division of the uniform parts admits a further distinction: There are some of them of which a portion has, in one sense, the same name as the whole (e.g. a portion of a blood-vessel has the name blood-vessel), and in another sense has not the same name. (In no sense is this the case with a non-uniform part; for instance, a portion of a face cannot be called face at all.)
ARISTOTLE

647 b

Πρῶτον μὲν ὁμιλοῦντος τοῖς ὁγροῖς μορίοις καὶ τοῖς ἔνεκέν εἰσιν. τὰ μὲν γὰρ ὄς ὑλή τῶν μερῶν ὑπὸ ἀνομοιομερῶν ἐστὶν (ἐκ τούτων γὰρ συνέστηκεν ἐκαστὸν τῶν ὀργανικῶν μερῶν, ἐξ ὀστῶν καὶ νεύρων καὶ σαρκῶν καὶ ἀλλων 25 τοιούτων συμβαλλομένων τὰ μὲν εἰς τὴν οὐσίαν τὰ δ’ εἰς τὴν ἐργασίαν), τὰ δὲ τροφῆ τούτους τῶν ὕγρων ἐστὶ (πάντα γὰρ ἐξ ὕγρου λαμβάνει τὴν αὐξησίαν), τὰ δὲ περιττόματα συμβαλλομένα εἶναι τούτων, οἰον τὴν τῇ ἐξηρᾶσα τροφής ὑπόστασιν καὶ τῇ τῆς ἕγρασ τοῖς ἐφευριστεὶν.

Αὐτῶν δὲ τούτων αἱ διαφορὰι πρὸς ἀλληλα τοῦ 30 βελτίων ἐνεκέν εἰσιν, οἶον τῶν τε ἀλλων καὶ αἵματος πρὸς ἀίμαα τὸ μὲν γὰρ λεπτότερον τὸ δὲ παχύτερον καὶ τὸ μὲν καθαρότερον ἐστὶ τὸ δὲ θολερώτερον, ἐτι δὲ τὸ μὲν ψυχρότερον τὸ δὲ θερμότερον, ἐν τῇ τοῖς μορίοις τοῦ ἐνὸς ζωῆς (τὸ γὰρ 35 ἐν τοῖς ἀνώ μέρη τοῖς κατὰ μόρια διαφέρει ταύταις ταῖς διαφοραῖς) καὶ ἐτέρω πρὸς ἐτέρων 648 a καὶ ὅλως τὰ μὲν ἐναιμα τῶν ζωῶν ἐστὶ, τὰ δ’ ἄντι τοῦ αἵματος ἐχεὶ ἐτέρων τι μόριον τοιοῦτον.

"Εστὶ δ’ ἵσχυος μὲν πονητικῶτερον τὸ παχύτερον αἴμα καὶ θερμότερον, αἰσθητικῶτερον δὲ καὶ νοερότερον τὸ λεπτότερον καὶ ψυχρότερον. τῇ αὐτῇ δ’ 5 ἐχει διαφορὰν καὶ τὸ ἀνάλογον ὑπάρχον ι πρὸς τὸ

1 τὸ ... ὑπάρχον P: τῶν ... ὑπάρχοντων vulg.

a Or, “reason.”

b See Introduction, pp. 32 ff.

c See Introduction, pp. 28 ff.

d With this passage compare Hippocrates, Peri diatèis, i. 35. See also below, 650 b 24 ff., and Introduction, pp. 37-39.

118
Now first of all there are many sorts of Cause to which the existence of these uniform parts, both the fluid and the solid ones, is to be ascribed. Some of them act as the material for the non-uniform parts (e.g. each of the instrumental parts is composed of these uniform parts—bones, sinews, fleshes, and the like, which contribute either to its essence, or else towards the discharge of its proper function). Another group of the uniform parts—fluid ones—act as nutriment for the ones just mentioned, since everything that grows gets the material for its growth from what is fluid; and yet a third group are residues produced from the second group: examples, the excrement deposited from the solid nutriment and (in those animals which have a bladder) from the fluid nutriment.

Further, variations are found among different specimens of these uniform parts, and this is to subserve a good purpose. Blood is an excellent illustration. Blood can be thin or thick, clear or muddy, cold or warm; and it can be different in different parts of the same animal: instances are known of animals in which the blood in the upper parts differs from that in the lower parts in respect of the characteristics just enumerated. And of course the blood of one animal differs from that of another. And there is the general division between the animals that have blood and those which instead of it have a part which is similar to it though not actually blood.

The thicker and warmer the blood is, the more it makes for strength; if it tends to be thin and cold, it is conducive to sensation and intelligence. The same difference holds good with the counterpart of
This sentiment, which at first sight appears to go against the Aristotelian teleology, is supported by actual instances, e.g. the horns of the backward-grazing oxen (659 a 19) and of the deer (663 a 11) and the talons of certain birds (694 a 20).
PARTS OF ANIMALS, II. II.

blood in other creatures: and thus we can explain why bees and other similar creatures are of a more intelligent nature than many animals that have blood in them; and among the latter class, why some (viz. those whose blood is cold and thin) are more intelligent than others. Best of all are those animals whose blood is hot and also thin and clear; they stand well both for courage and for intelligence. Consequently, too, the upper parts of the body have this pre-eminence over the lower parts; the male over the female; and the right side of the body over the left.

What applies to the blood applies as well to the other uniform parts and also to the non-uniform parts; similar variations occur. And it must be supposed that these variations either have some reference to the activities of the creatures and to their essential nature, or else bring them some advantage or disadvantage. For example, the eyes of some creatures are hard in substance, of others, fluid; some have eyelids, others have not. In both cases the difference is for the sake of greater accuracy of vision.

Before we can go on to consider the reasons why all animals must of necessity have blood in them or something which possesses the same nature, and also what the nature of blood itself is, we must first come to some decision about hot and cold. The nature of many things is to be referred back to these two principles, and there is much dispute about which animals and which parts of animals are hot and which are cold. Some assert that water-animals are hotter than land-animals, and they allege that the creatures' natural heat makes up for the coldness of their habitat.

121
648 a

θερμότης, καὶ τὰ ἄναιμα τῶν ἐναίμων καὶ τὰ θήλεαι τῶν ἄρρενων, ὅπως Παρμενίδης τὰς γυναικὰς τῶν ἀνδρῶν θερμοτέρας εἶναι φήσι καὶ ἐτεροί τινες ὡς διὰ τὴν θερμότητα καὶ πολυαιμούσαις γυνομένων τῶν γυναικείων, Ἕμπεδοκλῆς δὲ τοῦνατιον· ἔτι δ᾿ αἴμα καὶ χολήν οἱ μὲν θερμὸν ὀποτερονοῦν εἶναι φασιν αὐτῶν, οἱ δὲ ψυχρῶν. εἶ δ᾿ ἔχει τοσαῦτην τὸ θερμὸν καὶ τὸ ψυχρὸν ἀμφισβήτησιν, τί χρὴ περὶ τῶν ἀλλών ὑπολαβεῖν; ταῦτα γὰρ ἡμῖν ἐν- αργέστατα τῶν περὶ τὴν αἰσθήσιν.

"Εοικε δὲ διὰ τὸ πολλαχῶς λέγεσθαι τὸ θερμό-

648 b τερον ταῦτα συμβαίνειν· ἐκαστος γὰρ δοκεῖ τι λέγειν τάναντια λέγον. διὸ δεῖ μὴ λαιμάνειν πῶς δεῖ τῶν φύσει συνεστῶτων τὰ μὲν θερμὰ λέγειν τὰ δὲ ψυχρὰ καὶ τὰ μὲν ἔηρα τὰ δ᾿ ὑγρά, ἐπει διὸ τὴν αἴτια ταῦτα σχεδὸν καὶ θανάτου καὶ ζωῆς ἑοικεν 5 εἶναι φανερὸν, ἔτι δ᾿ ὑπνοῦ καὶ ἐγρηγόρσεως καὶ ἀκμῆς καὶ γήρως καὶ νόσου καὶ ὑγείας, ἀλλὰ οὐ πταιρίτητες καὶ λειτυτητες οὐδὲ βαρύτητες καὶ κου- φότητες οὐδ᾿ ἄλλο τῶν τοιούτων οὐδὲν ὡς εἰπεῖν. καὶ τοῦτο εὐλόγως συμβεβηκεν· καθάπερ γὰρ ἐν ἐτέροις εἰρηται πρότερον, ἀρχαὶ τῶν φυσικῶν 10 στοιχείων αὐταί εἰσι, θερμὸν καὶ ψυχρὸν καὶ ἔηρον καὶ ψυχρὸν.

Πότερον οὖν ἀπλῶς λέγεται τὸ θερμὸν ἡ πλεο-

ναχῶς; δεῖ δὴ λαβεῖν τί ἔργον τοῦ θερμοτέρου, ἡ

a See above, 646 a 15, and note.
Further, it is asserted that bloodless animals are hotter than those that have blood; and that females are hotter than males. Parmenides and others, for instance, assert that women are hotter than men on the ground of the menstrual flow, which they say is due to their heat and the abundance of their blood. Empedocles, however, maintains the opposite opinion. Again, some say that blood is hot and bile cold, others that bile is hot and blood cold. And if there is so much dispute about the hot and the cold, which after all are the most distinct of the things which affect our senses, what line are we to take about the rest of them?

Now it looks as if the difficulty is due to the term "hotter" being used in more senses than one, as there seems to be something in what each of these writers says, though their statements are contradictory. Hence we must permit no ambiguity in our application of the descriptions "hot" and "cold," "solid" and "fluid" to the substances that are found produced by nature. It is surely sufficiently established that these four principles (and not to any appreciable extent roughness, smoothness, heaviness, lightness, or any such things) are practically the causes controlling life and death, not to mention sleep and waking, prime and age, disease and health. And this, after all, is but reasonable, because (as I have said previously in another work) these four—hot, cold, solid, fluid—are the principles of the physical Elements.

Let us consider, then, whether the term "hot" has one sense or several. To decide this point, we must find out what is the particular effect which a body has in virtue of being hotter than another, or, if there are several such effects, how many there are.
πόσα, εἰ πλεῖω. ἕνα μὲν δὴ τρόπον λέγεται μᾶλλον θερμὸν ύφ᾽ οὐ μᾶλλον θερμαίνεται τὸ ἀπτόμενον,
15 ἄλλως δὲ τὸ μᾶλλον αἰσθητῶν ἐμποιοῦν ἐν τῷ θυγγάνειν, καὶ τοῦτ', ἐὰν μετὰ λύπης. ἦστι δ᾽ οτὲ
dοκεὶ τοῦτ' εἶναι ψεύδος· ἐνίστε γὰρ ἡ ἐξὶς αἰτία
tοῦ ἀλγείν αἰσθανομένους. ἦτι τὸ τηκτικὸτερον τοῦ
tηκτοῦ καὶ τοῦ καυστοῦ καυστικῶτερον. ἦτι ἐὰν
ἡ τὸ μὲν πλέον τὸ δ᾽ ἐλαττον τὸ αὐτό, τὸ πλέον τοῦ
20 ἐλαττονος θερμότερον. πρὸς δὲ τούτοις δυοῖν τὸ
μὴ ταχέως ψυχόμενον ἄλλα βραδέως θερμότερον,
καὶ τὸ βάττον θερμαίνομενον τοῦ θερμανομένου
βραδέως θερμότερον εἶναι τὴν φύσιν φαμέν, ὡς τὸ
μὲν ἐναντίον ὅτι πόρρω, τὸ δ᾽ ὀμοίων ὅτι ἐγγύς.
λέγεται μὲν οὖν εἰ μὴ πλεοναχῶς, ἄλλα τοσαυταχῶς
25 ἐτερον ἔτερον θερμότερον· τούτους δὲ τοὺς τρόπους
ἀδύνατον ὑπάρχειν τῷ αὐτῷ πάντας· θερμαίνει μὲν
γὰρ μᾶλλον τὸ ζεόν ύδωρ τῆς φλογὸς, καὶ εἰ δὲ καὶ
τήκει τὸ καυστὸν καὶ τηκτὸν ἡ φλόξ, τὸ δ᾽ ύδωρ
οὐδέν. ἦτι θερμότερον μὲν τὸ ζεόν ύδωρ ἡ πῦρ
ὀλίγον, ψύχεται δὲ καὶ βάττον καὶ μᾶλλον τὸ θερμὸν
30 ύδωρ μικροῦ πυρὸς· οὐ γὰρ γίνεται ψυχρὸν πῦρ,
ὑδωρ δὲ γίνεται πὰν. ἦτι θερμότερον μὲν κατὰ τὴν
ἀφήν τὸ ζεόν ύδωρ, ψύχεται δὲ βάττον καὶ πήγνυται
tοῦ ἐλαίου. ἦτι τὸ αἷμα κατὰ μὲν τὴν ἀφήν θερμό-
tερον ύδατος καὶ ἐλαιον, πήγνυται δὲ βάττον.
Ὡς λίθοι καὶ σίδηροι καὶ τὰ τοιαύτα θερμαίνεται μὲν
35 βραδύτερον ύδατος, καὶ εἰ δὴ θερμαυθέντα μᾶλλον.
πρὸς δὲ τούτος τῶν λεγομένων θερμῶν τὰ μὲν

a Alluding, perhaps, to the expansion due to heat.
PARTS OF ANIMALS, II. ii.

A is said to be "hotter" than B (1) if that which comes into contact with it is heated more by it than by B. (2) If it produces a more violent sensation when touched, and especially if the sensation is accompanied by pain. (The latter is not always a true indication, since sometimes the pain is due to the condition of the percipient.) (3) If it is a better melting or burning agent. (4) If it is of the same composition as B, but greater in bulk, a it is said to be "hotter" than B, and in addition (5) if it cools more slowly than B, or warms up more quickly: in both these cases we call the thing "hotter" in its nature—as we call one thing "contrary" to another when it is far removed from it, and "like" it when it is near it. But although the senses in which one thing is said to be "hotter" than another are certainly as many as this, if not more, yet no one thing can be "hotter" in all of these ways at once. For instance, boiling water can impart heat more effectively than flame; but flame is able to cause burning and melting, whereas water is not. Again, boiling water is hotter than a small fire, but the hot water will cool off more quickly and more thoroughly than the small fire, since fire does not become cold, but all water does. Again, boiling water is hotter to the touch than oil, yet it cools and solidifies more quickly. And again, blood is warmer to the touch than either water or oil, yet it congeals more quickly. Again, stone and iron and such substances get hot more slowly than water, but once they are hot they burn other things more than water can. In addition to all this there is another distinction to be made among the things that are called "hot": in some of them the
That is, "blood" is really "hot x," and the "x" is no more hot of its own nature than the "water" in "hot water." Cf. 649 b 21 ff., and Torstrik, Rh. Mus. xii. 161 ff.

Perhaps a reference to the resin which is in firwood or is obtained from it.
heat is their own; in others it has been derived from without. And there is a very great difference between these two ways of being hot, because one of them comes near to being hot "by accident" and not hot "of itself"; as is obvious, supposing anyone were to assert, if a fever-patient were "by accident" a man of culture, that the man of culture is hotter than a man whose heat is due to his perfect health. Thus some things are hot "of themselves" and some hot "by accident," and though the former cool more slowly, the latter are in many cases hotter in their effect upon the senses. Again, the former have a greater power of burning: e.g. a flame burns you more than boiling water, yet the boiling water, which is hot only "by accident," causes a stronger sensation of heat if you touch it. From this it is plain that it is no simple matter to decide which of two things is the hotter. The first will be hotter in one way, and the second in another. In some cases of this sort it is actually impossible to say simply that a thing is hot or is not hot. I mean cases in which the substratum in its permanent nature is not hot, but when coupled (with heat) is hot; as if we were to give a special name to hot water or hot iron: that is the mode in which blood is hot. These cases, in which the substratum is hot merely through some external influence, make it clear that cold is not just a privation but a real thing in itself. Perhaps even fire may be an instance of this kind. It may be that its substratum is smoke or charcoal: and, though smoke is always hot because it is an exhalation, charcoal when it goes out is cold. In the same way oil and firwood become cold. Further, practically all
ARISTOTLE

649 a

25 καὶ τὰ πυρωθέντα πάντα σχεδὸν, οἷον κονία καὶ τέφρα, καὶ τὰ ύποστήματα τῶν ζῶν, καὶ τῶν περιττωμάτων ἢ χολῆ, τῶς ἐμπεπυρεδέσθαι καὶ ἐγκαταλελείφθαι τι ἐν αὐτοῖς θερμοῖν. ἀλλον δὲ τρόπον θερμὰ¹ πεύκη καὶ τὰ πίονα, τῷ ταχὺ μεταβάλλειν εἰς ἐνέργειαι πυρὸς.

30 Δοκεῖ δὲ τὸ θερμὸν καὶ πηγνύναι καὶ τήκειν. ὥσα μὲν οὖν ὑδατος μόνον, τάτα πήγνυσι τὸ ψυχρόν, ὥσα δὲ γῆς, τὸ πῦρ· καὶ τῶν θερμῶν πηγνυται ὑπὸ ψυχροῦ ταχὺ μὲν ὥσα γῆς μᾶλλον καὶ ἀλύτως, λυτῶς δὲ ὥσα ὑδατος. ἀλλὰ περὶ μὲν τούτων ἐν ἑτέροις διώρυσται σαφέστερον, ποιὰ τὰ πηκτά, καὶ πηγνυται διὰ τίνας αἰτίας.

35 Τὸ δὲ τὸ θερμὸν καὶ ποίον θερμότερον ἐπειδὴ θέρμη

649 b λέγεται πλεοναξῶς, οὐ τὸν αὐτὸν τρόπον ὑπάρξει πάσιν, ἀλλὰ προσδιοριστέον ὅτι καθ’ αὐτὸ μὲν τόδε, κατὰ συμβεβηκός δὲ πολλάκις θάτερον,² ἐτι δὲ δυνάμει μὲν τοδί, τοδί δὲ κατ’ ἐνέργειαι, καὶ τόνδε μὲν τὸν τρόπον τοδί, τῷ μᾶλλον τὴν ἀφὴν θερ-μαίνειν, τοδί δὲ τῷ φλόγα ποιεῖν καὶ πυροῦν.

legate άντι πολλαχως, ἀκολουθήσεις ἄνθηλον ὅτι καὶ τὸ ψυχρόν κατὰ τὸν αὐτὸν λόγον.

Καὶ περὶ μὲν θερμοῦ καὶ ψυχροῦ καὶ τῆς ὑπεροξῆς αὐτῶν διωρίσθω τὸν τρόπον τοῦτον.

III. Ἐχόμενον δὲ καὶ περὶ ἑτροῦ καὶ ψυροῦ διελθεῖν ἀκολούθως τοῖς εἰρημένοις. λέγεται δὲ τάτα

1 θερμὰ Peck: θερμὸν vulg.
2 πολλάκις θάτερον] num τάλλοθερμότερον?

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a See Meteor. 332 b 31 ff., 388 b 10 ff.
b Probably the text should be altered to read: "B hotter by accident."
c See note on 646 a 16, and Introd. p. 32.
things that have passed through a process of combustion have heat in them, such as cinder, ash, the excrement of animals, and bile (an instance of a residue). These have passed through fire and some heat is left behind in them. Firwood and fatty substances are hot in another way: they can quickly change into the actuality of fire.

We must recognize that "the hot" can cause both congealing and melting. Things that consist of water only are solidified by the cold, those that consist of earth, by fire. Again, hot things are solidified by cold: those that consist chiefly of earth solidify quickly, and the product cannot be dissolved again; those that consist chiefly of water can be dissolved after solidification. I have dealt more particularly with these matters in another work, where I have stated what things can be solidified, and the causes that are responsible for it.

So, in view of the fact that there are numerous senses in which a thing is said to be "hot" or "hotter," the same meaning will not apply to all instances, but we must specify further, and say that A is hotter "of itself," B perhaps "by accident"; and again that C is hotter potentially, D actually; and we must also say in what way the thing's heat manifests itself: e.g. E causes a greater sensation of heat when touched; F causes flame and sets things on fire. And of course, if "the hot" is used in all these senses, there will be an equal variety of senses attaching to "the cold."

This will suffice for our examination of the terms "hot" and "cold," "hotter" and "colder."

III. It follows on naturally after this to discuss (b) "solid" and "fluid," on similar lines.
πλεοναχῶς, οίνον τὰ μὲν δυνάμει τὰ δ’ ἐνεργεία.
κρύσταλλος γὰρ καὶ πάν τὸ πεπηγὸς υγρὸν λέγεται
ξηρὰ¹ μὲν ἐνεργεία καὶ κατὰ συμβεβηκός, ὅντα
dυνάμει καὶ καθ’ αὐτὰ υγρά, γ’ δὲ καὶ τέφρα καὶ
15 τὰ τοιαῦτα μιχθέντα υγρῶ ἐνεργεία μὲν υγρὰ καὶ
κατὰ συμβεβηκός, καθ’ αὐτὰ δὲ καὶ δυνάμει ξηρά.
διακριθέντα δὲ ταῦτα τὰ μὲν ὕδατος ἀναπληστικὰ
καὶ ἐνεργεία καὶ δυνάμει υγρά, τὰ δὲ γῆς ἀπαντὰ
ξηρά, καὶ τὸ κυρίως καὶ ἀπλῶς ξηρὸν τοῦτον
μάλιστα λέγεται τῶν τρόπων. ὅμοιως δὲ καὶ θάτερα
20 τὰ υγρὰ κατὰ τὸν αὐτὸν λόγον ἔχει τὸ κυρίως καὶ
ἀπλῶς, καὶ ἐπὶ θερμῶν καὶ ψυχρῶν. τούτων δὲ
dιωρισμένων φανερὸν ὅτι τὸ αἷμα ἀδικ μὲν ἐστὶ
θερμὸν [οἶνον τι' ἢν αὐτῷ τὸ αἷματε εἶναι;]· καθάπερ
gὰρ³ εἰ ὄνομάτι τινι⁴ σημαίνομεν τὸ ζέον ὑδωρ,
ὕτω λέγεται· τὸ δ’ ὑποκείμενον καὶ ὁ ποτε ὁν
25 αἷμα ἐστιν, οὗ θερμὸν· καὶ καθ’ αὐτῷ ἐστὶ μὲν ὡς
θερμὸν ἐστιν, ἐστὶ δ’ ὡς οὖ· ἐν μὲν γὰρ τῷ
λόγῳ ὑπάρξει αὐτοῦ ἡ θερμότης, ὥσπερ ἐν τῷ
τοῦ λευκοῦ ἀνθρώπου τὸ λευκὸν. ἦ δὲ κατὰ πάθος,
τὸ αἷμα οὗ καθ’ αὗτο θερμὸν.⁵

‘Ομοίως δὲ καὶ περὶ ξηροῦ καὶ υγροῦ. ὅποι καὶ

¹ ξηρὰ Peck: ξηρὸν vulg.
² οἶνον τι Bekker. haec, signo interrog. adser., seclusi.
³ γὰρ Z: om. vulg.
⁴ ὄνοματι τιν PSUZ²: ὄνοματι τι EY: ὄνοματi vulg.
⁵ ll. 22-29 interpunctionem correxii.

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¹ i.e. they assume the shape of the receptacle into which they are put.
These terms are used in several senses. E.g. "solid" and "fluid" may mean either potentially solid and fluid or actually solid and fluid. Ice and other congealed fluids are said to be solid actually and by accident, though in themselves and potentially they are fluid. On the other hand, earth and ash and the like, when they have been mixed with a fluid, are fluid actually and by accident, but potentially and in themselves they are solid. When these mixtures have been resolved again into their components, we have on the one hand the watery constituents, which are anaplectic, and fluid actually as well as potentially, and on the other hand the earthy components which are all solid: and these are the cases where the term "solid" is applicable most properly and absolutely. In the same way, only those things which are actually as well as potentially fluid, or hot, or cold, are such in the proper and absolute sense of the terms. Bearing this distinction in mind, we see it is plain that in one way blood is hot [e.g. what is the essential definition of blood?], for the term "blood" is used just as the term for "boiling water" would be, if we had a special name to denote that; but in another way, i.e. in respect of its permanent substratum, blood is not hot. This means that in one respect blood is essentially hot, and in another respect is not. Heat will be included in the logos of blood, just as fairness is included in the logos of a fair man, and in this way blood is essentially hot; but in so far as it is hot owing to external influence, blood is not essentially hot.

A similar argument would hold with regard to the solid and the fluid. And that is why some of these
649 b

ἐν τῇ φύσει τῶν τοιούτων τὰ μὲν θερμὰ καὶ ύγρά,
χωρίζομεν δὲ πήγινται καὶ ψυχρὰ φαίνεται, οἷον
tὸ αἷμα, τὰ δὲ θερμὰ καὶ πάχος ἔχουσα καθάπερ ἡ
χολή, χωρίζομεν δὲ ἐκ τῆς φύσεως τῶν ἐχόντων
τοιούτων πάσχει. ψύχεται γὰρ καὶ ύγραίνεται: τὸ
μὲν γὰρ αἷμα ἐγραίνεται μᾶλλον, ὕγραίνεται δὲ ἡ
ξανθή χολή. τὸ δὲ μᾶλλον καὶ ἢπτον μετέχειν τῶν

35 ἀντικειμένων ὡς ὑπάρχον ὃς τιθέναι τούτοις.

650 a

Πῶς μὲν οὖν θερμὸν καὶ πῶς ύγρόν, καὶ πῶς
τῶν ἐναιτίων ἡ φύσις τοῦ αἵματος κεκοινώθηκεν,
εὑρηται σχεδόν.

Ἐπεὶ δὲ ἀνάγκη πᾶν τὸ αὐξανόμενον λαμβάνει
τροφήν, ἢ δὲ τροφὴ πᾶσιν ἐξ ύγροῦ καὶ ἕγρου, καὶ
τούτων ἡ πέψις γίνεται καὶ ἡ μεταβολὴ διὰ τῆς τοῦ
θερμοῦ δυνάμεως, καὶ τὰ ξῶα πάντα καὶ τὰ φυτά,
καὶ εἰ μὴ δὲ ἄλλην αἰτίαν, ἄλλα διὰ ταύτην ἀναγ-
καίον ἔχειν ἀρχήν θερμοῦ φυσικήν. [καὶ ταύτην
ὡσπερ] αἰ 〈δ’〉 ἐργασία τῆς τροφῆς πλειόνων εἰσὶ
μορίων. ἡ μὲν γὰρ πρώτη φανερὰ τοῖς ζωισ

10 λειτουργία διὰ τοῦ στομάτος οὖσα καὶ τῶν ἐν
τούτω μορίων, ὡσών ἡ τροφὴ δεῖται διαιρέσεως.
ἀλλ’ αὐτὴ μὲν οὐδεμιᾶς αἰτία πέψεως, ἀλλ’ εὐ-
πεθώς μᾶλλον. ἡ γὰρ εἰς μικρὰ διαιρέσεις τῆς
τροφῆς ράω ποιεῖ τῷ θερμῷ τὴν εργασίαν. ἡ δὲ τῆς
ἀνώ καὶ τῆς κάτω κοιλίας ἣδη μετὰ θερμοτήτως

1 ὑπάρχον Peck: ὑπάρχοντα vulg.
2 καὶ ταύτην ὡσπερ seclusi, 〈δ’〉 supplevi: καὶ ταύτην
〈πλεῖοσι μορίοις ἐνυπάρχονσαν〉 Camus.

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a See above, note on 644 a 17.
b See Introduction, p. 34.
c Lit. “the dynamis of the hot substance,” perhaps here
something more than a mere periphrasis for “the hot sub-
132
substances while in the living organism are hot and fluid, but when separated from it congeal and are observed to be cold, as blood does; others, like yellow bile, are hot and of a thick consistency while in the organism, but when separated from it undergo a change in the opposite direction and become cool and fluid. Blood becomes more solid, yellow bile becomes fluid. And we must assume that "more and less" participation in opposite characteristics is a property of these substances.

We have now pretty well explained in what way blood is hot, in what way it is fluid, and in what way it participates in opposite characteristics. Everything that grows must of necessity take food. This food is always supplied by fluid and solid matter, and the concoction and transformation of these is effected by the agency of heat. Hence, apart from other reasons, this would be a sufficient one for holding that of necessity all animals and plants must have in them a natural source of heat; though there are several parts which exert action upon the food. In the case of those animals whose food needs to be broken up, the first duty clearly belongs to the mouth and the parts in the mouth. But this operation does nothing whatever towards causing concoction: it merely enables the concoction to turn out successfully; because when the food has been broken up into small pieces the action of the heat upon it is rendered easier. The natural heat comes into play in the upper and in the lower gut, stance," as emphasizing its proper and specific natural character, which makes it a particularly good agent for effecting concoction. See Introduction, pp. 30-32.
φυσικής ποιεῖται τὴν πέψιν. ὃσπερ δὲ καὶ τὸ στόμα τῆς ἀκατεργάστου τροφῆς πόρος ἐστὶ, καὶ τὸ συνεχὲς αὐτῷ μόριον ὁ καλοῦσιν οἰσοφάγον, ὅσα τῶν ζῴων ἔχει τούτο τὸ μόριον, ἐως εἰς τὴν κοιλίαν, οὕτω καὶ ἄλλος δὲὶ πόροις εἶναι, δι᾽ ὧν ἀπαν λήμνεται τὸ σῶμα τὴν τροφήν, ὃσπερ ἐκ φάτνης, ἐκ τῆς κοιλίας καὶ τῆς τῶν ἐντέρων φύσεως. τὰ μὲν γὰρ φυτὰ λαμβάνει τὴν τροφήν κατεργασμένην ἐκ τῆς γῆς ταῖς ρίζαις (διὸ καὶ περίττωμα γίνεται τοῖς φυτοῖς· τῇ γάρ γη καὶ τῇ ἐν αὐτῇ θερμότητι χρήται ὃσπερ κοιλία), τὰ δὲ ξώα πάντα μὲν σχεδὸν, τὰ δὲ πορευτικὰ φανερῶς. ἦς, ὃσπερ ἐκείνα ταῖς ρίζαις, ταῦτα δὲὶ τίνι τὴν τροφήν λαμβάνειν, ἐως τὸ τῆς ἐχομένης πέψις λάβη τέλος. ἡ μὲν γὰρ τοῦ στόματος ἐργασία παραδίδωσι τῇ κοιλία, παρὰ δὲ ταύτης ἐτερον ἄναγκαιον λαμβάνειν, ὃπερ συμβέβηκεν· αἱ γὰρ φλέβες κατατείνονται διὰ τοῦ μεσεντερίου παράπαν, κἀτωθεὶν ἀρξάμεναι μέχρι τῆς κοιλίας. δὲὶ δὲ ταῦτα θεωρεῖν ἐκ τε τῶν ἀνατομῶν καὶ τῆς φυσικῆς ἱστορίας.

Ἐπεὶ δὲ πάσης τροφῆς ἐστὶ τὶ δεκτικὸν καὶ τῶν γινομένων περιττωμάτων, αἱ δὲ φλέβες οἰον ἀγγείον αἱματός εἰσιν, φανερὸν ὅτι τὸ αἷμα ἡ τελευταία τροφῆ τοῖς ζῴοις τοῖς ἐναῖμοις ἐστὶ, τοῖς δὲ ἀναίμοις

1 ἄλλος δὲὶ πόροις Peck: ἄλλας ἀρχὰς δὲὶ πλείους vulg.

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a Cf. Shakespeare, Coriolanus i. i. 133-152.
b The membrane to which the intestines are attached.
c Dissections (or Anatomy) is a treatise which has not survived.
which effect the concoction of the food by its aid. And, just as the mouth (and in some animals the so-called oesophagus too which is continuous with it) is the passage for the as yet untreated food, and conveys it to the stomach; so there must be other passages through which as from a manger the body as a whole may receive its food from the stomach and from the system of the intestines.\textsuperscript{a} Plants get their food from the earth by their roots; and since it is already treated and prepared no residue is produced by plants—they use the earth and the heat in it instead of a stomach, whereas practically all animals, and unmistakably those that move about from place to place, have a stomach, or bag,—as it were an earth inside them—and in order to get the food out of this, so that finally after the successive stages of concoction it may reach its completion, they must have some instrument corresponding to the roots of a plant. The mouth, then, having done its duty by the food, passes it on to the stomach, and there must of necessity be another part to receive it in its turn from the stomach. This duty is undertaken by the blood-vessels, which begin at the bottom of the mesentery,\textsuperscript{b} and extend throughout the length of it right up to the stomach. These matters should be studied in the \textit{Dissections}\textsuperscript{c} and my treatise on \textit{Natural History},\textsuperscript{d}

We see then that there is a receptacle for the food at each of its stages, and also for the residues that are produced; and as the blood-vessels are a sort of container for the blood, it is plain that the blood (or its counterpart) is the final form of that food in living

\textsuperscript{d} The \textit{Natural History}, otherwise \textit{History of Animals} or \textit{Researches upon Animals}. See 495 b 19 ff., 514 b 10 ff.
The text is a page from a translation of Aristotle's work, possibly from a philosophical or medical context. The text is in Greek, and the page number 650a indicates it's from a larger work. The content discusses topics such as analogy, perception, and the soul, among other philosophical ideas. There are references to other works by Aristotle and Hippocrates, indicating a detailed and scholarly approach to the subject matter. The page ends with a note referencing Cornford, an editor known for his work on Greek philosophy.
creatures. This explains why the blood diminishes in quantity when no food is taken and increases when it is; and why, when the food is good, the blood is healthy, when bad, poor. These and similar considerations make it clear that the purpose of the blood in living creatures is to provide them with nourishment; and also why it is that when the blood is touched it yields no sensation, as flesh does when it is touched. Indeed, none of the residues yields any sensation either, nor does the nourishment. This difference of behaviour is because the blood is not continuous with the flesh nor conjoined to it organically: it just stands in the heart and in the blood-vessels like water in a jar. A description of the way in which the parts of the body derive their growth from the blood, and the discussion of nourishment in general, comes more appropriately in the treatise on Generation and elsewhere. For the present it is enough to have said that the purpose of the blood is to provide nourishment, that is to say, nourishment for the parts of the body. So much and no more is pertinent to our present inquiry.

IV. The blood of some animals contains what are called fibres; the blood of others (e.g. the deer and the gazelle) does not. Blood which lacks fibres does not congeal, for the following reason. Part of the blood is of a more watery nature, and therefore does not congeal; while the other part, which is earthy, congeals as the fluid part evaporates off. The fibres are this earthy part.

Now some of the animals whose blood is watery have a specially subtle intelligence. This is due not to the coldness of their blood, but to its greater thin-
διὰ τὸ καθαρὸν εἶναι· τὸ γὰρ γεώδες οὐδέτερον ἔχει τούτων. εὐκίνητοτέραν γὰρ ἔχουσι τὴν αἰσθήσιν τὰ λεπτοτέραν ἔχοντα τὴν υγρότητα καὶ καθαρωτέραν. διὰ γὰρ τοῦτο καὶ τῶν ἀναίμων ἐναὶ συνετωτέραν ἔχει 25 τὴν ψυχῆν ἐνίων ἐναίμων, καθάπερ εἴρηται πρότερον, οἰόν ἡ μελίττα καὶ τὸ γένος τὸ τῶν μυρμήκων καὶ εἰ τι ἔτερον τοιούτον ἑστιν. δειλότερα δὲ τὰ λίαν ύδατωδή. ὁ γὰρ φόβος καταψύχει· προωδοποιηται οὖν τῷ πάθει τὰ τοιαύτην ἔχοντα τὴν ἐν τῇ καρδίᾳ κράσιν· τὸ γὰρ ὑδωρ τῷ ψυχρῷ πηκτόν ἑστιν. διὸ καὶ τάλλα τὰ ἄναμα δειλότερα τῶν ἐναίμων ἑστίν ὅσ ἀπλῶς εἰπεὶν, καὶ ἀκινητικὴς τε φοβούμενα καὶ προέται περιττώματα καὶ μεταβάλλει ἐναὶ τὰς χρόας αὐτῶν. τὰ δὲ πολλὰς ἔχοντα λίαν ἑπας καὶ παχείας γεωδέστερα τὴν φύσιν ἑστὶ καὶ θυμώδη τὸ 35 ἱθος καὶ ἐκστατικά διὰ τὸν θυμόν. θερμότητος γὰρ ποιητικὸν ὁ θυμός, τὰ δὲ στερεὰ θερμανθέντα μάλλον θερμαίνει τῶν υγρῶν· αἱ δ’ ἑνες στερεῖν καὶ γεώδες, ὥστε γίνονται οἴον πυρία ἐν τῷ αἷματι καὶ ζέσιν πουιδοῦν ἐν τοῖς θυμοῖς. διὸ οἱ ταῦροι καὶ οἱ κάπροι θυμώδεις καὶ ἐκστατικός· τὸ γὰρ αἷμα τοῦτων ἰνωδεστατον, καὶ τὸ γε τοῦ ταύρου τάχιστα 5 πῆγνυται πάντων. ἐξαιρουμένων δὲ τοῦτων τῶν ἵνων οὐ πῆγνυται τὸ αἷμα· καθάπερ γὰρ ἐκ πηλοῦ εἰ τις ἐξέλοι τὸ γεώδες οὐ πῆγνυται τὸ υδωρ, οὐτω καὶ τὸ αἷμα· αἱ γὰρ ἑνες γῆς. μὴ ἐξαιρουμένων

a At 648 a 2 ff.

b For the connexion between fear and cold cf. 667 a 16, 692 a 22 ff., and Rhetoric, 1389 b 30.

138
Parts of animals, ii. iv.

ness and clarity, neither of which characteristics belongs to the earthy substance; and an animal which has the thinner and clearer sort of fluid in it has also a more mobile faculty of sensation. This is why, as I said before, some of the bloodless creatures have a more intelligent Soul than some of the blooded ones; e.g. the bee and the ants and such insects. Those, however, that have excessively watery blood are somewhat timorous. This is because water is congealed by cold; and coldness also accompanies fear; therefore in those creatures whose heart contains a predominantly watery blend, the way is already prepared for a timorous disposition. This, too, is why, generally speaking, the bloodless creatures are more timorous than the blooded ones and why they stand motionless when they are frightened and discharge their residues and (in some cases) change their colour. On the other side, there are the animals that have specially plentiful and thick fibres in their blood; these are of an earthier nature, and are of a passionate temperament and liable to outbursts of passion. Passion produces heat; and solids, when they have been heated, give off more heat than fluids. So the fibres, which are solid and earthy, become as it were embers inside the blood and cause it to boil up when the fits of passion come on. That is why bulls and boars are so liable to these fits of passion. Their blood is very fibrous; indeed, that of the bull is the quickest of all to congeal. But just as when the earthy matter is taken out of mud, the water which remains does not congeal; so when the fibres, which consist of earth, are taken out of the blood, it no longer congeals. If they are
As it were, the "raw" material.

I have used the terms "lard" and "suet" rather than "soft fat" and "hard fat" because they represent more closely the distinction made by Aristotle. The difference between them is now known to be less fundamental, and is
not taken out, it does congeal, as moist earth does under the influence of cold: the cold expels the heat and makes the fluid evaporate, as has been said before; so it is due to the solidifying effect of the cold, and not of the hot, that what remains becomes congealed. And while it is in the body the blood is fluid on account of the heat which is there. There are many points both in regard to the temperament of animals and their power of sensation which are controlled by the character of the blood. This is what we should expect: for the blood is the material of which the whole body consists—material in the case of living creatures being nourishment, and blood is the final form which the nourishment assumes. For this reason a great deal depends upon whether the blood be hot, cold, thin, thick, muddy, or clear. Serum is the watery part of blood; and it is watery either because it has not yet undergone concoction or because it has been already corrupted; consequently some of the serum is the result of a necessary process, and some is there for the purpose of producing blood.

V. The difference between lard and suet is parallel to a difference in the blood. They both consist of blood that has been concocted as the result of plentiful nourishment; that is, the surplus blood that is not used up to nourish the fleshy parts of the animal, but is well concocted and well nourished. (This point is proved by their greasiness, for grease in fluids is a combination of Air and Fire.) This explains why there is no lard or suet in any of the bloodless animals. And among the others, those whose blood is denser tend to contain suet rather than lard. Suet due to varying proportions of unsaturated triglycerides and the lengths of the carbon chains.
πήγνυται καθάπερ καὶ τὸ αἷμα τὸ ἐνώδες καὶ αὐτὸ καὶ οἱ ζωμοὶ οἱ τοιοῦτοι· ὄλγον γὰρ ἔχει ὑδατος, 
30 τὸ δὲ πολὺ γῆς. διὸ τὰ μὴ ἄμφωδοντα ἄλλα κερατώδη στεάρ ἔχει· φανερὰ δ’ ἡ φύσις αὐτῶν τοῦ τοιοῦτον στοιχείου πλήρης οὕσα τῷ κερατώδης εἶναι καὶ ἀστραγάλους ἔχειν· ἀπαντά γὰρ ἔγρα καὶ γενρά τὴν φύσιν ἔστιν. τὰ δ’ ἄμφωδοντα καὶ 
35 ἀκέρατα καὶ πολυσχίδη πιμελὴν ἔχει ἀντὶ στέατος, ἡ οὖ πήγνυται οὐδὲ θρύπτεται ἐξηραινομένη διὰ τὸ μὴ εἶναι γεώδη τὴν φύσιν αὐτῆς.

Μέτρια μὲν οὖν ταῦτα οὖντα ἐν τοῖς μορίοις τῶν 
651 b ἥγων χωμελεί (πρὸς μὲν γὰρ Αἰσθησιν οὐκ ἐμποδίζει, 
πρὸς δὲ ὑγείας καὶ δύναμιν ἔχει βοήθειας), ὑπερ-
βάλοντα δὲ τῷ πλήθει φθείρει καὶ βλάπτει. εἰ 
γὰρ πᾶν γένοιτο τὸ σώμα πιμελη καὶ στέαρ, ἀπό-
λοιτ’ ἄν. ἥγων μὲν γὰρ ἔστι κατὰ τὸ αἰσθητικὸν
5 μόριον, ἡ δὲ σάρξ καὶ τὸ ἀνάλογον αἰσθητικὸν· τὸ 
δ’ αἷμα, ὡσπερ ἐιρηται καὶ πρότερον, οὐκ ἔχει 
Αἰσθησιν, διὸ οὐδὲ πιμελὴ οὐδὲ στεαρ· αἷμα γὰρ 
πεπεμμένον ἔστιν. ὥστ’ εἰ πᾶν γένοιτο τὸ σῶμα 
τοιοῦτον, οὐκ ἂν ἔχοι οὐδεμίαν αἰσθησιν. διὸ καὶ 
γηράσκει ταχέως τὰ λίαν πίονα· ὀλιγαίμα γὰρ ἄτε εἰς 
10 τὴν πιότητα ἀναλισκομένου τοῦ αἵματος, τὰ δ’ ὀλίγ-
αίμα ἢδη προωδοποιήται πρὸς τὴν φθορὰν· ἡ γὰρ 
φθορὰ ὀλιγαίμα τις ἔστι, καὶ τὸ ὀλιγαίμον ἑπη-
τικὸν καὶ ὑπὸ πυξροῦ τοῦ τυχόντος καὶ ὑπὸ θερμοῦ.

1 sic Th.: animal pauci sanguinis Σ: ὀλγς vulg.
is of an earthy character; it contains but little water against a large proportion of earth; so it congeals just as fibrous blood and broths do. So too the animals which have horns but have teeth in one jaw only contain suet. And it is clear that their natural constitution is full of this element (earth) from the fact that they have horns and hucklebones, for they are all of them solid and earthy in constitution. On the other hand, the animals which have incisor teeth in both jaws and have toes (not uncloven hoofs), but no horns, contain lard instead of suet. Lard neither congeals nor splits up into small pieces when it dries, owing to the fact that it is not earthy.

Lard and suet when present in the parts of animals in moderate quantities are beneficial: they do not hinder the action of the senses, and they contribute towards the health and strength of the body. But when the amount of them is excessive they are destructive and injurious. This is shown by the consideration that if the whole body were to become lard and suet, it would perish. The \textit{sine qua non} of a living creature is its sensory part, which is flesh or its counterpart; and since, as I have said before, blood is not sensitive, neither lard nor suet, which are just concocted blood, is sensitive. Therefore, if the whole body were to become either of these, it would have no sensation whatever. For this reason, too, unduly fat animals age quickly: their blood gets used up to produce fat, so there is very little of it left; and anything that has but little blood is well on the road to decay. In fact, decay is just a form of blood-deficiency; and an animal deficient in blood is easily susceptible to the effects of accidental cold and
καὶ ἀγονώτερα δὴ τὰ πιονὰ ἔστι διὰ τὴν αὐτὴν αἰτίαν· ὁ γὰρ ἔδει ἐκ τοῦ αἴματος εἰς τὴν γονὴν ἱέναι καὶ τὸ σπέρμα, τούτ' εἰς τὴν πυμηλὴν ἀναλίσκεται καὶ τὸ στέαρ· πεπτόμενον γὰρ τὸ αἷμα γίνεται ταῦτα, ὡστε ἦ ὀλως οὐ γίνεται περίττωμα αὐτοῖς οὐδὲν ἦ ὀλίγον.

Καὶ περὶ μὲν αἴματος καὶ ἱχώρος καὶ πυμηλῆς καὶ στέατος, τὸ τέ ἐστιν ἐκαστὸν αὐτῶν καὶ διὰ τίνας αἰτίας, εἴρηται.

VI. Ἐστι δὲ καὶ ὁ μυελὸς αἴματός τις φύσις, καὶ οὐχ ὄσπερ οἶονται τῖνες, τῆς γονῆς σπερματικὴ δύναμις. δηλοὶ δ' ἐν τοῖς νέοις πάμπαν· ἀτε γάρ εὖ αἴματος συνεστῶτοι τῶν μορίων καὶ τῆς τροφῆς οὕσης τοῖς ἐμβρύοις αἴματος, καὶ ἐν τοῖς ὀστοῖς ὁ μυελὸς αἴματώδης ἐστὶν· αὐξανομένων δὲ καὶ πεπτομένων, καθάπερ καὶ τὰ μόρια μεταβάλλει καὶ τὰ σπλάγχνα τὰς χρόας (ὑπερβολῇ γὰρ αἴματώδες καὶ τῶν σπλάγχνων ἐκαστὸν ἐστὶν ἐτί νέων ὄντων), οὕτω καὶ ὁ μυελὸς.

Καὶ τῶν μὲν πυμηλῶδων λιπαρὸς καὶ πυμηλῆς ὀμοιος, ὡσις δὲ μὴ πυμηλῆς ὀμοιοῦ ἄλλα στέαρ γίνεται τὸ αἷμα πεπτόμενον, τούτως δὲ στεατώδης. διὸ τοῖς μὲν κερατοφόροις καὶ μὴ ἀμφώδουσι στεατώδης, τοῖς δ' ἀμφώδουσι καὶ πολυσχιδέσι πυμηλώδης. (-Requested text from above, on 647 b 27. Plato, Timaeus, 73 c.)

1 ὀμοιοὶ Z1: ὀμοιοὶ alii.
heat. The same cause is responsible for the comparative sterility of fat animals: that part of the blood which ought to go to form semen and seed gets used up in forming lard and suet, which are formed by the concoction of blood. Hence in fat animals there is either no residue at all, or else very little.

I have now spoken of blood, serum, lard and suet, describing the nature and the Causes of each of them.

VI. Marrow, again, is really a form of blood, and not, as some think, the same as the seminal substance of the seed. This is proved by the case of very young animals. In the embryo, the parts are composed out of blood and its nourishment is blood; so it is not surprising that the marrow in the bones has a blood-like appearance. As they grow and become mature, the marrow changes its colour just like the other parts of the body and the viscera, which while the creature is young all have a blood-like appearance owing to the large quantity of blood in them.

Animals which contain lard have greasy marrow, like lard; those whose concocted blood produces not a substance like lard but suet have suety marrow. Hence, in the horned animals which have teeth in one jaw only the marrow is suety, and in the animals that have teeth in both jaws and are polydactylous it is like lard. (The spinal marrow cannot possibly be of this nature because it has to be continuous and to pass without a break right through the whole spine which is divided into separate vertebrae; and if it were fatty or suety it could not hold together as well as it does, but it would be either brittle or fluid.)


Lit. "are concocted."

A good instance of Aristotle's usage of the term "part."
'Ενια δ’ οὐκ ἔχει τῶν ζῴων ὡς ἄξιως εἰπεῖν μυελόν, ὅσων τὰ ὀστᾶ ἱσχυρὰ καὶ πυκνά, οἷον τὰ τοῦ λέοντος· τούτου γὰρ τὰ ὀστᾶ, διὰ τὸ πάμπαν ἄσημον ἔχειν, δοκεῖ οὖκ ἔχειν ὅλως μυελόν. ἔπει δὲ τὴν μὲν τῶν ὀστῶν ἀνάγκη φύσιν ὑπάρχειν τοῖς ζῴωις ἢ τὸ ἀνάλογον τοῖς ὀστοῖς, οἷον τοῖς ἐνύδροις τὴν ἀκανθαν, ἀναγκαῖον ἐνίοις ὑπάρχειν καὶ μυελόν, ἐμπεριλαμβανομένης τῆς τροφῆς ἐξ ἢς γίνεται τὰ ὀστᾶ. ὅτι δ’ ἡ τροφὴ πᾶσιν αἷμα, εἰρηται πρότερον. εὐλόγως δὲ καὶ στειατώδεις οἱ μυελοὶ καὶ πιμελώδεις εἰσίν· διὰ γὰρ τὴν ἀλέαν τὴν γνωμόμενην ύπὸ τοῦ περιέχεσθαι τοῖς ὀστοῖς πέττεται τὸ αἷμα, ἢ δὲ καθ’ αὐτὸ πέψις αἵματος στέαρ καὶ πιμελή ἐστιν. καὶ ἐν τοῖς δὴ τὰ ὀστὰ πυκνὰ ἔχονσι καὶ ἱσχυρὰ εὐλόγως ἐν τοῖς μὲν οὐκ ἐνεστὶ, τοῖς δ’ ὀλίγοις ἐνεστὶν· εἰς γὰρ τὰ ὀστὰ ἀναλίσκεται ἡ τροφή.

’Εν δὲ τοῖς μὴ ἔχουσιν ὀστὰ ἀλλ’ ἀκανθαν ὁ ῥαχίτης μόνος ἐστὶ μυελὸς· ὀλίγαμά τε γὰρ φύσει ὑπάρχει οὖντα, καὶ κοίλῃ ἀκανθα μόνον ἢ τῆς ῥαχεώς ἐστὶν. διὸ ἐν ταύτῃ ἐγγίνεται· μόνη τε γὰρ ἔχει χώραν, καὶ μόνη δεῖται συνδέσμον διὰ τὰς διαλήψεις. διὸ καὶ ὁ ἐνταῦθα μυελὸς, ὡσπερ εἰρηται, ἀλλοιότερός ἐστιν· διὰ τὸ ἀντὶ περόνης

1 ὀλίγοις per errorem Bekker.
Some animals have no marrow worth mentioning; these are they whose bones are strong and close-textured: for instance, the Lion, whose bones contain so insignificant an amount of marrow that they look as if they contained none at all. Now in view of the fact that the bodies of animals must have in them either bones or the counterpart of bones (e.g. the spines in water-animals), it follows of necessity that some of them must contain marrow as well, due to the enclosing of the nourishment out of which the bones are formed. Now we have stated already that the nourishment of all the parts of the body is blood. And it is quite reasonable that the various sorts of marrow should be suety and lardy; because the blood undergoes concoction owing to the heat produced by its being surrounded by bone, and the product of blood when it undergoes concoction by itself is suet and lard. And also, of the animals that have strong, close-textured bones, some have no marrow, others have but little, and this is reasonable too, because the nourishment gets used up to supply the substance of the bones themselves.

In those animals that have no bones but spine instead, the backbone contains the only marrow they possess. It is the nature of these creatures to have but a small amount of blood, and their only hollow spine is that of the backbone. Therefore the marrow is formed in it—indeed, it is the only bone where there is room for the marrow, and the only one which requires something to connect it together, owing to its being divided up into segments. This also explains why the marrow here is (as I have already said) somewhat different from the marrow elsewhere. It has to serve as a fastening,
652 a  

γὰρ γίνεσθαι γλύσχρος, καὶ νευρώδης ἐστὶν ὑ' ἔχῃ τάσιν.

20 Διὰ τί μὲν οὖν μυελὸν ἔχει τὰ ζώα τὰ ἐχοντα μυελὸν, εἰρήται· καὶ τί ἐστιν ὁ μυελὸς, ἐκ τούτων φανερῶν, ὅτι τῆς αἰματικῆς τροφῆς τῆς εἰς ὅστα καὶ ἀκανθαν μεριζομένης ἐστὶ τὸ ἐμπεριλαμβανόμενον περίττωμα πεφθέν.

VII. Περὶ δ' ἐγκεφάλου σχεδὸν ἐστιν ἐχόμενον

25 εἴπειν· πολλοῖς γὰρ καὶ ὁ ἐγκεφάλος δοκεῖ μυελὸς εἶναι καὶ ἀρχῇ τοῦ μυελοῦ διὰ τὸ συνεχῆ τὸν ῥαχίτην αὐτῷ ὅραν μυελόν. ἔστι δὲ πᾶν τούναντίον αὐτῷ τὴν φύσιν ὡς εἴπειν· ὁ μὲν γὰρ ἐγκέφαλος ψυχρότατον τῶν ἐν τῷ σώματι μορίων, ὁ δὲ μυελὸς θερμὸς τὴν φύσιν· δηλοὶ δ' ἡ λιπαρότης αὐτοῦ καὶ τὸ πῖον. διὸ καὶ συνεχῆς ὁ ῥαχίτης τῶν ἐγκεφάλω ἐστὶν· αἰε γὰρ ἡ φύσις μηχανᾶται πρὸς τὴν ἐκάστου ὑπερβολὴν βοήθειαν τὴν τοῦ ἐναντίου παρεδρίαν, ἵνα ἀνισάξῃ τὴν θατέρου ὑπερβολὴν θάτερον. ὅτι μὲν οὖν ὁ μυελὸς θερμὸς ἐστιν, δήλου ἐκ πολλῶν. ἢ δὲ τοῦ ἐγκεφάλου ψυχρότητος φανερὰ μὲν καὶ κατὰ τὴν ἡμέραν, ἐτὶ δ' ἀναμορτατον τῶν υγρῶν τῶν ἐν τῷ σώματι πάντων (οὐδ' ὅτι οὖν γὰρ αἴματος ἔχει ἐν

652 b αὐτῷ) καὶ αὐχμηρότατον. ἔστι δ' οὖτε περίττωμα οὔτε τῶν συνεχῶν μορίων, ἀλλὰ ἰδίος ἡ φύσις, καὶ εὐλόγως τοιαῦτη, ὅτι μὲν οὖν οὐκ ἔχει συνεχειαν οὐδεμιᾶν πρὸς τὰ αἰσθητικὰ μόρια, δήλου μὲν καὶ διὰ τῆς οὔπεσω, ἐτὶ δὲ μᾶλλον τῶν μηδεμίων ποιεῖν αἰσθητικὴν διγγανόμενος, ὥσπερ οὖδ' ὅτι οὖδ' τὸ αἷμα οὖδ' τὸ περίττωμα τῶν ζώων.

1 θερμὸς PZ: θερμών vulg.
and so it is sticky; and it is sinewy too so that it can stretch.

We have now explained why marrow is present in certain animals. We have also made clear what marrow is. The surplus of the blood-like nourishment which is distributed to the bones and spine gets enclosed within them, and after it has undergone concoction then it is marrow.

VII. The brain is the next subject on our list. It comes appropriately after the marrow, as many think that the brain is really marrow and is the source of the marrow, because, as observation shows, the spinal marrow is continuous with the brain. As a matter of fact, however, the two are quite opposite in nature. The brain is the coldest of all the parts in the body, whereas the marrow is hot, as is shown by the fact that it is greasy and fat. And that is the real reason why the spinal marrow is continuous with the brain. Nature is always contriving to set next to anything that is excessive a reinforcement of the opposite substance, so that the one may level out the excess of the other. Now there are many indications that the marrow is hot; and the coldness of the brain is shown not only by its being cold to the touch, but also by its being the driest of all the fluid parts of the body and the one that has the least blood in it—in fact, it has none at all. It is, however, not a residue, nor is it to be classed among the parts that are continuous. It is peculiar in its nature, and this after all is but reasonable. Inspection shows that the brain has no continuity with the sensory parts, but this is shown still more unmistakably by the fact that like the blood and the residue of animals it produces no sensation when it is touched.

a Cf. Plato, Timaeus 75 c, d.
'Ὑπάρχει δὲ τοῖς ἱζώσις πρὸς τὴν τῆς φύσεως ὅλης σωτηρίαν. οἱ μὲν γὰρ τοῦ ζῶου τὴν ψυχὴν τιθέασι πῦρ ἣ τοιαύτην τινὰ δύναμιν, φορτικῶς τιθέντες: βέλτιον δ' ἦσως φάναι ἐν τοιούτῳ των 10 σώματι συνεστάναι. τούτου δ' αἰτίου ὃτι τοῖς τῆς ψυχῆς ἐργοῖς ὑπηρετικῶτατον τῶν σωμάτων τὸ θερμὸν ἐστὶν, τὸ τρέφειν γὰρ καὶ κυνεῖν ψυχῆς ἐργὸν ἐστὶ, ταύτα δὲ διὰ ταύτης μάλιστα γίνεται τῆς δυνάμεως. ὃμοιον οὖν τὸ τῆς ψυχῆς εἶναι φάναι πῦρ καὶ τὸ πρίονα ἢ τρύπανον τὸν τέκτονα ἢ τὴν τεκτονικήν, ὃτι τὸ ἐργὸν περαινεῖται ἐγχύς ἀλλήλων οὕσων. ὃτι μὲν οὖν θερμότητος τὰ ζώα μετέχειν ἄναγκαιον, δῆλον ἐκ τούτων: ἐπεὶ δ' ἀπαντά δεῖται τῆς ἐναντίας ῥοπῆς, ἢν τυχχάνη τοῦ μετρίου καὶ τοῦ μέσου (τὴν γὰρ οὐσίαν ἔχει τοῦτο καὶ τὸν λόγον, τῶν δ' ἀκρῶν ἐκάτερον οὐκ ἔχει ἡ 20 χωρίς), διὰ ταύτην τὴν αἰτίαν πρὸς τὸν τῆς καρδίας τόπον καὶ τὴν ἐν αὐτῇ θερμότητα μεμηχάνηται τὸν ἐγκέφαλον ἢ φύσις, καὶ τούτου χάριν ὑπάρχει τοῦτο τὸ μόριον τῶν ζώως, τὴν φύσιν ἔχον κοινὴν ὑδατός καὶ γῆς, καὶ διὰ τοῦτο τὰ (μὲν) ἐναμα ἔχει πάντα ἐγκέφαλον, τῶν δ' ἀλλῶν οὐδέν ὡς εἰπεῖν, πλὴν ὅτι 25 κατὰ τὸ ἀνάλογον, οὗν ὁ πολύπους· ὀλυγόθερμα γὰρ πάντα διὰ τὴν ἀναμίαν.

'Ὁ μὲν οὖν ἐγκέφαλος εὑκρατοῦν ποιεῖ τὴν ἐν τῇ καρδίᾳ θερμότητα καὶ ζέσω: ὥστε δὲ καὶ τοῦτο τὸ μόριον τυχχάνη μετρίας θερμότητας, ᾧ ἐκατέρας τῆς φλεβῶς, τῆς τε μεγάλης καὶ τῆς καλουμένης ἀορτῆς, τελευτῶσιν αἱ φλέβες εἰς τὴν μὴν ἑγγα τὴν

1 (μὲν) Rackham.

a e.g. Democritus; see Aristotle, De anima, 403 b 31.

b Or, "proportion."
The brain is present in order to preserve the animal organism as a whole. Some maintain that the Soul of an animal is Fire or some such substance. This is a crude way of putting it; and might be improved upon by saying that the Soul subsists in some body of a fiery nature. The reason for this is that the hot substance is the most serviceable of all for the activities of the Soul, since one of the activities of the Soul is to nourish; another is to cause motion; and these are most readily effected by means of this substance (viz. the hot). So to say that the Soul is fire is like saying that the craftsman, or his craft, is the saw or the auger which he uses, on the ground that the activity is performed while the two are near together. From what we have said this at any rate is clear: animals must of necessity have in them a certain amount of heat. Now, everything needs something to counterbalance it, so that it may achieve moderation and the mean; for it is the mean, and not either of the extremes apart, which has reality and rationality. For this cause nature has contrived the brain to counterbalance the region of the heart and the heat in it; and that is why animals have a brain, the composition of which is a combination of Water and Earth. Hence, although all blooded animals have a brain, practically none of the others has (unless it be just a counterpart, as in the case of the Octopus), for since they lack blood they have but little heat.

The brain, then, makes the heat and the boiling in the heart well blent and tempered; yet in order that the brain may still have a moderate heat, blood-vessels run from the great Blood-vessel and what is known as the Aorta, till they reach the membrane.
περὶ τὸν ἐγκέφαλον. πρὸς δὲ τὸ τῇ θερμοτητὶ μὴ βλάπτειν, ἀντὶ μὲν μεγάλων (καὶ) ὀλίγων πυκναὶ καὶ λεπταὶ φλέβες περιέχουσιν αὐτόν, ἀντὶ δὲ θολε-ροῦ καὶ παχέος αἵματος λεπτὸν καὶ καθαρὸν. διὸ καὶ τὰ ρέματα τοῖς σώμασιν ἐκ τῆς κεφαλῆς ἐστὶ
35 τὴν ἀρχήν, ὅσοις ἂν ἦ τὰ περὶ τὸν ἐγκέφαλον ψυχρότερα τῆς συμμέτρου κράσεως· ἀναθυμιω-
μένης γὰρ διὰ τῶν φλεβῶν ἀνω τῆς τροφῆς τὸ περίττωμα ψυχόμενον διὰ τὴν τοῦ τόπου τούτου δύναμιν ρέματα ποιεῖ φλέγματος καὶ ἰχώρος. δὲ δὲ λαβεῖν, ὡς μεγάλω παρεικάζοντα μικρόν, ὁμοίως συμβαίνει ὡσπερ τὴν τῶν ὑετῶν γένεσιν.
5 ἀναθυμιωμένης γὰρ ἐκ τῆς γῆς τῆς ἀτμίδος καὶ φερομένης ὑπὸ τοῦ θερμοῦ πρὸς τὸν ἄνω τόπον, ὅταν ἐν τῷ ὑπὲρ τῆς γῆς γένηται ἀέρι ὁντι πυχρῷ, συνιστάται πάλιν εἰς ύδωρ διὰ τὴν ψύξιν καὶ βεῖ κάτω πρὸς τὴν γῆν. ἀλλὰ περὶ μὲν τούτων ἐν ταῖς τῶν νόσων ἀρχαῖς ἀρμόττει λέγειν, ἐφ’ ὅσον τῆς φυ-
10 σικῆς φιλοσοφίας ἐστὶν εἰπεῖν περὶ αὐτῶν.
Ποιεῖ δὲ καὶ τὸν ὑπόν τὸς ζύοις τοῦτο τὸ μόριον τοῖς ἔχουσιν ἐγκέφαλον, τοῖς δὲ μὴ ἔχουσι
τὸ ἀνάλογον· καταψύχον γὰρ τὴν ἀπὸ τῆς τροφῆς τοῦ αἵματος ἐπίρρυσιν (ὅ καὶ διὰ τινὰς ὁμοίας
ἀλτίας ἀλλας), βαρύνει τε τὸν τόπον (διὸ τὴν κεφαλὴν
15 καρπηβαροῦσιν οἱ ὑπνώσοντες) καὶ κάτω ποιεῖ τὸ
θερμὸν ὑποφεύγειν μετὰ τοῦ αἵματος. διὸ πλεῖον
ἀθροιζόμενον ἐπὶ τὸν κάτω τόπον ἀπεργάζεται τὸν
ὑπόν, καὶ τὸ δύνασθαι ἐστάναι ὀρθὰ ἀφαιρεῖται
ὅσα τῶν ζώων ὀρθὰ τὴν φύσιν ἐστί, τῶν δ’ ἄλλων

1 (καὶ) Rackham.
2 θολεροῦ coni. Buss. (turbidi Σ) : πολλοῦ vulg.
which surrounds the brain. And in order to prevent injury being done through heat, the blood-vessels surrounding it are not few and large but small and multitudinous; and the blood is not muddy and thick but thin and clear. This also explains why fluxes begin in the head; they occur when the parts around the brain are colder than the rightly-proportioned blend.\(^a\) What happens is that, as the nourishment exhales upwards through the blood-vessels, the residue from it becomes cooled owing to the specific nature of the brain, and produces fluxes of phlegm and serum. And we should be justified in maintaining that this process resembles, on a small scale, the one which produces rain-showers. Damp vapour exhales up from the earth and is carried into the upper regions by the heat; and when it reaches the cold air up aloft, it condenses back again into water owing to the cold, and pours down towards the earth. However, so far as Natural Philosophy is concerned with these matters, the proper place to speak of them is in the *Origins of Diseases.*\(^b\)

Furthermore, it is the brain (or, if there is no brain, its counterpart) which produces sleep in animals. It cools the onflow of blood which comes from the food (or else is due to other causes of the same sort), and weighs down the part where it is (that is why when a person is sleepy his head is weighed down), and causes the hot substance to escape below together with the blood. Hence, the blood accumulates unduly in the lower region of the body and produces sleep; at the same time it takes away from those animals whose nature is to stand upright the power to do so, and the others it prevents from

\(^a\) See p. 38.  
\(^b\) No such treatise exists.
τὴν ὀρθότητα τῆς κεφαλῆς· περὶ δὲν εὑρηται καθ' αὐτὰ ἐν τε τοῖς περὶ αἰσθήσεως καὶ περὶ ὕπνου διωρισμένους.

"Οτι δ' ἐστὶν ὁ ἐγκέφαλος κοινὸς υοδατος καὶ γῆς, δηλοὶ τὸ συμβαίνον περὶ αὐτῶν· ἔφομενος γὰρ γίνεται ἡγρός καὶ σκληρός, καὶ λείπεται τὸ γεώδες ἐξατμισθέντος τοῦ υδατος ὑπὸ τῆς θερμότητος, ὥσπερ τα τῶν χειμώπων ἐβήμαται καὶ τῶν ἄλλων καρπῶν, διὰ τὸ γῆς εἶναι τὸ πλείστον μέρος, ἔξωδόντος τοῦ μιχθέντος υγροῦ· καὶ γὰρ ταῦτα γίνεται σκληρά καὶ γενή πάμπαν.

"Ἐχει δὲ τῶν ζώων ἐγκέφαλον πλείστον ἀνθρωπος ὡς κατὰ μέγεθος, καὶ τῶν ἀνθρώπων οἱ ἄρρενες τῶν θηλείων· καὶ γὰρ τὸν περὶ τὴν καρδίαν καὶ τὸν πλεύμονα τόπον θερμότατον καὶ ἐναιμότατον. διὸ καὶ μόνον ἔστὶ τῶν ζώων ὁρθόν· ἢ γὰρ τοῦ θερμοῦ φύσις ἐνισχύουσα ποιεῖ τὴν αὐξησιν ἀπὸ τοῦ μέσου κατὰ τὴν αὐτῆς φορὰν. πρὸς οὖν πολλὴν θερμότητα ἀντίκειται πλεῖων ψυχρώτητα καὶ ψυχρότητα, καὶ διὰ τὸ πλήθος ὁμαίητα πήγιναι τὸ περὶ τὴν κεφαλὴν ὡςποῦν, ὃ καλοῦσι βρέγμα τινές, διὰ τὸ πολὺν χρόνον τὸ θερμὸν ἀπατμίζειν· τῶν δὲ ἄλλων οὐδεὶ τοῦτο συμβαίνει τῶν ἐναίμοις ζώων· καὶ ραφᾶς δὲ πλείστας ἔχει περὶ τὴν κεφαλήν, καὶ τὸ ἄρρεν πλεῖστον θηλείων, διὰ τὴν αὐτὴν αἰτίαν, ὡς οὗ τόπος εὖπνους ἐ, καὶ μάλλον ὁ πλεῖων ἐγκέφαλος· ψυχρανόμενος γὰρ ἢ ἐγκέφαλος μάλλον οὐ ποιήσει τὸ αὐτοῦ ἐγγον, ἀλλ' ἢ οὐ ψύξει ἢ πηξει, ὡστε

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a See De somno, 455 b 28 ff., especially 456 b 17 ff.
b The cranial bone, which covers the anterior fontanelle.

154
holding their heads upright. These matters have been spoken of separately in the treatises on *Sensation* and on *Sleep*.

I said the brain is compounded of Water and Earth. This is shown by what happens when it is boiled. Then it becomes solid and hard: the earthy substance is left behind after the Water has evaporated owing to the heat. It is just what happens when pulse and other forms of fruit are boiled; they also get hard and earthy altogether, because the greater part of them is earth, and the fluid mixed with it departs when they are boiled.

Of all the animals, man has the largest brain for his size; and men have a larger brain than women. In both cases the largeness is due to there being a great deal of heat and blood in the region around the heart and the lung. This too explains why man is the only animal that stands upright. As the hot substance prevails in the body it induces growth, beginning from the centre along its own line of travel. It is against great heat, then, that a large supply of fluid and cold is provided. This bulk of moisture is also the reason why the bone that surrounds the brain (called by some the *bregma*) is the last of all to solidify; the hot substance takes a long time to evaporate it off. This phenomenon does not occur in any other of the blooded animals. Again, man has more sutures in the skull than any other animal, and males have more than females. The size of the brain is the reason for this also; it is to secure ventilation, and the larger the brain, the more ventilation it requires. If the brain becomes unduly fluid or unduly solid, it will not perform its proper function, but will either fail to cool the blood or else
5 νόσους καὶ παρανοίας ποιεῖν καὶ θανάτους· τὸ γὰρ ἐν τῇ καρδίᾳ θερμὸν καὶ ἡ ἀρχὴ συμπαθέστατον ἐστὶ καὶ ταχεῖαν ποιεῖται τῇν αἰσθήσιν μεταβάλλοντός τι καὶ πάσχοντος τοῦ περὶ τὸν ἐγκέφαλον αἰματος.

Περὶ μὲν οὖν τῶν συμφύτων τοῖς ζῴοις ύγρῶν 10 σχεδὸν εἴρηται περὶ πάντων· τῶν δὲ ύστερογενῶν τὰ τε περιττώματα τῆς τροφῆς· ἐστὶν, τὸ τε τῆς κύστεως ὑπόστημα καὶ τὸ τῆς κοιλίας, καὶ παρὰ ταύτα γονῆ καὶ γάλα τοῖς πεφυκόσιν ἔχειν ἐκαστά τούτων. τὰ μὲν οὖν τῆς τροφῆς περιττώματα περὶ τὴν τῆς τροφῆς σκέψιν καὶ θεωρίαν οὐκεῖοις ἔχει 15 τοὺς λόγους, τίς τε τῶν ζῴων ὑπάρχει καὶ διὰ τίνας αἰτίας, τὰ δὲ περὶ σπέρματος καὶ γάλακτος ἐν τοῖς περὶ γενέσεως· τὸ μὲν γὰρ ἀρχὴ γενέσεως αὐτῶν ἐστιν, τὸ δὲ χάριν γενέσεως.

VIII. Περὶ δὲ τῶν ἄλλων μορίων τῶν ὁμοιο- 20 μερῶν σκεπτέον, καὶ πρῶτον περὶ σαρκὸς ἐν τοῖς ἐξουσι σάρκας, ἐν δὲ τοῖς ἄλλοις τὸ ἀνάλογον· τοῦτο γὰρ ἀρχὴ καὶ σῶμα καθ’ αὐτό τῶν ζῴων ἐστὶν. δὴ λοιπὸν δὲ καὶ κατὰ τὸν λόγον· τὸ γὰρ ζῷον ὑπὸ- ζόμεθα τῷ ἐχειν αἰσθήσιν, πρῶτον δὲ τὴν πρώτην αὕτη δ’ ἐστὶν ἀφή, ταύτης δ’ αἰσθητήριον τὸ τοιοῦ- 25 τον μόριον ἐστὶν, ἦτοι τὸ πρῶτον, ὥσπερ ἡ κόρη

* At De gen. an. 722 a, 776 a 15 ff.*
will make it set fast, thus producing various forms of disease, madness, and death. Indeed, the heat that is in the heart, being the source, is extremely responsive to any influence upon it; and if the blood which surrounds the brain undergoes any change or any other affection, then this heat at once becomes sensitive of it.

We may now claim to have considered all the fluids which are present in animal bodies from their very earliest stages. There are others which are first produced only at some later stage, and among these we must reckon the residues of the nourishment—that is to say, the deposits from the bladder and from the gut; and also semen, and milk; these make their appearance according to the species and sex of the animal concerned. Discussion of the residues of the nourishment will come in appropriately during our general consideration and examination of nourishment; we shall then show in what animals they occur, and why they do so. Semen, which gives rise to generation, and milk, which exists on account of generation, we shall deal with in the treatise on Generation.a

VIII. We must now go on to consider the rest of the uniform parts. Let us take first of all Flesh (and, where Flesh is absent, its counterpart), for this is to animals both a principle and a body in itself. Its primacy can also be logically shown, as follows. We define an animal as something that has the power of sensation, and chiefly the primary sensation, which is touch; and the organ through which this sensation is effected is the flesh (or its counterpart). And flesh is either its primary organ (comparable to the pupil in the case of sight), or else it is the organ and
653b  τῆς ὁφεως, ἦ τὸ δὲ οὖ συνειλημμένον, ὡσπερ ᾧν εἰ τις προσλάβοι τῇ κόρῃ τὸ διαφανὲς πάν. ἐπὶ μὲν οὖν τῶν ἄλλων αἰσθησεως ἀδύνατον τε καὶ οὐδὲν προὐργον τοῦτ’ ἦν ποιήσαι τῇ φύσει, τὸ δ’ ἀπτικὸν ἐξ ἀνάγκης· μόνον γὰρ ἦ μάλιστα τοῦτ’ ἔστι σωματῶδες τῶν αἰσθητηρίων. κατὰ δὲ τὴν αἰσθήσιν παντα τάλλα τούτων χάριν ὄντα, λέγω δ’ οἴον ὡστά καὶ δέρμα καὶ νεῦρα καὶ φλέβες, ἐτί δὲ τρίχες καὶ τὸ τῶν ὀνύχων γένος, καὶ εἰ τι τοιοῦτον ἐπερόν ἐστίν. ἡ μὲν γὰρ τῶν ὀστῶν φύσις σωτηρίας ἔνεκεν μεμηχανήται (τοῦ)¹ μαλακοῦ, σκληρὰ τὴν φύσιν ὄνσα, ἐν τοῖς ἔχουσιν ὡστά· ἐν δὲ τοῖς μὴ ἔχουσι, τὸ ἀνάλογον, οἷον ἐν τοῖς ἰχθύσι τοῖς μὲν ἀκανθὰ τοῖς δὲ χόνδροις.

Τὰ μὲν οὖν ἔχει τῶν ζῶων ἐντὸς τῆς τοιαύτην 654a βοηθειαν, ἐνιὰ δὲ τῶν ἀναίμων ἐκτός, ὡσπερ τῶν τε μαλακοστράκων ἐκαστὸν, οἷον καρκίνοι καὶ τὸ τῶν καράβων γένος, καὶ τὸ τῶν ὀστρακοδέρμων ὄστρακων, οἶον τὰ καλούμενα ὡστρακα· πᾶσι γὰρ τούτοις τὸ μὲν σαρκῶδες ἐντός, τὸ δὲ συνέχου καὶ φυλάττου ἐκτός τὸ γεώδες ἐστίν· πρὸς γὰρ τῇ φυλακῇ τῆς συνεχείας, τῷ ἔχειν όλίγον αὐτῶν τὴν φύσιν θερμῶν ἀναίμων ὄντων, οἶον πιγεύς τις περικείμενον τὸ ὀστρακον φυλάττει τὸ ἐμπεπυρεμένον θερμῶν. ἡ δὲ χελώνη καὶ τὸ τῶν ἐμύδων γένος ὡμοίως ἔχειν

¹ <τοῦ> Ogle.

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**Notes:**

- **a** Apparently because the objects with which it deals are more “corporeal” than those of the other senses—it has to be in bodily contact with them.
- **b** As apart from a priori reasoning.
- **c** Sometimes, as here, “counterpart” could be represented by the modern term “analogue.”
- **d** Lit., “the soft-shelled creatures.”
the medium of the sensation combined in one (comparable to the pupil plus the whole of the transparent medium in the case of sight). Now not only was it pointless, it was impossible for Nature to make such a combination in the case of the other senses; with touch, however, it was due to necessity, since its sense-organ is the only one which is corporeal—or at least it is definitely the most corporeal one. It is also clear from our actual experience in sensation that all the other parts exist for the sake of the organ of touch (the flesh). In these I include the bones, the skin, the sinews, the blood-vessels; also the hair, nails of every sort and kind, and the like. The bones, for instance, which are hard in substance, have been devised for the preservation of the soft parts. The same is true of the counterpart of the bones in other creatures: two examples in species of fish are spine and cartilage.

Now with some animals this hard supporting substance is situated inside the body, with others (some of the bloodless ones) it is outside. It is outside in the case of all the Crustacea (e.g. the Crabs and the group of Crayfish), and the group of Testacea too, e.g. those that are known as Oysters. All these have their fleshy part inside, and the earthy part which holds it together and protects it is outside—outside, because it performs an additional function as well: since these creatures are bloodless, they possess but little heat, and the shell acts like a couvre-feu; it encloses the faintly burning heat and protects it. Another quite different group of creatures, the Turtles and the group of freshwater

* Lit., "the shell-skinned creatures." "Testacea" is the nearest modern term. See Introduction, p. 23.
654 a
dokei tou'tois, eteron on genos touton. ta δ' 10 enotoma twon xwovn kaì ta malakia tou'tois t' enantios kaì autois antikeimenous suneisthkev. oudeven gar ostwdes exein eoikey oude yegron apokekrimenov, o ti kai axion eiptein, allà ta mev malakia scheidon ola sarkwdei kai malakà, pròs de to mè eutfplantos einai to swma autwv, katapeter ta 15 sarkwdei, metakev sarkos kai neyron tivn phusin exei. malakon men gar osper sárxi estin, exei de tásin osper neyron. tivn de skhian exei tis sarakos ou kai' euvnarioin allà kata kýklaus diairethi. outhei gar [αν] exein xhrismathaton an eìh² prois tivn 20 isoix. uparxei δ' ev autois kai to anaklygion tais twon ixhuvon akánthais, oion ev men tais sptieis to kaloumenon sption, ev de tais teubisi to kaloumenon eífoe. to³ δ' aü twon poluopodwv (genos)⁴ touótoun oudeven exei dia to mikron exeiv to kutos tivn kaloumenh kefalh, thátera δ' eumhkei. diá prois tivn orhótteta autow kai tivn akamhian òp- 25 egrafe taüta hè phusis, oúster twon enaímwn tois men ostouj tois δ' akanvhan. ta δ' enotoma tou'tois t' enantiosw exei kai tois enaímous, katháper eîpomen oudeven gar afworismenov exei skleron, to de malakon, all' olon to swma skleron, sklerótpta de toiaúteta, ostou men sarkwdesteran, sarkos δ' ¹ [αν] seclusi. ² xhismat ara eìh SU. ³ to Platt: ta vulg. ⁴ (genos) Platt.
Tortoises, are apparently in like case. On the other hand, the Insects and the Cephalopods are differently constructed from these, as well as being different from each other. Not only, as it appears, have they no bony part, but they have practically no earthy part at all distinct from the rest of the body. The Cephalopods are almost wholly soft and fleshy, yet in order to prevent their bodies from being easily destructible as fleshy structures are, the substance of which they are formed is intermediate between flesh and sinew, having the softness of flesh and the elasticity of sinew. When it is split up, it breaks as flesh does, that is, not longitudinally but into circular portions. The reason for this seems to be that such a structure secures the greatest strength. There is found also in these creatures the counterpart of the spinous bones of fishes; examples are: the "pounce" (os sepiae) of the cuttlefish, and the "pen" (gladius) of the calamaries. Nothing of this sort, however, appears in the Octopuses: this is because in them what is called the "head" forms but a small sac, whereas in the cuttlefish and calamaries the "head" is of considerable length. So we see that, in order to secure that they should be straight and inflexible, nature prescribed for them this hard support, just as she gave to the blooded creatures bones or spines. Quite a different contrivance obtains in the Insects—different both from the Cephalopods and from the blooded creatures, as has already been stated. In the Insects we do not find the clear-cut distinction of hard parts and soft; here, the whole body is hard, yet its hardness is such that it is more fleshlike than
ARISTOTLE

654 a
30 ὀστωδεστέραν καὶ γεωδεστέραν, πρὸς τὸ μὴ εὐ-
diaίρετον εἶναι τὸ σῶμα αὐτῶν.

IX. Ἐχει δ’ ὁμοίως η’ τε τῶν ὀστῶν καὶ η’
tῶν φλεβῶν φύσις. ἑκατέρα γὰρ αὐτῶν ἄφ’ ἐνὸς
ηργμένη συνεχῆς ἐστὶ, καὶ οὔτ’ ὀστοῦν ἐστὶν αὐτὸ
85 καθ’ αὐτὸ οὐδέν, ἀλλ’ η’ μόριον ὡς συνεχοῦς η’
ἀπτόμενον καὶ προσδεδεμένον, ἵνα χρῆται η’ φύσις
καὶ ὡς ἐνι καὶ συνεχεῖ καὶ ὡς δυσὶ καὶ διηρημένοις
πρὸς τὴν κάμψιν. ὁμοίως δὲ καὶ φλέψ οὐδεμία
αὐτῇ καθ’ αὐτὴν ἐστὶν, ἀλλὰ πάσαι μόριον μιᾶς
εἰσιν. ὀστοῦν τε γὰρ εἶ τι κεχωρισμένον ἢν, τὸ τ’
5 ἔργον οὐκ ἂν ἐποιεὶ οὗ χάριν η’ τῶν ὀστῶν ἐστὶ
φύσις (οὔτε γὰρ ἂν κάμψεως ἢν αὐτίον οὔτ’ ὀρθό-
tητος οὐδεμίας μὴ συνεχές ὃν ἀλλὰ διαλεῖπον), ἔτι
τ’ ἑβλαπτεὶν ἂν ὀσπερ ἀκανθά τις η’ βέλος ἐνὸς ταῖς
σαρξίν. εἴτε φλέψ ἢν τις κεχωρισμένη καὶ μὴ
συνεχῆς πρὸς τὴν ἄρχην, οὐκ ἂν ἔσωξε τὸ ἐν αὐτῇ
10 αἷμα. ἦ γὰρ ἀπ’ ἐκείνης θερμότης κωλύει πτήγνυ-
σθαι, φαίνεται δὲ καὶ σπόμενον τὸ χωρίζομενον.
ἀρχῆ δὲ τῶν μὲν φλεβῶν ἡ καρδία, τῶν δ’ ὀστῶν ἡ
καλομεμένη ράχις τοῖς ἐξουσίων ὡς πάσιν, ἀφ’ ἢς
συνεχῆς ἡ τῶν ἀλλῶν ὀστῶν ἐστὶ φύσις· ἦ γὰρ τὸ
μῆκος καὶ τὴν ὀρθότητα συνέχουσα τῶν ζῴων ἡ
15 ράχις ἐστίν. ἐπεὶ δ’ ἀνάγκη κινουμένου τοῦ ζῷου
bone is and more bony and earthy than flesh. The purpose of this is to ensure that the body shall not easily break up.

IX. The system of the bones is similar to that of the blood-vessels: each is a connected system beginning from one point. There is no such thing as a bone by itself in isolation; every bone is either actually part of the connected scheme, or else is attached to it and so is in contact with it. This enables Nature to use any couple of bones either as a single connected piece, or, when flexion is required, as two distinct pieces. In like manner, there is no such thing as a blood-vessel by itself in isolation: they are all of them parts of one blood-vessel. An isolated bone could never discharge the function for which all bones exist; for, being discontinuous and disconnected from the rest, it could never serve as the means either for bending or for straightening a limb; but worse than that, it would be a source of harm, like a thorn or an arrow sticking in the flesh. Similarly, if we imagine a blood-vessel isolated and not connected with the source of them all, it could never keep the blood within it in a proper condition, since it is the heat which comes from that source which prevents the blood from congealing, as is shown by the putrefaction of blood when separated from it. This source of the blood-vessels is of course the heart, and the corresponding source of the bones in all bony species is what is called the backbone. The system of the bones is a connected whole, starting from the backbone, since the backbone connects together the length of the animal’s body and holds it straight. Now although this backbone is a unity because it is connected together, it

Περὶ δὲ τὰ ὀστά αἱ σάρκες περιπεφύκασιν, προσειλημμέναι λεπτοῖς καὶ ἱνώδεις δεσμοῖς· ὅν ἔνεκεν τὸ τῶν ὀστῶν ἐστὶ γένος. ὅσπερ γὰρ οἱ πλάττοντες ἐκ πηλοῦ ζῷον ἡ τινος ἀλλῆς υγρᾶς συστάσεως υφιστάσι τῶν στερεῶν τι σωμάτων, εἰθ’ οὔτω περιπλάττουσι, τὸν αὐτοὺ τρόπον ἡ φύσις δεδημιουργηκέν πί τῶν σαρκῶν τὸ ζῷων. τοῖς μὲν οὖν ἅλλοις ὑπεστὶν ὀστά τοῖς σαρκώδεσι μορίοις, τοῖς μὲν κινούμενοις διὰ κάμψιν τοῦτου χάριν, τοῖς δ᾿ ακινήτως φυλακῆς ἐνεκεν, οἷον αἰ

655 a συγκλείονται πλευρὰς τὸ στῆθος σωτηρίας χάριν

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¹ τὰ Peck: τὰς Z: ἡ vulg.: οστὰ τῶν μορίων ἐστὶν τὰς μὲν (ἡν vulg.) ἐχεῖ τὰ κώλα καὶ κάμψιν Z.
² τοῖς SU: τε vulg.: γε EY.
³ ll. 16-25: hunc locum correx, partim Σ et Albertum secutus. vid. p. 46. fortasse et ἐπεὶ δ’ ἀνάγκη . . . σπον-

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⁴ ἐἰσὶν vulg.
is also a thing of many parts because of its division into vertebrae, since the body must be able to bend while the animal is in motion. And the bones of the various limbs (in those animals which have them) are connected with this backbone, from which they originate. Some of them have extremities which fit on to each other: either (a) one is hollow and the other rounded, or (b) both are hollow and hold a huckle-bone between them (as it might be a bolt), to admit of bending and extension, since these movements would be quite impossible or at any rate unsatisfactory without such an arrangement. (c) There are some joints in which the adjacent ends of the two bones are similar in shape; [these are bound together by sinews,] and there are pieces of cartilage inserted in between them, like a pad, to prevent them from rubbing against each other.¹

Now the whole system of the bones exists to subserve the fleshy parts of the body, which have their place around the bones and are attached to them by thin fibrous threads. Modellers who set out to mould an animal out of clay or some other plastic substance begin first of all with a hard and solid core and mould their figure round it. Nature’s method has been the same in fashioning animals out of flesh. With one exception, all the fleshy parts have a core of bone: for the parts that move and bend, this is present as a means for enabling the limb to bend; for those that do not move, it serves as a protection: an example of this are the ribs, enclosing the chest, which are a means of protection for the viscera in

¹ The text of this paragraph has been confused by a number of interpolations, most of which I have omitted in translating.
Τῶν περὶ τὴν καρδιάν σπλάγχνων· τὰ δὲ περὶ τὴν κοιλίαν ἀνόστεα πάσιν, ὅπως μὴ κωλύῃ τὴν ἀνοίδησιν τὴν ἀπὸ τῆς τροφῆς γνωμένην τοῖς ζῴοις ἐξ ἀνάγκης καὶ τοῖς θῆλεσι τὴν ἐν αὐτοῖς τῶν ἐμβρών αὐξῆσιν.

5 Τὰ μὲν οὖν ζωοτόκα τῶν ζῴων καὶ ἐν αὐτοῖς καὶ ἐκτὸς παραπλησίαν ἔχει τὴν τῶν ὀστῶν δύναμιν καὶ ἱσχυράν. πολὺ γὰρ μείζων πάντα τὰ τοιούτα τῶν μὴ ζωοτόκων ὡς κατὰ λόγον εἰπεῖν τῶν σωμάτων· ἐναχοῦ γὰρ πολλὰ γίνεται μεγάλα τῶν ζωοτόκων,

10 οἷον ἐν Διβύῃ καὶ τοῖς τόποις τοῖς θερμοῖς καὶ τοῖς ξηροῖς. τοῖς δὲ μεγάλοις ἱσχυροτέρων δεῖ τῶν ὑπερευσμάτων καὶ μειόνων καὶ σκληροτέρων, καὶ τούτων αὐτῶν τοῖς βιαστικωτέροις. διὸ τὰ τῶν ἀρρένων σκληρότερα ἢ τὰ τῶν θηλείων, καὶ τὰ τῶν σαρκοφάγων (ἡ τροφή γὰρ διὰ μάχης τούτως), ὥσπερ τὰ τοῦ λέοντος· οὕτω γὰρ ἔχει ταῦτα

15 σκληρῶν τὴν φύσιν ὡστ' ἐξάπτεσθαι τυπομενῶν καθάπερ ἐκ λίθων πῦρ. ἔχει δὲ καὶ ὁ δελφὸς οὐκ ἀκάνθας ἀλλ' ὀστᾶ· ζωοτόκος γὰρ ἐστιν.

Τοῖς δ' ἐναίμοις μὲν μὴ ζωοτόκους δὲ παραλλάττει κατὰ μικρὸν ἡ φύσις, οἷον τοῖς ὀρνισιν ὀστὰ μὲν, ἀσθενέστερα δε. τῶν δ' ἰχθυῶν τοῖς μὲν

20 ἱσχυροκοι ἄκανθα, καὶ τοῖς ὀφεσιν ἀκανθώδης ἐστὶν ἢ τῶν ὀστῶν φύσις, πλὴν τοῖς λίαν μεγάλοις· τούτοις δὲ, δι' ἄπερ καὶ τοῖς ζωοτόκοις, πρὸς τὴν ἱσχύν ἱσχυροτέρων δεί τῶν στερεωμάτων. τὰ δὲ καλοῦμενα σελάχη χονδράκανθα τὴν φύσιν ἐστίν· ὑγροτέραν τε γὰρ ἀναγκαίον αὐτῶν εἶναι τὴν κί-

* Cartilaginous fishes, including the sharks.
the region of the heart. The exception is the parts near the belly, which in all animals are boneless. The purpose of this is that the swelling which takes place of necessity after the receipt of nourishment may not be hampered, and (in females) to prevent any interference with the growth of the fetus.

The nature of the bones is similar in all viviparous animals (that is, internally viviparous as well as externally); and as the Vivipara are much larger proportionately in bodily size than other animals, their bones are strong. In some places many of these animals grow to a great size, as for example in Libya and other hot dry countries. These large animals need stronger and bigger and harder supports, especially those of them that are particularly violent in their habits. Hence, the bones of males are harder than the bones of females, and those of carnivorous animals than those of herbivorous, because the carnivorous have to fight for their food. An example is the Lion: it has such hard bones that when they are struck fire is kindled as it is from stones. Note that the Dolphin, being viviparous, has bones like the other viviparous creatures, and not fish-spines.

In the creatures which though blooded are not viviparous Nature has made a series of graduated changes: for example, birds have bones, but they are weaker than the bones of the Vivipara. The oviparous fishes have fish-spine, not bone; and the serpents have bone whose nature is that of fish-spine; except the very large species, and they have bones, because (just like the Vivipara) if their bodies are to be strong the solid framework of them must be stronger. The creatures called Selachia have spines made of cartilage. This is because their movement
ARISTOTLE

655 a

25 νησιν, ὡστε δεῖ καὶ τὴν τῶν ἐρευσμάτων μὴ κραδι- 
ρον εἶναι ἀλλὰ μαλακωτέραν, καὶ τὸ γεώδες εἰς 
τὸ δέρμα πάν ἀνήλωκεν ἡ φύσις· ἀμα δὲ τὴν αὐτὴν 
ὑπεροχὴν εἰς πολλοὺς τόπους ἀδυνατεῖ διανέμειν ἡ 
φύσις. ἔνεστι δὲ καὶ ἐν τοῖς ζωοτόκοις πολλὰ τῶν 
ὀστῶν χονδρώδη, ἐν ὅσοις συμφέρει μαλακόν εἶναι 
καὶ μυξώδες τὸ στερεὸν διὰ τὴν σάρκα τὴν περι- 
κειμένην, οἷον συμβέβηκε περὶ τε τὰ ἤτα καὶ 
τοὺς μυκτήρας· ὑπάρχει γὰρ τὰ κραδαρα ταχέως 
ἐν τοῖς ἀπέχουσιν. ἡ δὲ φύσις ἡ αὐτὴ χόνδρου 
καὶ ὅστοι ἔστι, διαφέρει δὲ τῷ μάλλον καὶ ἴττον· 
διὸ καὶ οὐδέτερον αὐξάνεται ἀποκοτὲν.

85 Ὁ μὲν οὖν ἐν τοῖς πεζοῖς ἀμύελοι χόνδροι κεκα- 
μιμένων μυελῷ· τὸ γὰρ χωρίζομενον εἰς ἄπαν 
μεμιμένον μαλακήν ποιεῖ καὶ μυξώδην τὴν τοῦ 
χόνδρου σύστασιν. ἐν δὲ τοῖς σελάχεσιν ἡ ῥάχις 
χονδρώδης μὲν ἕστιν, ἔχει δὲ μυελόν· ἀντὶ ὅστοι 
γὰρ αὐτοῖς ὑπάρχει τούτῳ τὸ μόριον. 

Σύνεγγυς δὲ κατὰ τὴν ἀφήν ἔστι τοῖς ὅστοις καὶ 
τὰ τοιάδε τῶν μορίων, οἷον ὄνυχες τε καὶ ὀπλαί καὶ 
χῆλαι καὶ κέρατα καὶ ρύγχη τὰ τῶν ὀρνίθων. πάντα 
δὲ τὰ ὁτα βοηθείας ἔχουσι χάριν [τὰ ζῷα]· τὰ γὰρ ἐξ 
αὐτῶν συνεστηκότα ὀλα καὶ συνώνυμα τοῖς μορίοις, 
οἷον ὀπλή τε ὀλη καὶ κέρας ὀλον, μεμικάνηται πρὸς 
τὴν σωτηρίαν ἐκάστοις. ἐν τούτῳ δὲ τῷ γένει καὶ

1 ζυμώδες Z. 
2 ζυμώδη ΕΠSZ. 
3 [τὰ ζῷα] secludit Rackham.

a Cf. the "law of organic equivalents."

b See note on 644 a 17.
PARTS OF ANIMALS, II. ix.

has to be somewhat supple, and accordingly the supporting framework of their bodies must be somewhat pliable, not brittle. In addition, Nature cannot allot the same plentiful supply of any one substance to many different parts of the body; and in the case of the Selachia she has used up all the available earthy substance in constructing their skin. In the Vivipara too there are many instances of cartilaginous bones: they are found where it is an advantage that the solid framework should be pliable and glutinous for the benefit of the flesh that surrounds them. This applies to the ears and the nostrils. Such projecting parts quickly get broken if they are brittle. Cartilage and bone are the same in kind and differ only by "the more and less"; so neither of them continues to grow when it has been cut out of the living organism.

The cartilages of land-animals contain no marrow—that is, no marrow existing as a separate thing. What in ordinary bones is separable is here mixed in with the body of the cartilage and gives it its pliable and glutinous character. In the Selachia, however, although the backbone is cartilaginous it contains marrow, because it stands to these creatures in place of a bone.

The following substances or "parts" resemble bones very closely as regards their feel: the various sorts of nail; hoof and talon; horn, and beak. All these substances are present for the sake of self-defence. This is shown by the fact that the complete structures which are made out of them and bear the same names—e.g. the complete hoof, or horn—have been contrived in each case by Nature for the creature's self-preservation. We must reckon the teeth in this
655 b

η τῶν ὀδόντων ἐστὶ φύσις, τοῖς μὲν ὑπάρχουσα
10 πρὸς ἐν ἔργον τὴν τῆς τροφῆς ἐργασίαν, τοῖς δὲ πρὸς τε τοῦτο καὶ πρὸς ἀλκήν, οἶνον τοῖς καρχαρ-όδουσι καὶ χαυλιόδουσι πάσιν. εξ ἀνάγκης δὲ πάντα ταύτα γεώδη καὶ στερεὰν ἔχει τὴν φύσιν ὀπλοῦ γὰρ αὐτῇ δύναμις. διὸ καὶ πάντα τὰ τοιαῦτα μᾶλλον ἐν τοῖς πετράποσιν ὑπάρχει ζῷοι τῶν
15 ζωοτόκων, διὰ τὸ γεωδεστέραν ἔχειν πάντα τὴν σύστασιν ἢ τὸ τῶν ἀνθρώπων γένος. ἀλλὰ καὶ περὶ τούτων καὶ τῶν ἐχομένων, οἶνον δέρματος καὶ κύστεως καὶ ὑμένος καὶ τριχῶν καὶ πτερῶν καὶ τῶν ἀνάλογων τούτων καὶ εἰ τι τοιοῦτον ἐστὶ μέρος, ὑστερον ἄμα τοῖς ἀνομοιομερέσι θεωρητέον τὴν
20 αἰτίαν αὐτῶν, καὶ τίνος ἐνεκεν ὑπάρχει τοῖς ζῷοις ἐκαστον· ἐκ τῶν ἔργων γὰρ γνωρίζειν, ὡσπερ κάκεινα, καὶ ταῦτα ἀναγκαῖον ἂν εἴη. ἀλλ' ὅτι συνώνυμα τοῖς ὅλοις τὰ μέρη, τὴν τάξιν ἀπελάβειν ἐν τοῖς ὁμοιομερέσι νῦν. εἰσι δὲ ἀρχαὶ πάντων τούτων τὸ τε ὅστοιν καὶ ἡ σάρξ. ἐτι δὲ περὶ γονῆς καὶ γάλακτος ἀπελίπομεν ἐν τῇ περὶ τῶν
25 υγρῶν καὶ ὁμοιομερῶν θεωρίας τοῖς γὰρ περὶ γενέσεως λόγοις ἀρμόττουσαν ἔχει τὴν σκέψιν· τὸ μὲν γὰρ αὐτῶν ἀρχὴ τὸ δὲ τροφή τῶν γινομένων ἐστίν.

X. Νῦν δὲ λέγωμεν οἶνον ἀπ' ἀρχῆς πάλιν, ἀρξά-μενοι πρῶτον ἀπὸ τῶν πρῶτων. πάσι γὰρ τοῖς

1 skúteos Buss. (skúteos EY).
class too. In some creatures teeth are present to discharge one function only—viz. mastication; in others they are a means of force as well (e.g. sawlike teeth and tusks). All these parts are of necessity earthy and solid in character; that is the proper sort of substance for a weapon. So there is a tendency for all parts of this sort to appear in the four-footed Vivipara more extensively than in man, because the former all have more earthy matter in their constitution. We shall, however, consider these substances, and the other kindred ones such as skin, bladder, membrane, hair, feather, and the counterparts of them, and all such parts, when we come to deal with the non-uniform parts. Then also we shall consider the Causes of them and for what purpose each of them is present in animal bodies; since it is true to say, of both sets of things, that our knowledge of them must be derived from a study of the functions which they discharge. The reason why we have just been taking them with the uniform substances and out of their proper order is that in them the name of the complete structure is the same as that of a portion of it, and also because the sources and principles of them all are bone and flesh. We also left out all mention of semen and milk when we were considering the fluid uniform substances. As semen is the source of the things that are generated and milk is the food that feeds them, the proper place to discuss these is in the treatise dealing with Generation.

X. We may now make what is practically a fresh beginning. We will begin first of all with the things that come first in importance.
These three parts of the "perfect" animals are again referred to at De juv. et sen. 468 a 13 ff. At De gen. an. 172
An animal can neither exist nor grow without food. Therefore in all living creatures of perfect formation there are two parts most necessary above all: one by which food is taken in and the other by which residues are eliminated. (Plants—which also we include under the head of living things—have, it is true, no place for the useless residue, but this is because their food, which they get out of the earth, is already concocted before it enters them, and instead of this residue they yield their fruit and seeds.) And in all creatures there is a third part intermediate between these indispensable two, and this is the seat of the source and principle of life. Plants, again, are so made as to remain in one place, and thus they do not exhibit a great variety of non-uniform substances; they have few actions to perform, and therefore but few organs are needed to perform them. For this reason we must consider plants and their formations separately. But with creatures that not only live but also have the power of sensation, the formations are more varied, and there is more diversity in some than in others, the greatest variety being found in those creatures which in addition to living have the capability of living the good life, as man has. Man is the only one of the animals known to us who has something of the divine in him, or if there are others, he has most. This is one reason why we ought to speak about man first, and another is that the shape of his external parts is better known than that of other animals. Another and obvious reason is that in man and in man alone do the natural parts appear in their natural situation: the

733 b 1 and 737 b 16, 26, the "perfect" animals are the viviparous ones. For the "most highly finished" animals see 666 a 28.
τούτου ἄνω πρὸς τὸ τοῦ ὀλού ἔχει ἄνω· μόνον γὰρ ὁρθὸν ἐστὶ τῶν ζῴων ἀνθρώπος.
Τὸ μὲν οὖν ἔχειν τὴν κεφαλὴν ἀσαρκον ἐκ τῶν 15 περὶ τὸν ἐγκέφαλον εἰρημένων ἀναγκαίοιν συμβέβηκεν. οὐ γὰρ ὁσπερ τινὲς λέγουσιν, ὅτι εἰ σαρκώδης ἦν, μακροβιώτερον ἄν ἦν τὸ γένος, ἀλλ' εὐαίσθησιας ἐνεκεν ἀσαρκὸν εἶναι φασιν' αἰσθάνεσθαι μὲν γὰρ τῷ ἐγκεφάλῳ, τὴν δ' αἰσθήσιν οὐ προσέχειν τὰ μόρια τὰ σαρκώδη λίαν. τούτων 20 δ' ουδέτερον ἐστὶν ἄλληθες, ἀλλὰ πολύσαρκος μὲν ὁ τόπος ὃν δ' περὶ τὸν ἐγκέφαλον τούναντίον ἄν ἀπειργάζετο οὐ ἕνεκα ὑπάρχει τοῖς ζῴωις ὁ ἐγκέφαλος (οὐ γὰρ ἃν ἐδύνατο καταψύχειν ἀλεαίνων αὐτὸς λίαν), τῶν τ' αἰσθήσεων οὐκ αἵτιος οὐδεμᾶς, ὃς γε ἀναίσθητος καὶ αὐτὸς ἐστὶν ὁσπερ ὁτιοῦν 25 τῶν περιττωμάτων. ἀλλ' οὗχ εὐρισκόντες διὰ τίνα αἵτιαν ἐναὶ τῶν αἰσθήσεων ἐν τῇ κεφαλῇ τοῖς ζῷοις εἰσὶ, τούτῳ δ' ὁρώντες ἱδιαίτερον ὃν τῶν ἄλλων μορίων, ἐκ συλλογισμοῦ πρὸς ἀλληλα συνδυάζουσιν. ὅτι μὲν οὖν ἀρχὴ τῶν αἰσθήσεων ἐστὶν ὁ περὶ τὴν καρδίαν τόπος, διάφοροι πρότερον ἐν τοῖς περὶ αἰσθήσεως, καὶ διότι αἱ μὲν δύο 80 φανερῶς ἡρτημέναι πρὸς τὴν καρδίαν εἰσίν, ἢ τε τῶν ἀπτῶν καὶ ἢ τῶν χυμῶν, τῶν δὲ τριῶν ἢ μὲν τῆς ὀσφρήσεως μέση, ἀκοῆ δὲ καὶ ὄψις μάλιστ' ἐν τῇ κεφαλῇ διὰ τὴν τῶν αἰσθητηρίων φύσιν εἰσί, καὶ

a See the identical phrase in De resp. 477 a 22.
b Cf. Plato, Timaeus 75 a-c.
upper part of man is placed towards the upper part of the universe. In other words, man is the only animal that stands upright.

In man, the head is lacking in flesh, and this follows of necessity from what we have said about the brain. Some say (erroneously) that if the head abounded with flesh mankind's lifespan would be longer than it is, and they explain the absence of flesh as on purpose to facilitate sensation, their view being that the brain is the organ of sensation, and that sensation cannot penetrate parts that are too fleshy. Neither of these assertions is true. The truth is that if the part surrounding the brain were fleshy, the effect of the brain would be the very reverse of that for which it is intended: it would be unable to cool the rest of the body because it would be too hot itself. And, of course, the brain is not responsible for any of the sensations at all; it has no more power of sensation than any of the residues. People adopt these erroneous views because they are unable to discover the reason why some of the senses are placed in the head; but they see that the head is a somewhat unusual part, compared with the rest, so they put two and two together and argue that the brain is the seat of sensation. The correct view, that the seat and source of sensation is the region of the heart, has already been set forth in the treatise Of Sensation, where also I show why it is that two of the senses, touch and taste, are evidently connected to the heart; of the remaining three, smell is placed between the other two, hearing and sight, and these are practically always located in the head; this is owing to the nature of the organs through which

*De sensu, 438 b 25 ff.*
τούτων ἡ ὀψις πᾶσιν ἔπει ἢ γ’ ἀκοὴ καὶ ἡ ὁσφρησις
ἐπὶ τῶν ἱχθυῶν καὶ τῶν τοιούτων ποιεῖ τὸ λεγόμενον φανερὸν ἀκούοντι μὲν γὰρ καὶ ὁσφραίονται, αἰσθητήριον δ’ οὐδὲν ἔχουσι φανερὸν ἐν τῇ κεφαλῇ τούτων τῶν αἰσθητῶν. 1 ἡ δ’ ὀψις πᾶσι τοῖς ἔχουσιν

656 b εὐλόγως ἔστι περὶ τῶν ἐγκεφαλῶν ὅ μὲν γὰρ ὑγρὸς καὶ ψυχρὸς, ἡ δ’ ὑδώρ τὴν φύσιν ἔστιν τοῦτο γὰρ τῶν διαφανῶν εὐφυλακτότατον ἔστιν. ἔτι δὲ τὰς ἀκριβεστέρας τῶν αἰσθήσεων διὰ τῶν καθαρότερον ἐχόντων τὸ αἷμα μορίων ἀναγκαῖον ἀκριβεστέρας γίνεσθαι ἡκκόπτει γὰρ ἡ τῆς ἐν τῷ αἴματι θερμότητος κίνησις τὴν αἰσθητικὴν ἐνέργειαν διὰ ταῦτα τὰς αἰτίας ἐν τῇ κεφαλῇ τούτων τὰ αἰσθητήρια ἐστιν.

Οὐ μόνον δ’ ἔστι τὸ ἐμπροσθεν ἄσαρκον, ἀλλὰ τὸ ὄπισθεν τῆς κεφαλῆς, διὰ τὸ πάσι τοῖς ἔχουσιν αὐτῆς ὀρθότατον δεῖν εἶναι τοῦτο τὸ μόριον οὐδὲν γὰρ ὀρθούσθαι δύναται φορτίον ἔχον, ἢν δ’ ἂν τοιοῦτον, εἰ σεσαρκωμένην εἰχὲ τὴν κεφαλὴν. 2 ἢ καὶ δῆλον ὅτι οὐ τῆς τοῦ ἐγκεφάλου αἰσθήσεως χάριν ἄσαρκος ἡ κεφαλὴ ἐστὶν τὸ γὰρ ὄπισθεν οὐκ ἔχει ἐγκεφαλῶν ἄσαρκον δ’ ὀμοίως.

"Εχει δὲ καὶ τῆς ἁκοῆς εὐλόγως ἐνια τῶν ζῷων ἐν τῷ τόπῳ τῷ περὶ τῆς κεφαλῆς τὸ γὰρ κενὸν καλοῦμενον ἄερος πληρὲς ἐστὶ, τὸ δὲ τῆς ἁκοῆς αἰσθητήριον ἄερος εἶναι φαμεν.

1 (ἐπεὶ ... αἰσθητῶν) Cook Wilson, qui et (οὗ) post λεγόμενον, l. 35.

176
they operate. Sight is always located there. The case of hearing and smell in fishes and the like shows that the opinion I maintain is patently correct. These creatures hear and smell, although they have no obvious and visible organs for these senses in the head. As for sight, it is reasonable enough that when present it should always be located near the brain, for the brain is fluid and cold, and the sense-organ of sight is identical in its nature with water, which of all transparent substances is the easiest to keep confined. Again, those senses which are intended for more precise work than the others must necessarily receive greater precision by being situated in parts where the blood is specially pure, since the movement of the heat in the blood ousts the activity appropriate to sensation. These are the reasons why the organs of these senses are placed in the head.

Now the back of the head is free from fleshiness as well as the front. This is because the head is the part which all animals that possess one have to hold as upright as possible. Nothing that carries a burden can raise itself upright, and the head would be burdened if it were well covered with flesh. And this is another reason to show that the lack of flesh on the head is not for the purpose of enabling the brain to function in sensation. There is no brain in the back of the head, although the back has no more flesh on it than the front.

Some animals have their organ of hearing as well as of sight located in the region of the head. This is well explained on our view, which is that the organ of hearing is of air. The space in the head called the vacuum is full of air.
ARISTOTLE

656 b

Εκ μὲν οὖν τῶν ὀφθαλμῶν οἱ πόροι φέρουσιν εἰς τὰς περὶ τὸν ἐγκέφαλον φλέβας. πάλιν δὲ ἐκ τῶν ὦτων ὑσαύτως πόρος εἰς τούπωσθεν συνάπτει.

["Εστὶ δ' οὖτ' ἀναίμον οὐδὲν αἰσθητικὸν οὔτε τὸ αἷμα, ἀλλὰ τῶν ἑκ τούτου τι. διόπερ οὐδὲν ἐν τοῖς ἐναίμοις ἀναίμον αἰσθητικὸν, οὐδ' αὐτὸ τὸ αἷμα. οὐδὲν γὰρ τῶν χών μόριον.]

"Ἐχει δ' εν τῷ ἐμπροσθεν τὸν ἐγκέφαλον πάντα τὰ ἔχοντα τοῦτο τὸ μόριον, διὰ τὸ ἐμπροσθεν εἶναι ἐφ' δ' αἰσθάνεται, τὴν δ' αἴσθησιν ἀπὸ τῆς καρδίας, ταύτην δ' εἶναι εν τοῖς ἐμπροσθεν, καὶ τὸ αἰσθάνεσθαι διὰ τῶν ἐναίμων γίνεσθαι μορίων, φλεβῶν δ' εἶναι κενὸν τὸ ὁπίσθεν κύτος. τέτακται δὲ τὸν τρόπον τούτου τὰ αἰσθητήρια τῇ φύσει καλῶς, τὰ μὲν τῆς ἀκοῆς ἐπὶ μέσης τῆς περιφερείας (ἀκούει γὰρ οὐ μόνον κατ' εὐθυωρίαν ἀλλὰ πάντοθεν), ἡ δ' οἴμη εἰς τὸ ἐμπροσθεν (ὄρα γὰρ κατ' εὐθυωρίαν, ἡ δὲ κίνησις εἰς τὸ ἐμπροσθεν, προσερνὲ δὲ δεῖ ἐφ' ὅ ἡ κίνησις). ἡ δὲ τῆς ὀσφρῆσεως μεταξὺ τῶν ὁμμάτων εὐλόγως. διπλοῦν μὲν γάρ ἐστὶν ἐκαστὸν τῶν αἰσθητήριων διὰ τὸ διπλοῦν εἶναι τὸ σῶμα, τὸ μὲν δεξιόν τὸ δ' ἀριστερόν. ἐπὶ μὲν οὖν τῆς ἀφῆς τοῦτ' ἄδηλον. τούτοι δ' αἴτιον ὥστε ὑπὲρ τοῦ πρῶτον αἰσθητήριον ἡ σάρξ καὶ τὸ τοιοῦτον μόριον, ἀλλ' ἐντόσ. ἐπὶ δὲ τῆς γλώττης ἦττον μὲν, μάλλον δ' ἡ ἐπὶ τῆς ἀφῆς ἐστὶ γὰρ οὐν

1 οὐδ' αὐτὸ τὸ αἷμα om. E.
2 ll. 19-22 seclusi (20-22 Ogle) : partim ex 666 a 16 translata.

* This passage seems to be a note on a remark which comes a few lines below, and should probably be omitted from the text. Part of it is taken from 666 a 16.

178
Passages (or channels) run from the eyes to the blood-vessels that are round the brain. And, again, a passage runs from the ears and connects to the back of the brain.

[No bloodless part is capable of sensation, nor indeed is the blood itself. It is the parts which are made out of blood that have this faculty. Hence, in the blooded animals, no bloodless part is capable of sensation, nor indeed is the blood itself, for it is no part of animals.]

The brain, whenever there is one, is in the forepart of the head. This is (a) because all acts of sensation take place in a forward direction; (b) because the heart, from which sensation has its origin, is in the forepart of the body; and (c) because the process of sensation depends upon parts that have blood in them, whereas the sac at the back of the head contains no blood-vessels at all. In fact, Nature has located the sense-organs in a very satisfactory manner. The ears are half-way round the circumference of the head, because they are to hear sounds from all directions alike and not only from straight before them. The eyes face front: this is because sight is along one straight line, and we must be able to see along the line in which we are moving, which is directly forward. The nostrils are between the eyes, and this is quite reasonable. Each of the sense-organs is double, because the body itself is double: it has a right side and a left side. It must be admitted that this duality is not at all clear in the case of touch: this is because the primary sense-organ of touch is not the flesh or a corresponding part, but something internal. With the tongue the duality is not very clear, but more so than with touch.
Aristotle seems to refer here to the forked tongues of certain animals. See 660 b 7 ff.
(Taste, in fact, is itself, as it were, a sort of touch.) The duality is plain, however, even with this sense, for it is seen to be divided. With the other senses, the organ is more evidently parted into two: there are two ears and two eyes, and two passages for the nostrils in the nose. The sense of smell, if it had been otherwise placed—separated into two, that is, like the sense of hearing—would not have been able to perform its proper function; nor would that part of the body in which it is situated, since in animals which have nostrils, the sensation of smell is effected by means of inspiration, and this part is at the front and in the middle. This is why Nature has brought the nostrils together in a straight line and made them the central of the three sense-organs in the head, located where the motion of in-breathing takes place.

In the other animals as well as in man these sense-organs are very satisfactorily arranged as required by the peculiar nature of each animal. XI. For instance, the quadrupeds have ears that stand out free from the head, and they are higher than the eyes—or appear to be, although this is not really so: it is an illusion due to the fact that these animals are not upright but stand on all fours. And as they are usually in this posture when in motion, it is useful for them to have their ears well up in the air, and also movable: this enables them to be turned round and pick up sounds better from all directions.

XII. Birds have the auditory passages only, owing to the hardness of their skin, and because they have feathers instead of hair, which means that they have not got the right material for forming ears. The same argument applies to those oviparous
τετραπόδων τὰ ψωτόκα καὶ φολιδωτὰ· δὲ γὰρ αὐτὸς ἀρμόσει καὶ ἐπὶ ἐκείνων λόγος. ἔχει δὲ καὶ ἡ φώκη τῶν ψωτόκων οὐκ ὤτα ἄλλα πόρους ἄκοιδα, διὰ τὸ πεπηρωμένον εἶναι τετράπον.

25 XIII. Καὶ οἱ μὲν ἄνθρωποι καὶ οἱ ὁρνιθεῖς καὶ τὰ ψωτόκα καὶ τὰ ψωτόκα τῶν τετραπόδων φυλακῆς ἔχουσι τῆς ὀψεως, τὰ μὲν ψωτόκα βλέφαρα δύο, οἷς καὶ σκαρδαμύττουσι, τῶν δὲ ὁρνιθῶν ἄλλοι τε καὶ οἱ βαρεὶς καὶ τὰ ψωτόκα τῶν τετραπόδων τῇ κάτω βλεφάριδι μύουσι· σκαρδαμύττουσι δ’ οἱ ὁρνιθεῖς ἐκ τῶν κανθῶν ὑμένι. τοῦ μὲν οὖν φυλακῆς ἔχειν αὐτοῖς τὸ υγρὰ τὰ ὄμματα εἰναι ἵνα οὖν βλέψωσι [τοῦτον τὸν τρόπον ὑπὸ τῆς φύσεως]. σκληρόδερμα γὰρ οὖν ἄβλαβεστερα μὲν ἂν ἣν ὑπὸ τῶν ἐξωθέν προσπιπτόντων, οὐκ ὥσσυπτα δὲ· τοῦτον μὲν οὖν ἐνεκα λεπτὸν τὸ δέρμα τὸ περὶ τὴν κόρην ἐστὶ, τῆς δὲ σωτηρίας χάριν τὰ βλέφαρα· καὶ διὰ τοῦτο σκαρδαμύττει τε πάντα καὶ μάλιστ’ ἄνθρωπος, πάντα μὲν ὅπως τὰ προσπιπτόντα τοῖς βλεφάροις κωλύσωι (καὶ τοῦτο οὖκ ἐκ προαιρέσεως, ἀλλ’ ἡ φύσις ἐποίησε), πλειστάκις δ’ ὁ ἄνθρωπος διὰ τὸ λεπτοδερμότατος εἶναι.

657 b Ἡ δὲ βλεφαρίς ἐστὶ δέρματι περειλημμένη· διὸ καὶ οὐ συμφύεται οὔτε βλεφαρίς οὔτ’ ἄκροποσθία, ὅτι ἄνεν σαρκὸς δέρματα ἐστίν.

5 Τῶν δὲ ὁρνιθῶν οὐσι τῇ κάτω βλεφάριδι μύουσι, καὶ τὰ ψωτόκα τῶν τετραπόδων, διὰ τὴν σκληρόσ-

1 om. Ζ1.  
2 toûτου μὲν οὖν] toû μὲν οὖν εὖ EPZ.

a Or, “imperfectly developed.” Cf. Bk. III. ch. viii.

182
quadrupeds which have horny scales. One viviparous animal, the Seal, has no ears but only auditory passages; but this is because, though a quadruped, it is deformed.a

XIII. Man, the Birds, and the Quadrupeds (both viviparous and oviparous) have a protective covering for their eyes. The viviparous quadrupeds have two eyelids to each eye (which also enable them to blink); some of the birds, especially the heavily built ones, and the oviparous quadrupeds, when they close their eyes, do so with the lower eyelid; birds, however, can blink, with the aid of a membrane that comes out of the corner of the eye. The reason for the existence of these protective coverings is that the eye is fluid in order to ensure keenness of vision. If the eye had been constructed with a hard skin it would of course have been less liable to injury by impact from without, but its vision would have been duller. For this cause the skin round the pupil is left thin and fine, and the safety of the eye is ensured by the addition of the eyelids. The movement of the eyelids known as blinking is a natural and instinctive one, not dependent on the will, and its object is to prevent things from getting into the eyes. All animals that have eyelids do it, but human beings blink most of all, because they have the thinnest and finest skin.

Now the eyelid is encased with skin; and that is why, like the tip of the foreskin, it will not unite again once it has been cut, because both of them are skin and contain no flesh.

We said just now that some birds and the oviparous quadrupeds close the eye with the lower
657 b
tητα τοῦ δέρματος τοῦ περὶ τῆν κεφαλὴν οὕτω μύονσιν. οἱ μὲν γὰρ βαρεῖς τῶν πτερωτῶν διὰ τὸ μὴ πτητικὸι εἶναι τὴν τῶν πτερῶν αὔξησιν εἰς τὴν τοῦ δέρματος παχύτητα τετραμμένην ἔχουσιν. διὸ καὶ οὕτωι μὲν τῷ κάτω βλεφάρῳ μύονσι, περιστεραὶ δὲ καὶ τὰ τοιαῦτα ἀμφοῖν. τὰ δὲ τετράποδα τῶν ψωτόκων φολιώτα ἐστὶν· ταῦτα δὲ σκληρότερα πάντα τριχῶς, ὡστε καὶ τὰ δέρματα τοῦ δέρματος· τὸ μὲν οὖν περὶ τῆν κεφαλὴν σκληρῶν ἐστὶν αὐτοῖς, διόπερ οὐκ ἔχει βλέφαρον ἐκεῖθεν, τὸ δὲ κάτωθεν σαρκώδες, ὡστ' ἔχειν τὸ βλέφαρον λεπτότητα καὶ τάσιν.

Σκαρδαμύττουσι δ' οἱ βαρεῖς ὀρνιθεῖς τοῦτοι μὲν οὐ, τῶ δ' ύμένι, διὰ τὸ βραδεῖαν εἶναι τὴν τοῦτον κίνησιν, δεῖν δὲ ταχεῖαν γίνεσθαι, δ' ύμην τοιοῦτον. ἐκ δὲ τοῦ κανθοῦ τοῦ παρὰ τοὺς μυκτήρας σκαρδαμύττουσι, ὡς ἐξείτω τὰ προς τὴν πρὸς τὸν μυκτήρα πρόσφυσιν καὶ τὸ πρόσθιον ἀρχὴ τοῦ πλαγίου μᾶλλον.

Τὰ δὲ τετράποδα καὶ ψωτόκα οὐ σκαρδαμύττει ὁμοίως, ὅτι οὐδ' ύγρὰν αὐτοῖς ἀναγκαῖον ἔχειν καὶ ἀκριβῆ τὴν ὤψιν ἐπιγείοις οὕσιν· τοῖς δ' ὀρνισιν ἀναγκαῖον, πόρρωθεν γὰρ ἡ χρήσις τῆς ὤψεως. διὸ καὶ τὰ γαμφώνυχα μὲν ὀξυωτά (ἀνωθεν γὰρ αὐτοῖς ἡ θεωρία τῆς τροφῆς, διὸ καὶ ἀναπέτωτα ταῦτα μάλιστα τῶν ὀρνέων εἰς ὕψος), τὰ δ' ἐπίγεια καὶ μὴ πτητικά, οἷον ἀλεκτρυόνες καὶ τὰ τοιαῦτα,
eyelid only. This is due to the hardness of the skin which surrounds the head. (a) The heavily built birds are not great fliers, and so the material which would have supplied growth for the wings has been diverted, resulting in thickness of the skin. These creatures, then, use only the bottom eyelid to cover the eye; whereas pigeons and such use both eyelids. (b) With regard to the oviparous quadrupeds: As the horny scales with which they are covered are in every case harder than hair, so their skin also is harder than ordinary skin. And as the skin on their heads is hard, they can have no upper eyelid; but lower down the skin has some flesh with it, and so they have a lower eyelid that is thin and extensible.

Now the heavily built birds blink not with this lower eyelid, because its motion is slow, but with the membrane above mentioned, whose motion is swift, as is requisite. This blinking or nictitating begins at the corner of the eye nearest the nostrils, because it is better that the membranes should have one place of origin rather than two, and in these birds this is where the eye and nostril are conjoined; also, the front is more a place of origin than the side.

The oviparous quadrupeds do not blink in this way, because, unlike birds, which have to use their eyes over great distances, they go upon the ground, and therefore there is no need for them to have fluid eyes or great accuracy of sight. The crooktaloned birds are sharp-sighted, for they view their prey from above, and that also explains why they fly to a greater height than other birds. The birds that remain on the ground, however, and do not fly much (e.g. barn-door fowls and the like) are
οὐκ ὀξυωπά· οὐδὲν γὰρ αὐτὰ κατεπείγει πρὸς τὸν βίον.

30 Οἱ δ' ἱσθύες καὶ τὰ ἔντομα καὶ τὰ σκληρόδερμα διαφέροντα μὲν ἔχουσι τὰ ὀξύματα, βλέφαρον δ' οὐδὲν αὐτῶν ἔχει. τὰ μὲν γὰρ σκληρόδερμα ὅλως οὐκ ἔχει· ἢ δὲ τοῦ βλεφάρου χρῆσις ταχεῖαν τὴν δερματικὴν ἔχει ἐργασίαν· ἀλλ' ἀντὶ ταύτης τῆς φυλακῆς πάντα σκληρόφθαλμα ἐστιν, οἰον βλέποντα διὰ τοῦ βλεφάρου προσπεφυκότος. ἐπεὶ δ' ἀναγκαίον διὰ τὴν σκληρότητα ἀμβλύτερων βλέψεων, κινουμένους ἐποίησεν ἡ φύσις τοὺς ὀφθαλμοὺς τοὺς ἐντόμους, καὶ μᾶλλον ἐτὶ τοῖς σκληροδέρμοις, ὥσπερ ἐνα τῶν τετραπόδων τὰ ὡτα, ὅπως ὀξύτερον βλέπη στρέφοντα πρὸς τὸ φῶς καὶ δεχόμενα τὴν αὐγήν. οἱ δ' ἱσθύες ύγρόφθαλμοι μὲν εἰσιν· ἀναγκαία γὰρ τοῖς πολλὴν ποιομένους κύνησιν ἡ τῆς ὀξεις ἐκ πολλοῦ χρῆσις. τοῖς μὲν οὖν πεζοῖς ὁ ἄμετρος ἐνδιοπτός· ἐκεῖνοι δ' ἔπει τὸ ὑδωρ πρὸς μὲν τὸ ἐξάυ βλέπειν ἐναντίον, οὐκ ἔχει δὲ πολλά τὰ προσκρούσματα πρὸς τὴν ὀξιν ὡσπερ ὁ ἄμετρος ἀρχηγός ὑπὸ τοῦτο οὐκ ἔχει βλέφαρον (οὐδὲν γὰρ ἡ φύσις ποιεῖ μάτην), πρὸς δὲ τὴν παχύτητα τοῦ ὑδατος ὑγρόφθαλμοί εἰσιν.

XIV. Βλεφαρίδας δ' ἐπὶ τῶν βλεφάρων ἔχουσιν ὁσα τρίχας ἔχουσιν, ὀρνιθες δὲ καὶ τῶν φολιδωτῶν οὐδέν· οὐ γὰρ ἔχουσι τρίχας. περὶ γὰρ τοῦ στρούθου τοῦ Λιβυκοῦ τὴν αἰτίαν ὑστερον ἐρούμεν· τούτο

1 τὴν Ogle: καὶ vulg.: τὴν ante ἐργασίαν vulg., om. SU.

186
not sharp-sighted, since there is no urgent necessity for it in their kind of life.

Many differences in the eye itself are found among the Fishes, the Insects and the hard-skinned Crustacea, though not one of them has eyelids. In the hard-skinned Crustacea there cannot be an eyelid at all, for the action of an eyelid depends upon swift working of the skin. To compensate for the lack of this protection, all these creatures have hard eyes: it is as though the eyelid were all of a piece with the eyeball, and the creature looked through the lid as well. But since the vision is bound to be dimmed by this hardness of the eye, Nature has given the Insects (and even more noticeably the Crustacea) movable eyes, just as she has given some quadrupeds movable ears; this is to enable them to turn towards the light and catch its rays and so to quicken their vision. Fish have fluid eyes for the following reason. They move about a good deal and have to use their sight over long distances. Now when land-animals do this, they are looking through air, which is highly transparent; but fish move about in water, which is inimical to sharpness of vision; so to counteract its opacity their eyes are fluid in composition. At the same time, water contains far fewer objects to strike against the eyes than the air does; hence fish need no eyelids, and because Nature never makes anything without a purpose, they have none.

XIV. Those animals that have hair on their body have eyelashes on their eyelids: the others (birds and the creatures with horny scales) have none. There is one exception to this rule: the Libyan ostrich, which has eyelashes. The cause of this
658 a

15 γὰρ ἔχει βλεφαρίδας τὸ ζῷον. καὶ τῶν ἐχόντων τρίχας ἐπὶ ἀμφότερα οἱ ἄνθρωποι μόνον ἐχουσιν. τὰ γὰρ τετράποδα τῶν ζῴων ἐν τοῖς υπτίοις οὐκ ἔχει τρίχας, ἀλλὰ ἐν τοῖς πρανέσι μᾶλλον. οἱ δὲ ἄνθρωποι τουναντίον ἐν τοῖς υπτίοις μᾶλλον ἢ ἐν τοῖς πρανέσιν. σκέψης γὰρ χάριν αἱ τρίχες υπ- ἄρχουσι τοῖς ἐχουσιν. τοῖς μὲν οὖν τετράποσι τὰ 20 πρανή δεῖται μᾶλλον τῆς σκέψης, τὰ δὲ πρόσθια τιμιώτερα μὲν, ἀλλὰ λείαξε διὰ τὴν κάμψιν. τοῖς δὲ ἄνθρωποις ἐπεὶ ἔξ ίσον διὰ τὴν ὀρθότητα τὰ πρόσθια τοῖς ὀπισθίοις, τοῖς τιμιωτέροις ὑπέγραψεν ἡ φύσις τὴν βοήθειαν. αἰε γὰρ ἐκ τῶν ἐνδεχομένων αἰτία τοῦ βελτίωνός ἐστιν. καὶ διὰ τοῦτο 25 τῶν τετραπόδων οὐθὲν οὔτε βλεφαρίδα ἔχει τὴν κάτωθεν, ἀλλ᾽ ὑπὸ τοῦτο τὸ βλέφαρον ἐνίοις παρα- φύνεται μαναὶ τρίχες, οὔτε ἐν ταῖς μασχάλαις οὐτ᾽ ἐπὶ τῆς ἡβής, ὥσπερ τοῖς ἄνθρώποις. ἀλλ᾽ ἀντὶ τούτων τὰ μὲν καθ᾽ ὅλον τὸ σῶμα πρανέσ1 δεδά- συντα ταῖς θριξίν, οἴον τὸ τῶν κυνῶν γένος, τὰ δὲ 30 λοφιαν ἔχει, καθάπερ ἅπποι καὶ τὰ τουαῦτα τῶν ζῴων, τὰ δὲ χαίτην, ὥσπερ ὁ ἅρρην λέων. ἐτι δὲ ὅσα κέρκους ἔχει μῆκος ἐχουσάς, καὶ ταύτας ἐπι- κεκόσμηκεν ἡ φύσις θριξί, τοῖς μὲν μικρὸν ἐχουσι τοῦ στόλου μακραῖς, ὥσπερ τοῖς ἅπποις, τοῖς δὲ 35 μικρὸν βραχείας, καὶ κατὰ τὴν τοῦ ἄλλου σώματος φύσιν. πανταχοῦ γάρ ἀποδίδωσι λαβοῦσα ἐτέρωθεν πρὸς ἄλλο μόριον. ὅσοι δὲ τὸ σῶμα δασὺ λίαν πεποίηκε, τούτοις ἐνδεός ἔχει τὰ περὶ τὴν κέρκον, οἴον ἐπὶ τῶν ἄρκτων συμβέβηκεν.

658 b

1 πρανὲς delet Platt.
PARTS OF ANIMALS, II. xiv.

will be explained later. Man is the only animal which has eyelashes on both lids. Why is this? The quadrupeds tend to have more hair on their backs than on the underside of the body; but in man the reverse is true. The purpose of hair is to give protection; and as the quadrupeds go on all fours, they need more protection on their backs; so they have no hair on their front, although the front is the nobler of the two sides. Man goes upright, and so there is nothing to choose as regards his need of protection between front and back. Therefore Nature has prescribed the protection for the nobler side, the front—an example of how, out of given conditions, she is always the cause of that which is the better. This, then, is why none of the quadrupeds has lower eyelashes (though some have a few scattered hairs growing on the lower eyelid), or hair in the axillae or on the pubes, as man has. Instead of this, some of them have thick hair all over the back part of their body (e.g. dogs), some of them have a mane (e.g. horses and such), others a flowing mane, like the male lion. Again, if an animal has a tail of any length, Nature decks that with hair too; long hair for tails with a short stem (e.g. horses), short hair for tails with a long stem. This, however, is not independent of the general condition of the whole animal, for Nature gives something to one part of the body only after she has taken it from another part. So when she has made an animal’s body extremely hairy, we find that there is not much hair about the tail. An example of this is the Bears.

a See 697 b 13 ff.
b Platt deletes “the back part of.”
Τὴν δὲ κεφαλὴν ἀνθρωπός ἐστὶ τῶν ζωῶν δασύ-
τατον, εὖ ἀνάγκης μὲν διὰ τὴν υγρότητα τοῦ
ἐγκεφάλου καὶ διὰ τὰς ραφὰς (ὅπου γὰρ υγρὸν καὶ
5 θερμὸν πλείστον, ἐνταῦθ' ἀναγκαῖον πλείστην εἶναι
τὴν ἐκφυσιν), ἐνεκέν δὲ βοηθείας, ὅπως σκεπάζωσι
φυλάσσονται τὰς ὑπερβολὰς τοῦ τε ψυχοῦ καὶ τῆς
ἀλέας. πλείστος δὲ ὁ νῦν καὶ υγρότατος δὲ τῶν
ἀνθρώπων ἐγκεφαλος πλείστης καὶ τῆς φυλακῆς
δείται. τὸ γὰρ υγρότατον καὶ ξεῖ καὶ ψύχεται
10 μάλιστα, τὸ δ' ἐναντίως ἔχον ἀπαθέστερον ἐστὶν.
'Αλλὰ περὶ μὲν τούτων παρεκβῆναι συμβέβηκεν
ἔχομενοι τῆς περὶ τὰς βλεφαρίδας αἴτιας, διὰ τὴν
συγγένειαν αὐτῶν, ὡστε περὶ τῶν λοιπῶν ἐν τοῖς
οἰκείοις καιροῖς ἀποδοτέων τὴν μνείαν.

XV. Αἱ δ' ὀφφυες καὶ αἱ βλεφαρίδες ἀμφότεραι
15 βοηθείας χάριν εἰσίν, αἱ μὲν ὀφφυες τῶν κατα-
βαινόντων υγρῶν, ὅπως ἀποστέγωσιν οἷον ἀπογεί-
σωμα τῶν ἀπὸ τῆς κεφαλῆς υγρῶν, αἱ δὲ βλεφαρίδες
τῶν πρὸς τὰ ὄμματα προσπιττόντων ἐνεκέν, οἷον
τὰ χαρακώματα ποιοῦσι τινες πρὸ τῶν ἐργμάτων.1
εἰσὶ δ' αἱ μὲν ὀφφυες ἐπὶ συνθέσει ὀστῶν, διὸ καὶ
20 δασύνονται πολλοίς ἀπογχῆσκουσιν οὕτως ὡστε
deίσαι κουρᾶς. αἱ δὲ βλεφαρίδες ἐπὶ πέρατι
φλεβίων, ἡ γὰρ τὸ δέρμα περαίνει, καὶ τὰ φλέβια

1 ἐργμάτων scripsi: ἐργμάτων Bekker: ἐρμμάτων editores.

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a This is one of the passages fastened upon by Bacon in his tirade against the importation of final causes into physics, *Adv. of Learning* (publ. 1605), ii. pp. 29, 30: "This I finde done not onely by Plato, who euer ancreth vppon that shoare, but by Aristotle, Galen, and others, who do vsually likewise fall vppon these flatts of discoursing causes; For to say that the haires of the Eye-liddes are for a quic-sette and fence about
Man has the hairiest head of all the animals. This is (a) due to 

\textit{necessity}, because the brain is fluid, and the skull has many sutures; and a large outgrowth necessarily occurs where there is a large amount of fluid and hot substance. But also (b) it is \textit{on purpose} to give protection; that is, the hair affords shelter both from excessive cold and from excessive heat. The human brain is the biggest and the most fluid of all brains; therefore it needs the greatest amount of protection. A very fluid thing is very liable both to violent heating and violent cooling, while substances of an opposite nature are less liable to such affections.

This, however, is a digression. We were led into it because the subject was connected with our investigation of the cause of eyelashes. Anything further that there is to be said about it will be said in its proper place.

XV. Both eyebrows and eyelashes exist to afford protection to the eyes: the eyebrows, like the eaves of a house, are to protect the eyes from the fluids that run down from the head; the eyelashes are like the palisades which are sometimes put up in front of an enclosure; their purpose is to keep out things that try to get in.\footnote{a} However, the eyebrows are placed where two bones join (which is why they often get so thick in old age that they have to be cut); and the eyelashes are placed at the ends of small blood-vessels, which have to stop where the skin itself comes to

\textit{the Sight} . . . and the like, is well inquired & collected in \textit{Metaphisicke}, but in \textit{Phisicke} they are impertinent." But there is no incompatibility, p. 33, "For the cause rendred that the haires about the Eye-liddes are for the safeguard of the sight, doth not impugne the cause rendred, that Pilositie is incident to Orifices of Moisture." See also Xen. Mem. i. 4. 6.
péras ἔχει τοῦ μῆκους· ὅστ' ἀναγκαῖον διὰ τὴν ἀποικύσαν ἰκμάδα σωματικήν οὕσαν, ἂν μὴ τῆς φύσεως ἐργον ἐμποδίσῃ πρὸς ἅλλην χρήσιν, καὶ 25 διὰ τὴν τοιαύτην αἰτίαν εἷς ἀνάγκης ἐν τοῖς τόποις τοῦτοις γίνεσθαι τρίχας.

XVI. Τοῖς μὲν οὖν ἄλλοις ζῴοις τοῖς τετράποσι καὶ ζωοτόκοις οὐ πόρρω τρόπον τινὰ διέστηκεν ἄλληλων τὸ τῆς ὁσφρήσεως αἰσθητήριον, ἀλλ' ὁσα 30 μὲν ἔχει προμήκεις εἰς στενὸν ἀπηγμένας τὰς σιαγόνας, ἐν τῷ καλομεμένῳ ρύγχει καὶ τὸ τῶν μυκτήρων ἐνυπάρχει μόριον κατὰ τὸν ἐνδεχόμενον τρόπον, τοῖς δ' ἄλλοις μᾶλλον διηρθωμένον ἐστὶ πρὸς τὰς σιαγόνας. ὃς δ' ἐλέφας ἰδιαίτερον ἔχει τούτο τὸ μόριον τῶν ἄλλων ζῴων· τὸ τε γὰρ 35 μέγεθος καὶ τὴν δύναμιν ἔχει περιττήν. μυκτήρ γάρ ἐστιν ὃ τὴν τροφήν προσάγεται, καθάπερ χειρὶ χρώμενος, πρὸς τὸ στόμα, τὴν τε ἔχηραν καὶ τὴν ύγρὰν, καὶ τὰ δένδρα περιελεύθουν ἄνασσα, καὶ χρῆται καθάπερ ἂν εἰ χειρὶ. τὴν γὰρ φύσιν ἔλωδε ἀμα τὸ ἥων ἐστὶ καὶ πεζόν, ὅστ' ἐπεὶ τὴν τροφὴν ἐξ ὑγροῦ συνεβαινεν ἔχειν, ἀναπνεύει δ' ἀναγκαῖον 659 a πεζόν ὃν καὶ ἐναίμων, καὶ μὴ ταχεῖαν ποιεῖσθαι τὴν μεταβολὴν ἐκ τοῦ υγροῦ πρὸς τὸ ἔχηρον, καθάπερ ἐνα τῶν ζωοτόκων καὶ ἐναίμων καὶ ἀναπνεύστως, τὸ γὰρ μέγεθος οὐ υπερβάλλον, ἀναγκαῖον ὁμοίως ἢν χρῆσθαι τῷ υγρῷ ὦσπερ καὶ τῇ γῇ. οἷον οὖν τοῖς κολυμβηταῖς ἐνοι πρὸς τὴν ἀναπνοῇν ὀργανα 10 πορίζονται, ἢν πολὺν χρόνον ἐν τῇ θαλάσσῃ μένοντες ἐλκωσιν ἐξωθεῖν τοῦ υγροῦ διὰ τοῦ ὄργανον τὸν ἀέρα, τοιοῦτον ἢ φύσις τὸ τοῦ μυκτήρου μέγεθος ἐποίησε τοῖς ἐλέφασιν. διὸσ περ ἀναπνεύσουσιν

* Or “strength.”
an end. Thus, owing to the fact that the moisture which comes off is corporeal in composition, hair must be formed at these places even on account of a necessary cause such as this, unless some function of Nature impedes by diverting the moisture to another use.

XVI. The general run of viviparous quadrupeds differ very little among themselves as regards the organ of smell. The following variations occur, however. Those animals whose jaws project forward and become gradually narrower, forming what is called a snout, have the organ of smell in their snout—this being the only possibility; in the others, the jaws and nostrils are more definitely separated. The elephant's nose is unique owing to its enormous size and its extraordinary character. By means of his nose, as if it were a hand, the elephant conveys his food, both solid and fluid, to his mouth; by means of it he tears up trees, by winding it round them. In fact, he uses it for all purposes as if it were a hand. This is because the elephant has a double character: he is a land-animal, but he also lives in swamps. He has to get his food from the water; yet he has to breathe, because he is a land-animal and has blood; owing to his enormous size, however, he cannot transfer himself quickly from the water on to the land, as do quite a number of blooded viviparous animals that breathe; hence he has to be equally at home on land and in the water. Some divers, when they go down into the sea, provide themselves with a breathing-machine, by means of which they can inhale the air from above the surface while they remain for a long time in the water. Nature has provided the elephant with something of this sort by giving him a long nose. If ever the
αραντες ἀνω διὰ τοῦ ύδατος τον μυκτῆρα, ἂν ποτε ποιώνται δὶ' ύγρον τὴν πορείαν καθάπερ γὰρ
εἶπομεν, μυκτήρ ἐστιν ἡ προβοσκίς τοῖς ἐλέφασιν.
ἐπεὶ δὲ ἀδύνατον ὅντα μὴ κάμπτεσθαι δυνάμενον (ἐνεπό-
διζε γὰρ ἄν τῷ μήκει πρὸς τὸ λαβεῖν τὴν θύραθεν
tροφήν, καθάπερ φασὶ τὰ κέρατα τοῖς ὀπισθονόμοις
βούσιν· καὶ γὰρ ἐκεῖνος νέμεσθαι φασιν ύπο-
χωρούντας παλμπυγηδόν) ὑπάρξαντος οὗ τοιοῦ-
tου τοῦ μυκτήρος, ἡ φύσις παρακαταχρήται, καθ-
ἀπερ εἴωθεν, ἐπὶ πλείονα τοῖς αὐτοῖς μορίοις, ἀντὶ
tῆς τῶν προσθίων ποδῶν χρείας. τούτους γὰρ τὰ
πολυδάκτυλα τῶν τετραπόδων ἀντὶ χειρῶν ἔχουσιν,
ἀλλ' ὁ μόνον ἐνεχ' ὑποστάσεως τοῦ βάρους· οἱ δ' ἐλέφαντες τῶν πολυδακτύλων εἰσὶ, καὶ οὕτε διχά-
λους ἔχουσιν οὕτε μόνυχας τοὺς πόδας· ἐπεὶ δὲ τὸ
μέγεθος πολύ καὶ τὸ βάρος τὸ τοῦ σώματος, διὰ
tοῦτο μόνον ἐρείσματος εἰσὶ χάριν, καὶ διὰ τὴν
βραδυτῆτα καὶ τὴν ἀφυτὴν τῆς κάμψεως οὐ χρή-
σιμοὶ πρὸς ἀλλο οὐθέν.

Διὰ μὲν οὖν τὴν ἀναπνοὴν ἔχει μυκτῆρα, καθάπερ
καὶ τῶν ἄλλων ἔκαστον τῶν ἐχόντων πλεύμονα
ξόων, διὰ δὲ τὴν ἐν τῷ ύγρῷ διατριβήν καὶ τὴν
βραδυτῆτα τῆς ἐκείθεν μεταβολῆς δυνάμενον ἐλτ-
τεσθαι καὶ μακρὸν· ἀφηρημένης δὲ τῆς τῶν ποδῶν
χρήσεως, καὶ ἡ φύσις, ὀσπερ εἴπομεν, καταχρήται
καὶ πρὸς τὴν ἀπὸ τῶν ποδῶν γινομένην ἄν βοηθείαν
tούτῳ τῷ μορίῳ.

659 b Οἱ δ' ὀρνιθες καὶ οἱ ὀφεις καὶ ὀσα ἄλλ' ἐναίμα

1 χρήσιμοι Rackham: χρήσιμον vulg.
elephant has to make his way through deep water, he will put his trunk up to the surface and breathe through it. This is possible, because, as I have said already, the trunk is really a nostril. Now it would have been impossible for the nostril to be put to all these uses if it had not been soft and able to bend; for then by its very length it would have prevented the animal from getting its food, just as they say the horns of the "backward-grazing" oxen do, forcing them to walk backwards as they feed. So the trunk is soft and pliable; and in consequence Nature, as usual, takes advantage of this to make it discharge an extra function beside its original one: it has to serve instead of forefeet. Now in polydactylous quadrupeds the forefeet are there to serve as hands, not merely in order to support the weight of the animal; but elephants (which must be included under this class of animals, because they have neither a solid hoof nor a cloven one) are so large and so heavy that their forefeet can serve only as supports; and indeed they are no good for anything else because they move so slowly and are quite unsuited for bending.

So the elephant's nostril is there, in the first place, to enable him to breathe (as in all animals that have a lung); and also it is lengthened and able to coil itself round things because the elephant spends much of his time in the water and cannot quickly emerge upon land. And as his forefeet are not available for the normal function, Nature, as we said, presses the trunk into service to supply what should have been forthcoming from the feet.

The Birds and Serpents and the quadrupeds which

\textsuperscript{a} See above, on 648 a 16. This is from Herodotus, iv. 183.
καὶ φοτόκα¹ τῶν τετραπόδων, τοὺς μὲν πόρους ἔχουσι τῶν μυκτήρων πρὸ τοῦ στόματος, ὥστε δ’ εἴπειν μυκτήρας, εἰ μὴ διὰ τὸ ἔργον, οὐκ ἔχουσι φανερῶς διηρθωμένους. ἀλλ’ ἣ γ’ ὄρνις ὥστε 5 μηθέν αὖ εἴπειν ἔχει² ῥίνας. τούτῳ δὲ συμβέβηκεν, ὅτι ἀντὶ σιαγόνων ἔχει τὸ καλούμενον ῥύγχος. αἰτία δὲ τούτων ἡ φύσις ἡ τῶν ὀρνίθων συνεστηκυῖα τούτον τὸν τρόπον. δίπουν γὰρ ἐστὶ καὶ πτερυγωτόν, ὅστ’ ἀνάγκη μικρὸν τὸ βάρος ἔχειν τὸ τοῦ αὐχένος καὶ τὸ τῆς κεφαλῆς, ὥσπερ καὶ τὸ στῆθος 10 στενοῦ· ὅπως μὲν οὖν ἢ χρήσιμον πρὸς τὴν ἀλκήν καὶ διὰ τὴν τροφήν, ὡστάδες ἔχουσι τὸ ῥύγχος, στενοῦ δὲ διὰ τὴν μικρότητα τῆς κεφαλῆς. ἐν δὲ τῷ ῥύγχει τοὺς πόρους ἔχουσι τῆς ὀσφρήσεως, μυκτήρας δ’ ἔχειν ἄδυνατον.

Περὶ δὲ τῶν ἄλλων ζῴων τῶν μὴ ἀναπνεοῦντων 15 εἰρηται πρῶτον δι’ ἢν αἰτίαν οὖκ ἔχουσι μυκτήρας, ἀλλὰ τὰ μὲν διὰ τῶν βραγχίων, τὰ δὲ διὰ τοῦ αὐλοῦ, τὰ δ’ ἐντομα διὰ τοῦ ὑποζώματος αἰσθάνονται τῶν ὀσμῶν, καὶ πάντα τῷ συμφύτῳ πνεύματι τοῦ σώματος ὑπερ’ (καὶ)² κινεῖται. τούτῳ δ’ ὑπάρχει φύσις πάσι καὶ οὐ θύραθεν ἐπεισακτόν ἐστιν.

20 Ὡπὸ δὲ τοὺς μυκτήρας ἢ τῶν χειλῶν ἐστὶ φύσις τοῖς ἔχουσι τῶν ἐναίμων ὀδόντως. τοῖς γὰρ ὄρνισιν, καθάπερ εἴπομεν, διὰ τὴν τροφήν καὶ τὴν ἀλκήν τὸ ῥύγχος ὡστάδες ἐστιν· συνήκται γὰρ εἰς ἐν ἀντ’ ὀδόντων καὶ χειλῶν, ὥσπερ ἄν εἰ τίς ἠφελῶν 25 ἀνθρώπου τὰ χείλη καὶ συμφύσας τοὺς ἄνωθεν

¹ φοτόκα Ζ, vulg.: ξωτόκα EPSUY.
² ἔχει Ζ: ἔχει vulg.
like them are blooded and oviparous, have their nostril-passages in front of the mouth: but they have nothing which except for its function can be called nostrils—nothing distinctly articulated. A bird, at any rate, one might say has no nose at all. The reason for this is that its beak really replaces jaws. And this is because of the natural structure of birds. A bird is a winged biped; hence its head and its neck must be light in weight, and its breast must be narrow; and it has a beak, which (a) is made out of bony material, so that it will serve as a weapon as well as for the uptake of food, and (b) is narrow, owing to the small size of the head. It has the passages for smell in this beak, but it is impossible for it to have nostrils there.

We have spoken already about the animals that do not breathe, and shown why they have no nostrils: some of them smell by means of the gills, some through a blow-hole; while the insects smell through the middle part of the body. All of them smell, as all of them move, by means of the connate pneuma of their bodies, which is not introduced from without, but is present in all of them by nature.

In all blooded animals that have teeth, the lips have their place below the nostrils. (As stated already, birds have a bony beak for getting food and for defence; and this is as it were teeth and lips run into one. The nature of the beak can be illustrated thus. Supposing, in a human being, that the lips were removed, and all the upper teeth were welded to-

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*a* Cf. De somno et vig. 455 b 34 ff. For a full account of Σύμφυτον Πνεύμα see G.A. (Loeb edn.), pp. 576 ff.

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2 ὤπερ SUZ: ὁπερ vulg. 4 <καὶ> Peck.
659 b

όδόντας χωρίς καὶ τοὺς κάτωθεν προαγάγου μῆκος ποιήσας ἀμφοτέρωθεν εἰς στενὸν· εἶ ὅρα ἂν τούτῳ ἡδη ρύγχος ὄρνιθώδες. τοῖς μὲν οὖν ἄλλοις ζώοις πρὸς σωτηρίαν τῶν ὀδόντων ἢ τῶν χειλῶν φύσις ἐστὶ καὶ πρὸς φυλακήν, διόπερ ὡς ἐκείνων μετ-

30 ἔχουσι τοῦ ἀκριβῶς καὶ καλῶς ἡ τοῦνατιόν, οὕτω καὶ τοῦ διηρθρώσθαι τούτῳ τὸ μόριον ἔχουσιν· οἱ δὲ ἄνθρωποι μαλακὰ καὶ σαρκώδη καὶ δυνάμενα χωρί-ζεσθαι, φυλακῆς θ᾽ ἐνεκα τῶν ὀδόντων ὦσπερ καὶ τὰ ἄλλα, καὶ μᾶλλον ἐτι διὰ τὸ εὖ πρὸς γὰρ τὸ χρήσθαι τῷ λόγῳ καὶ ταῦτα. ὦσπερ γὰρ τὴν

35 γλῶτταν οὐχ ὁμοίαν τοῖς ἄλλοις ἐποίησεν ἡ φύσις, πρὸς ἐργασίας δύο καταχρησμεῖν, καθάπερ

660 a εἴπομεν ποιεῖν αὐτῇ ἐπὶ πολλῶν, τὴν μὲν γλῶτταν τῶν τε χυμῶν ἐνεκεν καὶ τοῦ λόγου, τὰ δὲ χείλη τούτου θ᾽ ἐνεκεν καὶ τῆς τῶν ὀδόντων φυλακῆς. ὁ μὲν γὰρ λόγος ὁ διὰ τῆς φωνῆς ἐκ τῶν γραμμάτων σύγκειται, τῆς δὲ γλώττης μὴ τοιαύτης οὐσίας μηδὲ

5 τῶν χειλῶν ύγρῶν οὐκ ἂν ἦν φθέγγεσθαι τὰ πλείστα τῶν γραμμάτων· τὰ μὲν γὰρ τῆς γλώττης εἰσὶ προσβολάς, τὰ δὲ συμβολάς τῶν χειλῶν. ποιας δὲ ταῦτα καὶ πόσας καὶ τίνας ἔχει διαφοράς, δεὶ πυνθάνεσθαι παρὰ τῶν μετρικῶν.

'Ανάγκη δ᾽ ἦν εὐθὺς ἀκολουθῆσαι τούτων τῶν

10 μορίων ἐκάτερον πρὸς τὴν εἰρημένην χρήσιν εὐεργά καὶ τοιαύτην ἐχοντα τὴν φύσιν· διὸ σάρκινα. μα-λακωτάτη δ᾽ ἡ σάρξ ἡ τῶν ἄνθρωπων ὑπήρχεν. τούτῳ δὲ διὰ τὸ αἰσθητικώτατον εἶναι τῶν ζῶν τὴν διὰ τῆς ἄφης αἰώθησιν.
PARTS OF ANIMALS, II. xvi.

together, and similarly all the bottom teeth, and then each set were extended in a forward direction, and made to taper: this would result in a beak such as birds have.) In all animals except man the lips are intended to preserve and to protect the teeth; hence we find that the distinctness of formation in the lips is directly proportionate to the nicety and exactitude of formation in the teeth. In man the lips are soft and fleshy and can be separated. Their purpose is (as in other animals) to protect the teeth; but—still more important—they subserve a good purpose, inasmuch as they are among the parts that make speech possible. This double function of the human lips, to facilitate speech as well as to protect the teeth, may be compared with that of the human tongue, which is unlike that of any other animal, and is used by Nature for two functions (a device of hers which we have often noted), (a) to perceive the various tastes, and (b) to be the means of speech. Now vocal speech consists of combinations of the various letters or sounds, some of which are produced by an impact of the tongue, others by closing the lips; and if the lips were not supple, or if the tongue were other than it is, the greater part of these could not possibly be pronounced. For further particulars about the various differences between these sounds you must consult the authorities on Metre.

It was necessary, however, from the start that each of these two parts should be adapted and well-fitted for their function as stated above; therefore their nature had to be suitable thereto, and that is why they are made of flesh. Human flesh is the softest kind of flesh there is; and this is because man's sense of touch is much more delicate than that of any other creature.
ARISTOTLE

XVII. Ὑπὸ δὲ τῶν οὐρανῶν ἐν τῷ στόματι ἡ
15 γλώττα τοῖς ζῴοις ἐστὶ, τοῖς μὲν πεζοῖς σχεδὸς
ὄμοις πᾶσιν, τοῖς δὲ ἄλλοις ἄνομοίως καὶ αὐτοῖς
πρὸς αὐτὰ καὶ πρὸς τὰ πεζὰ τῶν ζῴων. ὃ μὲν οὖν
ἀνθρωπὸς ἀπολελυμένην τε μάλιστα τὴν γλώτταν
καὶ πλατείαν καὶ μαλακωτάτην ἔχει, τοῖς πρὸς ἀμφοτέρας
ἡ τάς ἐργασίας χρήσιμος, πρὸς τῇ τῶν
20 τῶν χυμῶν αἰσθήσειν (ὅ γὰρ ἀνθρωπὸς εὐαίσθητο-
tatos τῶν ἄλλων ζῴων, καὶ ἡ μαλακὴ γλώττα
<αισθητικώτατη>² ἀπτικωτάτη γάρ, ἡ δὲ γενός ἀφή
τίς ἐστιν), καὶ πρὸς τὴν τῶν γραμμάτων διάρθρωσιν
καὶ πρὸς τὸν λόγον ἡ μαλακὴ καὶ πλατεία χρή-
σιμος. συνετέλεσεν γάρ καὶ προβάλλεις παντωδι
25 τοιαύτῃ οὐσα καὶ ἀπολελυμένη μάλιστ' ἀν δύνατο.
δηλοὶ δ' ὡσις μὴ λίαν ἀπολέλυται: φελλίζονται
γάρ καὶ τραυλίζουσιν, τοῦτο δ' ἐστὶν ἐνδεικν
tῶν γραμμάτων.

Ἐν τῷ πλατείαν εἶναι καὶ τῷ στενῇ ἐστιν.
ἐν γάρ τῷ μεγάλῳ καὶ τῷ μικρῷ, ἐν δὲ τῷ μικρῷ
τὸ μέγα οὐκ ἐστιν. διὸ καὶ τῶν ὄρνιθων οἱ μάλιστα
30 φθεγγόμενοι γράμματα πλατυγλωττότεροι τῶν ἄλ-
lων εἰσίν. τὰ δ' ἐναίμα καὶ ζωτόκα τῶν τετρα-
pόδων βραχεῖαν τῆς φωνῆς ἔχει διάρθρωσιν,
σκηνάν τε γάρ καὶ οὐκ ἀπολελυμένην ἔχουσι
καὶ παχεῖαν τὴν γλώτταν. τῶν δ' ὄρνιθων ἐνιοὶ
πολύφωνοι, καὶ πλατυτέραν οἱ γαμμάτων ἐχούσιν.
35 πολύφωνοι δ' οἱ μικρότεροι. καὶ χρῶνται τῇ
γλώττῃ καὶ πρὸς ἐρμηνεύειν ἄλληλοι πάντες μὲν,
660 ἐτεροὶ δὲ τῶν ἐτέρων μᾶλλον, ὥστε ἐπ' ἐνίοις καὶ

¹ καὶ μαλ. ἔχει post τε vulg.; transposui.
² αἰσθητικώτατη supplevi.
XVII. Under the vaulted roof of the mouth is the tongue, and it is practically the same in all land-animals; but there are variations in the other groups, whose tongues are as a whole different from those of land-animals and also different among themselves. The human tongue is the freest, the broadest, and the softest of all: this is to enable it to fulfil both its functions. On the one hand, it has to perceive all the various tastes, for man has the most delicate senses of all the animals, and a soft tongue is the most sensitive, because it is the most responsive to touch, and taste is a sort of touch. It has, also, to articulate the various sounds and to produce speech, and for this a tongue which is soft and broad is admirably suited, because it can roll back and dart forward in all directions; and herein too its freedom and looseness assists it. This is shown by the case of those whose tongues are slightly tied: their speech is indistinct and lisping, which is due to the fact that they cannot produce all the sounds.

A tongue which is broad can also become narrow, on the principle that the great includes the small, but not vice versa. That is why the clearest talkers, even among birds, are those which have the broadest tongues. On the other hand, the blooded viviparous quadrupeds have a limited vocal articulation; it is because their tongues are hard and thick and not sufficiently loose. Some birds—the smaller sorts—have a large variety of notes. The crook-taloned birds have fairly broad tongues. All birds use their tongues as a means of communication with other birds, and some to a very considerable extent, so much so that it is probable that in
μάθησιν εἶναι δοκεῖν παρ’ ἄλληλων. εἴρηται δὲ περὶ αὐτῶν ἐν ταῖς ἱστορίαις ταῖς περὶ τῶν ζῷων.

Τών δὲ πεζῶν καὶ φωτόκων καὶ ἐναἰμαμών πρὸς μὲν τὴν τῆς φωνῆς ἐργασίαν ἄχρηστον τὰ πολλά 5 τὴν γλώτταν ἔχει καὶ προσδεδεμένην καὶ σκληρᾶν, πρὸς δὲ τὴν τῶν χυμῶν γεύσιν οἱ τ’ ὀφεις καὶ οἱ σάφροι μακρὰν καὶ δικρόαν ἔχουσιν, οἱ μὲν ὀφεῖς οὕτω μακρὰν ὡστ’ εκτείνεσθαι ἐκ μικροῦ ἐπὶ πολὺ, δικρόαν δὲ καὶ τὸ ἄκρον λεπτὸν καὶ τριχώδες διὰ τὴν λιχνεῖαν τῆς φύσεως· διπλῆν γὰρ τὴν ἡδονὴν 10 κτάται τῶν χυμῶν, ὥσπερ διπλῆν ἔχοντα τὴν τῆς γεύσεως αἰσθήσιν.

"Εχεῖ δὲ καὶ τὰ μὴ ἐναίμα τῶν ζῴων τὸ αἰσθητικὸν τῶν χυμῶν μόριον καὶ τὰ ἐναίμα πάντα· καὶ γὰρ ὅσα μὴ δοκεῖ τοῖς πολλοῖς ἔχειν, οἶνον ἐνιοῦ τῶν ἰχθυῶν, καὶ οὕτω τρόπων τὶνα γλυκέρον ἔχουσι, καὶ 15 σχεδὸν παραπλησίως τοῖς ποταμίως κροκοδείλοις. οὐ φαίνονται δ’ οἱ πλείστοι αὐτῶν ἔχειν διὰ τῶν αἰτίαν εὐλογον· ἀκανθώδης τε γὰρ ἔστων ὁ τόπος τοῦ στόματος πάσι τοῖς τοιούτοις, καὶ διὰ τὸ μικρὸν χρόνον εἶναι τὴν αἴσθησιν τοῖς ἐνυδροῖς τῶν χυμῶν, ὥσπερ καὶ ἡ χρῆσις αὐτῆς βραχεία, οὕτω 20 βραχείαν ἔχουσιν αὐτῆς καὶ τὴν διάρθρωσιν. ταχεία δ’ ἡ δίδοσι εἰς τὴν κοιλίαν διὰ τὸ μὴ οἰόν τ’ εἶναι διατρίβειν ἐκχυμίζοντας· παρεμπίπτοι γὰρ ἂν ἐν τῷ ὦδωρ. ὡστ’ ἐὰν μὴ τὶς τὸ στόμα ἐπικλῆν, μὴ φαίνεσθαι ἀφεστικὸς τούτο τὸ μόριον. ἀκανθώδης δ’ ἔστιν οὕτως ὁ τόπος· σύγκειται γὰρ ἐκ τῆς 25 συμφαύσεως τῶν βραχχίων, ὃν ἡ φύσις ἀκανθώδης ἔστιν.

See Hist. An. 504 b 1, 536 a 20 ff., 597 b 26, 608 a 17.
some cases information is actually conveyed from one bird to another. I have spoken of these in the 
\textit{Researches upon Animals}.\textsuperscript{a}

The tongue is useless for the purpose of speech in most of the oviparous and blooded land-animals be-
cause it is fastened down and is hard; but it is very useful for the purpose of taste, \textit{e.g.} in the serpents and lizards, which have long, forked tongues. Serpents’ tongues are very long, but can be rolled into a small compass and then extended to a great distance; they are also forked, and the tips of them are fine and hairy, owing to their having such inordinate appetites; by this means the serpents get a double pleasure out of what they taste, owing to their possessing as it were a double organ for this sense.

Even some of the bloodless animals have an organ for perceiving tastes; and of course all the blooded animals have one, including those which most people would say had not, \textit{e.g.}, certain of the fishes, which have a paltry sort of tongue, very like what the river-crocodiles have. Most of these creatures look as if they had no tongue, and there is good reason for this. (1) All animals of this sort have spinous mouths; (2) the time which water-animals have for perceiving tastes is short; hence, since the use of this sense is short, so is the articulation of its organ. The reason why their food passes very quickly into the stomach is because they cannot spend much time sucking out its juices, otherwise the water would get in as well. So unless you pull the mouth well open, you will not be able to see that the tongue is a separate projection. The inside of the mouth is spinous, because it is formed by the juxtaposition of the gills which are of a spinous nature.
ΑΡΙΣΤΟΤΗΛΕΩΣ

630 b

Τοῖς δὲ κροκοδείλοις συμβάλλεται τι πρὸς τὴν τοῦ μορίου τούτου ἀναπηρίαν καὶ τὸ τὴν σιαγόνα τὴν κάτω ἀκίνητον ἔχειν. ἔστι μὲν γὰρ ἡ γλώττα τῇ κάτω συμφυής, οἶ δὲ έχουσιν ὥσπερ ἀνάπαλυ τὴν ἀνω κάτω· τοῖς γὰρ ἀλλοις ἡ ἀνω ἀκίνητος.

30 πρὸς μὲν οὖν τῇ ἀνω οὖκ ἔχουσι τὴν γλώτταν, οτι ἐναντίως ἀν ἔχοι πρὸς τὴν τῆς τροφῆς εἴσοδον, πρὸς δὲ τῇ κάτω, ὅτι ὥσπερ μετακειμένη ἡ ἀνω ἑστὶν. ἔτι δὲ καὶ συμβέβηκεν αὐτῷ πεζῷ ὃντι ξῆν τὰς ἰχθύων βίον, ὡστε καὶ διὰ τοῦτο ἀναγκαῖον ἀδιάρθρωτον αὐτὸν ἔχειν τοῦτο τὸ μόριον.

35 Τοῦ δὲ οὐρανοῦ σαρκώδη πολλοὶ καὶ τῶν ἰχθύων ἔχουσιν, καὶ τῶν ποταμίων ἐνοὶ σφόδρα σαρκώδη καὶ μαλακῶν, οἶνοι οἱ καλούμενοι κυπρῖνοι, ὡστε δοκεῖν τοῖς μὴ σκοποῦσιν ἀκριβῶς γλώτταν ἔχειν ταύτην. οἰ δὲ ἰχθύες διὰ τὴν εἰρημένην αὐτίαν ἔχουσι μὲν οὐ σαφῆς δὲ ἔχουσι τὴν διάρθρωσιν τῆς γλώττης. ἐπεὶ δὲ [τῆς τροφῆς χάριν]¹ καὶ τῶν χυμῶν αἴσθησις ἐνεστὶ μὲν τῷ γλώττωσι μορίῳ, οὐ παντὶ δὲ ὁμοίως ἀλλὰ τῷ ἀκρῷ μάλιστα, διὰ τοῦτο τοῖς ἰχθύσι τοῦτ' ἀφώρισται μόνον.

661 a Ἐπιθυμίαν δὲ ἔχει τροφῆς τὰ ζῷα πάντα ὡς ἔχοντα αἴσθησιν τῆς ἱδονῆς τῆς γνωμείης ἐκ τῆς τροφῆς· ἡ γὰρ ἐπιθυμία τοῦ ἱδέως ἑστὶν. ἀλλὰ τὸ μόριον οὐχ ὁμοίον τοῦτο πάσον, ὃ τὴν αἴσθησιν ποιουότατι τῆς τροφῆς, ἀλλὰ τοῖς μὲν ἀπολελυμένοιν τοῖς δὲ προσπεφυκόσ, οὗτος μηδὲν ἔργον ὑπάρχει

¹ [τῆς τροφῆς χάριν] praecedentium interpretationem seclusi, cetera correxì: τῆς εὖ τοῖς χυμοῖς ἐστὶν ἡ αἴσθησις (eis αἴσθησιν Z) τὸ μὲν (μὲν τὸ ΕΥΖ) γλώττωσι ἐχεῖ (ἐχει om. Z) μόριον vulg.

² pænti Z: pántη vulg.

204
PARTS OF ANIMALS, II. xvii.

Among the factors which contribute to the deformity of the crocodile's tongue is the immobility of its lower jaw, to which the tongue is naturally joined. We must remember, however, that the crocodile's jaws are topsy-turvy; the bottom one is on top and the top one below; this is clearly so, because in other animals the top jaw is the immovable one. The tongue is not fixed to the upper jaw (as one might expect it to be) because it would get in the way of the food as it entered the mouth, but to the lower one, which is really the upper one in the wrong place. Furthermore, although the crocodile is a land-animal, his manner of life is that of a fish, and this is another reason why he must have a tongue that is not distinctly articulated.

Many fish, however, have a fleshy roof to their mouths. In some of the fresh-water fish—e.g. those known as Cyprinoi—it is very fleshy and soft, so that casual observers think it is a tongue. In fish, however, for the reason already given, the tongue, though articulated, is not distinctly so; yet, inasmuch as the power also of perceiving tastes resides in the tongue-like organ, though not in the whole of it equally but chiefly in the tip, therefore on this account in fish the tip only is separate from the jaw.

Now all animals are able to perceive the pleasant taste which is derived from food, and so they have a desire for food, because desire aims at getting that which is pleasant. The part, however, by which this perception or sensation of the food takes place, is not identical in all of them, for some have a tongue which moves freely and loosely, others (which have no vocal functions) have a tongue that is fastened down.
Under this name Aristotle probably includes several species of Purpura and Murex. Tyrian purple (6, 6' dibrom-
Some again have a hard tongue; others a soft or fleshy one. So we find that even the Crustacea—e.g. the Crayfish and such—have a tongue-like object inside the mouth, and so have the Cephalopods—e.g. the Sepias and the Octopuses. Of the Insects, some have this organ inside the mouth (e.g. the Ants), and so have many of the Testacea. Others have it outside, as though it were a sting, in which case it is spongy and hollow, and so they can use it both for tasting and for drawing up their food. Clear examples of this are flies and bees and all such creatures, and also some of the Testacea. In the Purpuraceae, for instance, this "tongue" has such strength that they can actually bore through the shells of shellfish with it, including those of the spiral snails which are used as baits for them. Also, there are among the gad-flies and cattle-flies creatures that can pierce through the skin of the human body, and some can actually puncture animal hides as well. Tongues of this sort, we may say, are on a par with the elephant's nose; in their tongue these creatures have a useful sting just as the elephant has a handy implement in his trunk.

In all other animals the tongue conforms to the description we have given.

Indigo) is obtained from Murex brandaris. For the boring powers of these creatures' tongues see the reference for Purpura lapillus given by Ogle (Forbes and Hanley, Brit. Mollusca, iii. 385).
661 a  Ἐχόμενον δὲ τῶν εἰρημένων ἢ τῶν ὀδόντων ἢτι φύσις τοῖς ζῷοις, καὶ τὸ στόμα τὸ περι-
ἐχόμενον ὑπὸ τούτων καὶ συνεστηκὸς ἐκ τούτων.

661 b  Τοῖς μὲν οὖν ἄλλοις ἢ τῶν ὀδόντων φύσις κοινὴ 
μὲν ἐπὶ τὴν τῆς τροφῆς ἐργασίαν ὑπάρχει, χωρὶς 
δὲ κατὰ γένη τοὺς μὲν ἄλκης χάριν, καὶ ταύτης δι-
ηρημένης, ἐπὶ τε τὸ ποιεῖν καὶ τὸ μὴ πάσχειν: 
τὰ μὲν γὰρ ἀμφοῖν ἔνεκεν ἓχει, καὶ τοῦ μὴ παθεῖν 
καὶ τοῦ ποιεῖν, οἷον ὃσα σαρκοφάγα τῶν ἀγρίων 
τὴν φύσιν ἑστίν, τὰ δὲ βοηθεῖας χάριν, ὡσπερ 
πολλὰ τῶν ἀγρίων καὶ τῶν ἠμέρων.

'Ὁ δὲ ἀνθρωπὸς πρὸς τε τὴν κοινὴν χρῆσιν καλῶς 
ἔχει πεφυκότας· τοὺς μὲν προσθίους οξεῖς, ἢν 
διαίρωσι, τοὺς δὲ γομφίους πλατεῖς, ἢν λειώσωσιν· 
ὁρίζουσι δὲ ἐκατέρους οἱ κυνόδοντες, μέσοι τὴν 
φύσιν ἀμφοτέρων ὄντες· τὸ τε γὰρ μέσον ἀμφοτέρων 
μετέχει τῶν ἄκρων, οἱ τε κυνόδοντες τῇ μὲν 
οξείς τῇ δὲ πλατεῖς εἰσὶν· ὁμοίως δὲ καὶ ἐπὶ 
τῶν ἄλλων ζῴων, ὃσα μὴ πάντας ἔχουσιν οξεῖς 
—μάλιστα δὲ καὶ τούτους τοιούτους καὶ τοσοῦ-
τους πρὸς τὴν διάλεκτον· πολλὰ γὰρ πρὸς τὴν
BOOK III

The subject which follows naturally after our previous remarks is that of the Teeth. We shall also speak about the Mouth, for this is bounded by the teeth and is really formed by them.

In the lower animals teeth have one common function, namely, mastication; but they have additional functions in different groups of animals. In some they are present to serve as weapons, offensive and defensive, for there are animals which have them both for offence and defence (e.g. the wild carnivora); others (including many animals both wild and domesticated) have them for purposes of assistance.

Human teeth too are admirably adapted for the common purpose that all teeth subserv: the front ones are sharp, to bite up the food; the molars are broad and flat, to grind it small; and on the border between the two are the dog-teeth whose nature is intermediate between the two: and just as a mean shares the nature of both its extremes, so the dog-teeth are broad in one part and sharp in another. Thus the provision is similar to that of the other animals, except those whose teeth are all sharp; but in man even these sharp teeth, in respect of character and number, are adapted chiefly for the purposes of speech, since the
ARISTOTLE

631 b
15 γένεσιν τῶν γραμμάτων οἱ πρόσθιοι τῶν ὀδόντων συμβάλλονται.

"Ενια δὲ τῶν ζώων, ὡσπερ εἴπομεν, τροφῆς χάριν ἔχει μόνον. ὡσα δὲ καὶ πρὸς βοήθειαν τε καὶ πρὸς ἀλκήν, τὰ μὲν χαυλιώδοντας ἔχει, καθάπερ ἦσ, τὰ δὲ ὄξεις καὶ ἐπαλλάττοντας, οἶδεν καρχαρόδοντα

καλεῖται. ἐπεὶ γὰρ ἐν τοῖς ὀδούσιν ἡ ἵσχὺς αὐτῶν, τοῦτο δὲ γίνοιτ' ἀν διὰ τὴν ὀξύτητα, οἱ χρήσιμοι πρὸς τὴν ἀλκήν ἐναλλάξ ἐμπίπτουσιν, ὡς μὴ ἀμβλύνωνται τριβόμενοι πρὸς ἀλλήλους. οὐδὲν δὲ τῶν ζώων ἐστίν ἀμα καρχαρόδον καὶ χαυλιώδουν, διὰ τὸ μηδὲν μάτην ποιεῖν τὴν φύσιν μηδὲ περι-

εργον. ἐστι δὲ τῶν μὲν διὰ πληγῆς ἡ βοήθεια, τῶν δὲ διὰ δήγματος. διὸσπερ αἱ θήλειαι τῶν ὑῶν δάκνουσιν. οὐ γὰρ ἔχουσι χαυλιώδοντας.

(Καθόλου δὲ χρεῶν τι λαβεῖν, δ καὶ ἐπὶ τούτων καὶ ἐπὶ πολλῶν τῶν ὑστερον λεχθησομένων ἐσται χρήσιμον. τῶν τε γὰρ πρὸς ἀλκήν τε καὶ βοήθειαν

ὀργανικῶν μορίων ἕκαστα ἀποδίδοντι ἡ φύσις τοῖς δυναμένοις χρήσθαι μόνοις ἡ μᾶλλον, μάλιστα δὲ τῷ μάλιστα, οἶνον κέντρον, πλήκτρον, κέρατα, χαυλιώδοντας καὶ εἰ τι τοιοῦτον έτερον. ἐπεὶ δὲ τὸ ἄρρεν ἰσχυρότερον καὶ θυμικότερον, τὰ μὲν μόνα τὰ δὲ μᾶλλον ἔχει τὰ τουαῦτα τῶν μορίων. οὐσα

μὲν γὰρ ἀναγκαίων καὶ τοῖς θήλεσιν ἔχειν, οἶνον τὰ πρὸς τὴν τροφήν, ἔχουσι μὲν ἤττον δ' ἔχουσιν, οὐσα δὲ πρὸς μηδὲν τῶν ἀναγκαίων, οὖκ ἔχουσιν. καὶ

* See note on 644 a 17.

210
front teeth contribute a great deal to the formation of the sounds.

As we have said, the teeth of some of the animals have one function only, to break up the food. Of those animals whose teeth serve also as a defence and as weapons, some (like the Swine) have tusks, some have sharp interlocking teeth, and are called "saw-toothed" as a result. The strength of these latter animals lies in their teeth, and sharpness is the means of securing this; so the teeth which are serviceable as weapons are arranged to fit in side by side when the jaws are closed to prevent them from rubbing against each other and becoming blunt. No animal has saw-teeth as well as tusks; for Nature never does anything without purpose or makes anything superfluously. These teeth are used in self-defence by biting; tusks by striking. This explains why sows bite: they have no tusks.

(At this point we should make a generalization, which will help us both in our study of the foregoing cases and of many that are to follow. Nature allots defensive and offensive organs only to those creatures which can make use of them, or allots them "in a greater degree," and "in the greatest degree" to the animal which can use them to the greatest extent. This applies to stings, spurs, horns, tusks, and the rest. Example: Males are stronger than females and more spirited; hence sometimes the male of a species has one of these parts and the female has none, sometimes the male has it "in a greater degree." Parts which are necessary for the female as well as for the male, as for instance those needed for feeding, are of course present though "in a less degree"; but those which serve no necessary end are not
662 a διὰ τούτο τῶν ἐλάφων οἱ μὲν ἄρρενες ἔχουσι κέρατα, αἱ δὲ θήλειαι οὐκ ἔχουσιν. διαφέρει δὲ καὶ τὰ κέρατα τῶν θηλειῶν βοῶν καὶ τῶν παύρων· ὁμοίως δὲ καὶ ἐν τοῖς προβάτοις. καὶ πλήκτρα τῶν ἄρρενων ἐχόντων αἱ πολλαὶ τῶν θηλειῶν οὐκ ἔχουσιν. ὃς δ᾿ αὐτῶς ἔχει τούτο καὶ ἐπὶ τῶν ἄλλων τῶν τοιούτων.)

Οἱ δ᾿ ἱχθύες πάντες εἰσὶ καρχαρόδοντες, πλὴν τοῦ ἐνὸς τοῦ καλομένου σκάρου· πολλοὶ δ᾿ ἔχουσι καὶ ἐν ταῖς γλώτταις ὀδόντας καὶ ἐν τοῖς οὐρανοῖς. τούτου δ᾿ αὐτίον ὅτι ἀναγκαῖον ἐν ὑγροῖς οὗτο παρασκεύαι τὸ υγρὸν ἀμα τῇ τροφῇ, καὶ τούτῳ ταχέως ἐκπέμπειν. οὗ γὰρ ἐνδεχεται λεαινόντας διατρίβειν· εἰσρέει γὰρ ἀν τὸ υγρὸν εἰς τὰς κούλιας. διὰ τούτο πάντες εἰσίν ὄξεις πρὸς τὴν διαίρεσιν μονόν, καὶ πολλοὶ καὶ πολλαχῇ, ἵνα ἀντὶ τοῦ λεαίνειν εἰς πολλὰ κερματίζωσι τῷ πλήθει. γαμψοὶ δὲ διὰ τὸ τὴν ἀλκήν σχεδὸν ἀπασαν αὐτοῖς διὰ τούτων εἶναι.

"Εχει δὲ καὶ τὴν τοῦ στόματος φύσιν τὰ ζώα τούτων τε τῶν ἐργῶν ἑνεκα καὶ ἐτὶ τῆς ἀναπνοῆς, ὅσα ἀναπνεῖ τῶν ἢμῶν καὶ καταψύχεται θύραθεν. η γὰρ φύσις αὐτῆ καθ᾿ αὐτῆν, ὄσπερ εἶπομεν, τοῖς κοινοῖς πάντων μορίοις εἰς πολλὰ τῶν ἢντον κατα- χρήται, οἷον καὶ ἐπὶ τοῦ στόματος ή μὲν τροφή πάντων κοινών, ή δ᾿ ἀλκή τινῶν ἢδιον καὶ ο λόγος ἐτέρων, ἐτὶ δὲ τὸ ἀναπνεῖν οὐ πάντων κοινών. ἡ δὲ

1 sic P: διαίρεσιν. πάλιν καὶ vulg.

a Probably the parrot-fish. Cf. 675 a 3.
present. Thus, stags have horns, does have not. Thus, too, cows' horns are different from bulls' horns, and ewes' from rams'. In many species the males have spurs while the females have not. And so with the other such parts.)

All fishes are saw-toothed except one species, the Scarus. Many of them have teeth on their tongues and in the roof of the mouth. This is because as they live in the water they cannot help letting some of it in as they take in their food, and they have to get it out again as quickly as possible. If they failed to do so, and spent time grinding the food small, the water would run down into their gut. So all their teeth are sharp and intended only for cutting up the food. Further, they are numerous and placed all over the mouth; so by reason of their multitude they can reduce the food into tiny pieces, and this takes the place of the grinding process. They are also curved; this is because practically the whole of a fish's offensive force is concentrated in its teeth.

The mouth, too, is present in animals on purpose to fulfil these same offices, but it has also a further purpose, at any rate in those animals which breathe and are cooled from without—namely, to effect respiration. As we said earlier, Nature will often quite spontaneously take some part that is common to all animals and press it into service for some specialized purpose. Thus, the mouth is common to all animals, and its normal and universal function has to do with food: but sometimes it has an extra function, peculiar to some species only: in some it is a weapon, in others a means of speech; or more generally, though not universally, it serves for respiration. Nature has
残留部分的文本如下：

632 a  φύσις ἀπαντά συνήγαγεν εἰς ἐν, ποιοῦσα διαφορὰν αὐτοῦ τοῦ μορίου πρὸς τὰς τῆς ἐργασίας διαφοράς.
 25 διὸ τὰ μὲν ἐστὶ συστομώτερα, τὰ δὲ μεγαλόστομα.
όσα μὲν γὰρ τροφῆς καὶ ἀναπνοῆς καὶ λόγου χάριν, συστομώτερα, τῶν δὲ βοηθείας χάριν τὰ μὲν καρχαρόδοντα πάντα ἀνερρωγότα· οὕσης γὰρ αὐτοῖς τῆς ἄλκης ἐν τοῖς δήγμαις χρήσιμον τὸ μεγάλην εἶναι τὴν ἀνάπτυξιν τοῦ στόματος· πλείοσι
30 γὰρ καὶ κατὰ μείζον δῆξεται, ὅσονπερ ἂν ἐπὶ τὸ πλέον ἀνερρωγῇ τὸ στόμα. ἔχουσι δὲ καὶ τῶν ἰχθύων οἱ δηκτικοὶ καὶ σαρκοφάγοι τοιούτων στόμα, οἱ δὲ μὴ σαρκοφάγοι μύουρον· τοιούτων γὰρ αὐτοῖς χρήσιμον, ἐκείνο δὲ ἀχριστόν.

Τοῖς δ’ ὄρνισιν ἐστὶ τὸ καλούμενον ῥύγχος στόμα·
35 τούτῳ γὰρ ἀντὶ χειλῶν καὶ ὀδόντων ἐχουσιν. δια-
662 b φέρει δὲ τούτῳ κατὰ τὰς χρήσεις καὶ τὰς βοηθείας.
τὰ μὲν γὰρ γαμψώνυμα καλούμενα διὰ τὸ σαρκο-
φαγεῖν καὶ μηδενὶ τρέφεσθαι καρπῷ γαμψῷ ἔχει τὸ ῥύγχος ἀπαντά· χρήσιμον γὰρ πρὸς τὸ κρατεῖν καὶ
βιαστικῶτερον τοιούτο πεφυκός. ἢ δ’ ἄλκη ἐν
5 τούτῳ τε καὶ τοῖς ὄνυξι· διὸ καὶ τοὺς ὄνυχας
γαμψωτέρους ἐχουσιν. τῶν δ’ ἄλλων ἐκάστῳ πρὸς
τὸν βίον χρήσιμον ἔστι τὸ ῥύγχος, ὅτι τοῖς μὲν
δρυσκόποις ἵσχυρόν καὶ σκληρόν, καὶ κόραξι καὶ
κορακώδεσι, τοῖς δὲ μικροῖς γλαφυρόν πρὸς τὰς
συλλογὰς τῶν καρπῶν καὶ τὰς λῆψεις τῶν ξω-
10 δαρίων. ὅσα δὲ ποηφάγα καὶ ὅσα παρ’ ἐλη ζῆ, 214
brought all these functions together under one part, whose formation she varies in the different species to suit its various duties. That is why the animals which use their mouths for feeding, respiration and speaking have rather narrow mouths, while those that use them for self-defence have wide and gaping mouths. All the saw-toothed creatures have these wide mouths, for their method of attack is biting, and therefore they find it an advantage to have a mouth that will open wide; and the wider it opens the greater the space the bite will enclose, and the greater the number of teeth brought into action. Biting and carnivorous fishes have mouths of this sort; in the non-carnivorous ones it is on a tapering snout, and this suits their habits, whereas a gaping mouth would be useless.

In birds, the mouth appears in the form of a beak, which serves them instead of lips and teeth. Various sorts of beak are found, to suit the various uses including defensive purposes to which it is put. All of the birds known as crook-taloned have a curved beak, because they feed on flesh and take no vegetable food: a beak of this form is useful to them in mastering their prey, as being more adapted for the exertion of force. Their beak, then, is one weapon of offence, and their claws are another; that is why their claws are exceptionally curved. Every bird has a beak which is serviceable for its particular mode of life. The woodpeckers, for instance, have a strong, hard beak; so have crows, and other birds closely related to them; small birds, on the other hand, have a finely constructed beak, for picking up seeds and catching minute animals. Birds that feed on herbage and that live by marshes (e.g. swimmers and
katháper tā πλωτά kai stegánopotoda, tā mēn allon trópouν χρήσιμον ἔχει το ρύγχος, tā de platýrnuχa autōn ēstyn. toioútwv γάρ ὄντι ῥαδίωσ δύναται ὀρύσσειν, ὠσπερ καί tō̂n tetrαpόδων το τῆς ύτος: καί γάρ αὐτῇ ριξοφάγος. ἔτι δ' ἔχοντι καί τά 15 ριξοφάγα τῶν ὄρνεων καί τῶν ὀμοιοβίων ἐνια τά ἁκρα τοῦ ρύγχους κεχαραγμένα. ποιηφάγοις γάρ τούτος οὐδεν ποιεῖ ῥαδίως.

Περὶ μὲν οὖν τῶν ἄλλων μορίων τῶν ἐν τῇ κεφαλῇ σχεδὸν εὑρηται, τῶν δ' ἀνθρώπων καλεῖται τὸ μεταξὺ τῆς κεφαλῆς καί τοῦ αὐχένος πρόσωπον, 20 ἀπὸ τῆς πράξεως αὐτῆς ὄνομασθῆν, ὡς ἔοικεν· διὰ γάρ τὸ μόνον ὀρθὸν εἶναι τῶν ζῴων μόνον πρόσω- ρθεῖν ὀπωπε καί τὴν φωνὴν εἰς τὸ πρόσω δια- πέμπει.

II. Περὶ δὲ κεράτων λεκτέων· καί γάρ ταύτα πέφυκε τοῖς ἔχουσιν ἐν τῇ κεφαλῇ. ἔχει δ' οὐδὲν 25 μὴ ζωοτόκον. καθ' ὀμοιότητα δὲ καὶ μεταφορὰν λέγεται καὶ ἑτέρων τινῶν κέρατα· ἀλλ' οὐδενὶ αὐτῶν τὸ ἔργον τοῦ κέρατος ὑπάρχει. βοηθείας γάρ καὶ ἀλκῆς χάριν ἔχουσι τὰ ζωοτόκα, δ' τῶν ἄλλων τῶν λεγομένων ἔχειν κέρας οὐδενὶ συμ- βεβηκέν· οὐδὲν γάρ χρήται τοῖς κέρασιν οὔτ' 30 ἀμυνόμενον οὑτε πρὸς τὸ κρατεῖν, ἀπερ ἱσχύος ἐστιν ἔργα. ὡσα μὲν οὖν πολυσχιδῆ τῶν ζῴων, οὐδὲν ἔχει κέρας. τοῦτον δ' αὐτὸν ὅτι τὸ μὲν κέρας βοηθείας αὐτῶν ἐστι, τοῖς δὲ πολυσχιδέσιν ὑπάρχουσιν ἔτεραι βοηθεῖαι· δέδωκε γάρ ἡ φύσις τοῖς μὲν ὄνυχας τοῖς δ' ὀδόντας μαχητικοὺς, τοῖς

* Under this heading all the Mammalia known to Aristotle

216
web-footed birds) have a beak adapted for their mode of life, a special instance of which is the broad beak, which enables them to dig for roots easily, just as the broad snout of the pig enables it to dig—an example of a root-eating quadruped. These root-eating birds and other birds of similar habits sometimes have sharp points at the end of the beak. This enables them to deal easily with the herbaceous food which they take.

We have now, I think, spoken of practically all the parts that have their place in the head; but in man, the portion of the body between the head and the neck is called the Prosōpon (Face), a name derived, no doubt, from the function it performs. Man, the only animal that stands upright, is the only one that looks straight before him (prosōthen opōpe) or sends forth his voice straight before him (prosō, opa).

II. We still have to speak of Horns: these also, when present, grow out of the head. Horns are found only in the Vivipara; though some other creatures have what are called horns, owing to their resemblance to real horns. None of these so-called horns, however, performs the function proper to horns. The reason why the Vivipara have horns is for the sake of self-defence and attack, and this is not true of any of these other creatures, since none of them uses its “horns” for such feats of strength either defensively or offensively. The polydactylous animals, moreover, have no horns, because they possess other means of defence. Nature has given them claws or teeth to fight with, or some other part capable of

are included, except ruminants, solid-hoofed animals, and Cetacea.
ARISTOTLE

662 b
25 δ' ἀλλ' ὑπον οἱ καὶ τοὺς ἀλήθειαν, τῶν δὲ διχάλων
663 a τὰ μὲν πολλὰ κέρατα ἔχει πρὸς ἀλκῆν, καὶ τῶν
μωνύχων ἑνὶ, τὰ δὲ καὶ πρὸς βοήθειαν, ὅσοι
δὲ δεδωκεν ἢ φύσις ἀλήθειαν πρὸς σωτηρίαν, οὗν
ταχυτῆτα σώματος, καθάπερ τοῖς ἵπποις βεβοήθη-
κεν, ἢ μέγεθος, ὦσπερ ταῖς καμήλοις. καὶ γὰρ
5 μεγέθουσι ὑπερβολῆ τὴν ἀπὸ τῶν ἀλλῶν ἥμων
θορᾶν ίκανὴ κωλύειν, ὅπερ συμβεβηκε ταῖς καμή-
λοις, ἐτὶ δὲ μᾶλλον τοῖς ἐλέφασιν. τὰ δὲ χαλκι-
όδοντα, ὦσπερ καὶ τὸ τῶν υἱῶν γένως, δίχαλον ἄν. 2
"Οσοῖς δ' ἄχρηστος πέφυκεν ἢ τῶν κεράτων
έξοχή, τούτως προστεθείκεν ἐτέραν βοήθειαν ἢ
φύσις, οἷον ταῖς μὲν ἑλάφοις τάχος (τὸ γὰρ μέ-
γεθος αὐτῶν καὶ τὸ πολυσχιδές μᾶλλον βλάπτει ἢ
ὡφελεί), καὶ βουβάλοις δὲ καὶ δορκάσι (πρὸς ἐνα
μὲν γὰρ ἀνθιστάμενα τοῖς κέρασιν ἀμύνονται, τὰ δὲ
θηριώδη καὶ μάχιμα ἀποφεύγουσι), τοῖς δὲ βονάσιοις
(καὶ γὰρ τούτως γαμμά τὰ κέρατα πέφυκε πρὸς
15 ἀληθή) τὴν τοῦ περιττώματος ἄφεσιν: τούτῳ γὰρ
ἀμύνεται φοβηθέντα: καὶ ταύτῃ δὲ τῇ προέσει δια-
σωζέται ἐτέρα. ἀμα δ' ἰκανᾶς καὶ πλείους βοηθείας
οὐ δεδωκεν ἢ φύσις τοῖς αὐτοῖς.
"Εστι δὲ τὰ πλείστα τῶν κερατοφόρων δίχαλα,
λέγεται δὲ καὶ μῶνυχον, ὅν καλοῦσιν Ιπποῦν ὄνον.
20 Ῥάου ὅπως τὸ πλείστο, καθάπερ καὶ τὸ σῶμα
διήρηται τῶν ἥμων οἷς ποιεῖται τὴν κίνησιν, δεξίον
καὶ ἀριστερόν, καὶ κέρατα δύο πέφυκεν ἐχεὶν διὰ

1 δὲ post ὅσοις vulg.: del. Platt, Thurot.
2 ἄν Ogle.

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a Cf. above, on 648 a 16.
b The European bison.
c This is probably the Indian Rhinoceros. This account

218
rendering adequate defence. Most of the cloven-hoofed animals, and some of the solid-hoofed, have horns, as weapons of offence; some have horns for self-defence, as those animals which have not been given means of safety and self-defence of a different order—the speed, for instance, which Nature has given to horses, or the enormous size which camels have (and elephants even more), which is sufficient to prevent them from being destroyed by other animals. Some, however, have tusks, for instance swine, although they are cloven-hoofed.

In some animals the horns are a useless appendage, and to these Nature has given an additional means of defence. Deer have been given speed (because the size of their horns and the numerous branches are more of a nuisance to them than a help). So have the antelopes and the gazelles, which, although they withstand some attackers and defend themselves with their horns, run away from really fierce fighters. The Bonasus, whose horns curve inwards to meet each other, protects itself when frightened by the discharge of its excrement. There are other animals that protect themselves in the same way. Nature, however, has not given more than one adequate means of protection to any one animal.

Most of the horned animals are cloven-hoofed, though there is said to be one that is solid-hoofed, the Indian Ass, as it is called.

The great majority of horned animals have two horns, just as, in respect of the parts by which its movement is effected, the body is divided into two—the right and the left. And the of it comes from the Indica of Ktesias of Knidos, quoted in Photius’s Bibliotheca, lxxii. pp. 48 b 19 (Bekker) foli.
663 a

tην αυτήν αιτίαν1· ἐστὶ δὲ καὶ μονοκέρατα, οἶνον ὁ τ' ὀρυξ καὶ ὁ Ἰνδικὸς καλούμενοι ὄνος. ἐστὶ δ' ὁ μὲν ὀρυξ δίχαλον, ὁ δ' ὄνος μῶνυχον. ἔχει δὲ τὰ 25 μονοκέρατα τὸ κέρας ἐν τῷ μέσῳ τῆς κεφαλῆς· οὔτω γὰρ ἐκάτερον τῶν μερῶν μάλιστ' ἂν ἔχοι κέρας ἐν· τὸ γὰρ μέσον ὁμοίως κοινὸν ἀμφοτέρων τῶν ἐσχάτων. εὐλόγως δ' ἂν δόξει μονόκερων εἶναι τὸ μῶνυχον τοῦ δίχαλον μᾶλλον· ὀπλὴ γὰρ καὶ χηλὴ τὴν αὐτήν ἔχει κέρατι φύσων, ὥστ' ἀμα 30 καὶ τοῖς αὐτοῖς ἡ σχῖσις γίνεται τῶν ὀπλῶν καὶ τῶν κεφατῶν. ἔτι δ' ἡ σχῖσις καὶ τὸ δίχαλον κατ' ἐλλειψιν τῆς φύσεως ἐστιν, ὥστ' εὐλόγως τοῖς μοινύχοις ἐν ταῖς ὀπλαῖς δοῦσα τὴν ὑπεροχὴν ἡ φύσις ἀνωθέν ἀφείλε καὶ μονόκερων ἐποίησεν.

'Ορθῶς δὲ καὶ τὸ ἐπὶ τῆς κεφαλῆς ποιῆσαι τήν 35 τῶν κεφατῶν φύσιν, ἀλλὰ μὴ καθάπερ ὁ Λισώπου Μώμος διαμέμφεται τῶν ταύρων ὦτι οὐκ ἐπὶ τοῖς

663 b ὠμοὶς ἔχει τὰ κέρατα, ὥθεν τὰς πληγὰς ἐποιεῖτ' ἂν ἰσχυροτάτας, ἀλλ' ἐπὶ τοῦ ἀσθενεστάτου μέρους τῆς κεφαλῆς. οὐ γὰρ ὀξὺ βλέπων ὁ Μώμος ταῦτ' ἐπετύμησεν. ὦσπερ γὰρ καὶ έι ἐτέρωθι ποι τοῦ 5 σώματος κέρατα ἐπεφύκει, βάρος ἂν παρεῖχεν ἀλ- λως οὐδὲν ὠντα χρήσιμα καὶ ἐμπόδια τῶν ἔργων πολλοῖς ἤν, οὔτω καὶ ἐπὶ τῶν ὠμῶν πεφυκότα. οὐ γὰρ μόνον χρή σκοπεῖν πόθεν ἰσχυρότεραι αἰ πλη- γαί, ἀλλὰ καὶ πόθεν πορρώτεραι· ὥστ' ἐπει χεῖρας μὲν οὐκ ἑχουσιν, ἐπὶ δὲ τῶν ποδῶν ἅδυνατον, ἐν δὲ

1 αὐτήν αἰτίαν Peck: αἰτίαν ταύτην vulg.

a See Babrius, Myth. Aesop. lix. 8-10.
reason in both cases is the same. There are, however, some animals that have one horn only, e.g. the Oryx (whose hoof is cloven) and the "Indian Ass" (whose hoof is solid). These creatures have their horn in the middle of the head: this is the nearest approximation to letting each side have its own horn, because the middle is common equally to both extremes. Now it is quite reasonable that the one horn should go with the solid hoof rather than with the cloven hoof, because hoof is identical in nature with horn, and we should expect to find divided hoofs and divided horns together in the same animal. Again, division of the hoof is really due to deficiency of material, so it is reasonable that as Nature has used more material in the hoofs of the solid-hoofed animals, she has taken something away from the upper parts and made one horn only.

Again, Nature acted aright in placing the horns on the head. Momus in Aesop's fable is quite wrong when he finds fault with the bull for having his horns on the head, which is the weakest part of all, instead of on the shoulders, which, he says, would have enabled them to deliver the strongest possible blow. Such a criticism shows Momus's lack of perspicacity. If the horns had been placed on the shoulders, as indeed on any other part of the body, they would have been a dead weight, and would have been no assistance but rather a hindrance to many of the animal's activities. And besides, strength of stroke is not the only point to be considered: width of range is equally important. Where could the horns have been placed to secure this? It would have been impossible to have them on the feet; knees with horns on them would have
ARISTOTLE

663 b
toîs γόνασιν ὅντα τὴν κάμψιν ἐκώλυντες ἄν, ἀναγ-
10 καίον ἀσπερ νῦν ἐξουσίαν, ἐπὶ τῆς κεφαλῆς ἑχειν. ἕμα δὲ καὶ πρὸς τὰς ἄλλας κυψῆσεις τοῦ σῶματος ἀνεμοπόδιστα πέφυκεν οὕτω μάλιστα.

"Εσθι δὲ τὰ κέρατα δι’ ὅλου στερεὰ τοῖς ἐλάφωις μόνοις, καὶ ἀπὸβάλλει μόνον, ἔνεκεν μὲν ὑφελείας κουφιζόμενον, ἐξ ἀνάγκης δὲ διὰ τὸ βάρος. τῶν δὲ ἄλλων τὰ κέρατα μέχρι τινὸς κοιλα, τὰ δ’ ἀκρα στερεὰ διὰ τὸ πρὸς τὰς πληγὰς τοῦτ’ εἶναι χρή-
σιμον. ὅπως δὲ μηδὲ τὸ κοῖλον ἀσθενεῖς ἡ δ’ πέφυκεν ἐκ τοῦ δέρματος, ἐν τούτω εἰνήμορσταί <τὸ>3 στερεοῦν ἐκ τῶν ὀστῶν. οὕτω γὰρ καὶ τὰ κέρατα ἔχοντα πρὸς ἀλκήν τε χρησμώτατ’ ἐστὶ" καὶ πρὸς τὸν ἄλλον βίον ἀνοχλότατα.

Τίνος μὲν οὖν ἔνεκεν ἡ τῶν κεράτων φύσις, εἰρηταί, καὶ διὰ τίν’ αὐτίνα τὰ μὲν ἐχουσὶν τοιαῦτα τὰ δ’ οὐκ ἐχουσιν.

Πῶς δὲ τῆς ἀναγκαίας φύσεως ἐχούσης τοῖς ὑπάρχουσιν ἐξ ἀνάγκης ἡ κατὰ τὸν λόγον φύσις ἑνεκά του κατακέχρηται, λέγωμεν.

Πρῶτον μὲν οὖν τὸ σωματῶδες καὶ γεωδές πλεῖον ὑπάρχει τοῖς μείζοσι τῶν ζωῶν, κερατοφόρον δὲ μικρὸν πάμπαν οὐδὲν ὑσμεν. ἐλάχιστον γὰρ ἐστὶ τῶν γνωριζομένων δορκάς. δεὶ δὲ τὴν φύσιν θεωρεῖν εἰς τὰ πολλὰ βλέποντα: ἥ γὰρ ἐν τῷ παντὶ ἥ ὡς ἐπὶ τὸ πολὺ τὸ κατὰ φύσιν ἐστίν. τὸ δ’ ὀστῶδες εὖ

4 ἐστὶ Platt: εἶναι vulg.: εἶ ἐν Thurot.

* For the contrast between “necessary nature” and 222
PARTS OF ANIMALS, III. II.

been unable to bend; and the bull has no hands; so they had to be where they are—on the head. And being there, they offer the least possible hindrance to the movements of the body in general.

Deer alone have horns that are solid throughout; and deer alone shed their horns: this is done (a) on purpose to get the advantage of the extra lightness, (b) of necessity, owing to the weight of the horns. In other animals the horns are hollow up to a certain distance, but the tips are solid because solid tips are an advantage when striking. And to prevent undue weakness even in the hollow part, which grows out from the skin, the solid piece which is fitted into it comes up from the bones. In this way the horns are rendered most serviceable for offensive purposes and least hampering during the rest of the time.

This completes our statement of the purpose for which horns exist and the reason why some animals have them and some have not.

We must now describe the character of that "necessary nature," owing to which certain things are present of necessity, things which have been used by "rational nature" to subserve a "purpose." 

To begin with, then: the larger the animal, the greater the quantity of corporeal or earthy matter there is in it. We know no really small horned animal—the smallest known one is the gazelle. (To study Nature we have to consider the majority of cases, for it is either in what is universal or what happens in the majority of cases that Nature's ways are to be found. Now all the bone in animals’


223
καὶ πλείοντον ἐν τοῖς μεγάλοις ὡς ἐπὶ τὸ πολὺ βλέποντας εἶπεν. τὴν γοῦν τοιούτου σώματος περιττωματικὴν ὑπερβολὴν ἐν τοῖς μείζον τῶν ζών ὑπάρχουσαν ἐπὶ βοῆθειαν καὶ τὸ συμφέρον καταχρῆται ἡ φύσις, καὶ τὴν ρέουσαν ἐξ ἀνάγκης εἰς τὸν ἄνω τόπον τοῖς μὲν εἰς ὁδόντας καὶ χαμηλοῦσθαι ἀπένειμε, τοῖς δὲ εἰς κέρατα. διὸ τῶν κερατοφόρων οὐδέν ἐστιν ἀμφωδον· ἄνω γὰρ οὔκ ἔχει τοὺς προσθέους ὁδόντας· ἀφελοῦσα γὰρ ἐντεῦθεν ἡ φύσις τοῖς κέρασι προσέθηκε, καὶ ἡ διδομένη τροφὴ εἰς τοὺς ὁδόντας τούτους εἰς τὴν τῶν κεράτων αὐξήσιν ἀναλίσκεται. τοῦ δὲ τὰς θηλείας ἀλάφους κέρατα μὲν μὴ ἔχειν, περὶ δὲ τοὺς ὁδόντας ὁμοίως τοῖς ἄρρεσιν, αἰτιον τὸ τὴν αὐτὴν εἶναι φύσιν ἀμφοῖν καὶ κερατοφόρον, ἀφύρηται δὲ τὰ κέρατα ταῖς θηλείαις διὰ τὸ χρῆσιμα μὲν μὴ εἶναι μηδὲ τοῖς ἄρρεσιν, βλάπτεσθαι δὲ ἡσσον διὰ τὴν ἴσχυν.

Τῶν δὲ ἄλλων ζώων ὅσοις μὴ εἰς κέρατα ἀποκρίνεται τὸ τοιοῦτον μόριον τοῦ σώματος, ἐνίοις μὲν τῶν ὁδόντων αὐτῶν ἑπηύξησε τὸ μέγεθος κοινῆ πάντων, ἐνίοις δὲ χαμηλοῦσθαι ὡστερ κέρατα ἐκ τῶν γνάθων ἑποίησεν.

Περὶ μὲν οὖν τῶν ἐν τῇ κεφαλῇ μορίων ταύτῃ διωρίσθων.

III. Ὡπὸ δὲ τὴν κεφαλὴν ὁ αὐχένα πεφυκὼς ἐστὶ τοῖς ἔχουσιν αὐχένα τῶν ζώων. οὕ γὰρ πάντα τοῦτο τὸ μόριον ἔχει, ἀλλὰ μόνα τὰ ἔχοντα ὅν

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*a i.e. constituent substance. See on 648 a 2.
PARTS OF ANIMALS, III. ii.–III.

bodies consists of earthy matter; so if we consider the majority of cases, we can say that there is most earthy matter in the biggest animals.) At any rate, in the larger animals there is present a surplus of this corporeal or earthy matter, produced as a residue, and this Nature makes use of and turns to advantage to provide them with means of defence. That portion of it which by necessity courses upwards she allots to form teeth and tusks in some animals, and to form horns in others. And we can see from this why no horned animal has incisor teeth in both jaws, but only in the bottom jaw. Nature has taken away from the teeth to add to the horns; so that the nourishment which would normally be supplied to the upper teeth is here used to grow the horns. Why is it, then, that female deer, although they have no horns, are no better off for teeth than the male deer? The answer is: Both of them are, by nature, horned animals; but the females have lost their horns because they would be not only useless but dangerous. The horns are indeed of no more use to the males, but they are less dangerous because the males are stronger.

Thus in some animals this "part" of the body is secreted for the formation of horns; in others, however, it causes a general increase in the size of the teeth, and in others again it produces tusks, which are like horns springing out of the jaws instead of the head.

We have now dealt with the "parts" that appertain to the head.

III. The place of the neck, when there is one, is below the head. I say "when there is one," because only those animals have this part which also have
χάριν ὁ αὐχήν πέφυκεν· ταῦτα δὲ ἔστιν ὦ τε φάρυγξ καὶ ὁ καλοῦμενος οἰσοφάγος.

'Ο μὲν οὖν φάρυγξ τοῦ πνεύματος ἐνεκέν πέφυκεν· διὰ τούτου γὰρ εἰσάγεται τὸ πνεῦμα τὰ ζώα καὶ ἐκπέμπει ἀναπνέοντα καὶ ἐκπνέοντα. διὸ τὰ μὴ ἔχοντα πλεῦμονα οὐκ ἔχουσιν οὐδὲ αὐχένα, οἶδον τὸ τῶν ἱχθύων γένος. οὗ δὲ οἰσοφάγος ἔστι δι’ οὗ ἡ τροφὴ πορεύεται εἰς τὴν κοιλίαν· ὥσθ’ ὅσα μὴ ἔχει αὐχένα, οὐδὲ οἰσοφάγον ἐπιδήλως ἔχουσιν. οὐκ ἀναγκαῖον δ’ ἔχειν τὸν οἰσοφάγον τῆς τροφῆς ἐνεκέν· οὐθὲν γὰρ παρασκευάζει πρὸς αὐτὴν. ἔτι δὲ μετὰ τὴν τοῦ στόματος θέσιν ἐνδέχεται κεῖσθαι τὴν κοιλίαν εὐθέως, τὸν δὲ πλεῦμονα οὐκ ἐνδέχεται.

25 δεὶ γὰρ εἰναί τινα κοινὸν οἶδον αὐλώνα, δὶ οὗ μερείται τὸ πνεῦμα κατὰ τὰς ἀρτηρίας εἰς τὰς σύριγγας, διμερῆ ὅντα· καὶ κάλλιστ’ ἂν οὕτως ἀποτελοὶ τὴν ἀναπνοὴν καὶ ἐκπνοὴν. τοῦ δ’ ὄργανον τοῦ περὶ τὴν ἀναπνοὴν ἐξ ἀνάγκης ἔχοντος μήκος, ἀναγκαῖον τὸν οἰσοφάγον εἶναι μεταξὺ τοῦ στόματος καὶ τῆς κοιλίας. ἔστι δὲ ὁ μὲν οἰσοφάγος σαρκώδης, ἔχων νευρώδη τάσιν, νευρώδης μὲν, ὡς ἔχῃ διάτασιν εἰσιούσις τῆς τροφῆς, σαρκώδης ἔδε, ὡς μαλακὸς ἢ καὶ ἐνδιδῷ καὶ μὴ βλάπτηται τραχυνόμενος ὑπὸ τῶν κατάρτων.

Ἀριστοτέλης

664 β ἐκ χονδρῶδους σώματος· οὐ γὰρ μόνον ἀναπνοῆς ἐνεκέν ἔστιν ἄλλα καὶ φωνῆς, δεὶ δὲ τὸ ψοφήσεων μέλλον λείον εἶναι καὶ στερεότητα ἔχειν. κεῖται δ’ ἐμπροσθὲν ἡ ἀρτηρία τοῦ οἰσοφάγου, καίπερ ἐμποδίζουσα αὐτὸν περὶ τὴν ὑποδοχὴν τῆς τροφῆς.

30 ἓν γὰρ τι παρεισρή ἔχειν ὡς ἄγρον εἰς τὴν ἀρτη-

1 διμερῆ ὅντα Peck: διμερῆς ὃν vulg.: διμεροῖς òntos Th.
PARTS OF ANIMALS, III.

those parts that the neck subserves—viz. the larynx and the oesophagus, as it is called.

The larynx is present for the sake of the breath: when animals breathe in and out, the breath passes through the larynx. Thus creatures which have no lung (e.g. fish) have no neck either. The oesophagus is the passage by which the food makes its way to the stomach; so those that have no neck have no distinct oesophagus. So far as food is concerned, however, an oesophagus is not necessary, since it exerts no action upon the food; and there is really no reason why the stomach should not be placed immediately next the mouth. The lung, however, could not be so placed, because some sort of tube must be present, common to both lungs, and divided into two, by which the breath is divided along the bronchial tubes into the air-tubes: this is the best method for securing good breathing, both in and out. This respiratory organ, then, of necessity, is of some length; and this necessitates the presence of an oesophagus, to connect the mouth to the stomach. Now the oesophagus is fleshy, and it can also be extended like a sinew. It is sinewy so that it can stretch as the food enters in; and it is fleshy so that it may be soft and yielding and not be damaged by the food grating on it as it goes down.

What are called the larynx and windpipe are constructed of cartilaginous substance, since the purpose they serve includes speech as well as respiration; and an instrument that is to produce sound must be smooth and firm. The windpipe is situated in front of the oesophagus, although it causes it some hindrance when food is being admitted—as when a piece of food, no matter whether solid or fluid, gets
Several

ούκ ευθέως εἰς τὴν κύστιν συλλέγεται τὸ ύγρόν,

ἐπὶ τῶν εἰσὶ τῆς κοιλίαν πρότερον τὰ γὰρ τῆς κοιλίας

περιττόματα φαίνεται χρωματίζειν ἢ ἤλος τοῦ μέλανος οὐνοῦ. συμβεβηκε δὲ τοῦτο πολλάκις φανερὸν

καὶ ἐπὶ τῶν εἰς τὴν κοιλίαν τραυμάτων. ἀλλὰ γὰρ

ἐνώς εὐθῆς τὸ τούς εὐθείας πῶν λόγων λιαν ἐξετάζειν.

‘Ἡ δ’ ἀρτηρία τῶν διακείσθαι, καθάπερ εἴπομεν,

ἐν τῷ πρόσθεν ὑπὸ τῆς τροφῆς ἐνοχλεῖσθαι. ἀλλ’ ἢ

φύσις πρὸς τούτῳ μεμηχάνηται τῇ ἐπιγλωττίδᾳ,

ταύτην δ’ οὐκ ἔχουσιν ἀπαντᾶ τὰ ζωοτοκοῦντα, ἀλλ’ ὡς πλεύμονα ἐχει καὶ τὸ δέρμα τριχωτὸν, καὶ

μὴ φολιδωτὰ μηδὲ πτερωτὰ πέφυκεν. τούτοις δ’

ἀντὶ τῆς ἐπιγλωττίδος συνάγεται καὶ διοίγεται ὃ

φάρυγξ ὄνπερ τρόπον ἐκεῖνος. ἐπιβάλλει τε καὶ

ἀναπτύσσεται, τοῦ ὑπερ τῇ εἰσόδῳ τε καὶ ἐξόδῳ ἀναπτυσσόμενος, τῆς δὲ τροφῆς εἰσ-
into the windpipe by mistake, and causes a great deal of choking and distress and violent coughing. This sort of thing occurs and can be observed whenever a piece of food goes the wrong way; yet they must be mysteries to those who hold that animals take in their drink by way of the windpipe. And there are many counts on which we can show that this is a ridiculous opinion to hold. (a) There is no passage leading from the lung into the stomach, such as the oesophagus, which, as we can see, leads thither from the mouth. And again, (b) there is no doubt where the fluid discharge comes from in cases of vomiting and sea-sickness. (c) It is plain, too, that the fluid matter which we take does not collect immediately in the bladder, but goes first into the stomach. This is shown by the fact that the dregs of dark wine affect the colour of the residual discharge from the stomach; and this colouring has often been observed in cases where the stomach has been wounded. Still, perhaps it is silly to be too minute in discussing these silly theories.

The windpipe, as we have said, is situated in front, and therefore is interfered with by the food. To deal with this difficulty, Nature has contrived the epiglottis. Not all Vivipara have this, but only those which have a lung, and a hairy skin, and are not covered with horny scales or feathers. Those that are so covered have, to serve instead of the epiglottis, a larynx which closes and opens, just as the epiglottis does in the others; it comes down and lifts up again: it lifts up during the entrance and exit of the breath, and subsides while food is being taken, to prevent

\[\text{See e.g. Plato, } \text{Timaeus 70c7, and Taylor ad loc.}\]

\[\text{Ogle changes the text here to read "blooded animals," which brings the statement nearer the truth.}\]
664 b

ιούσης ἐπιπτυσσόμενος, ἵνα μηθέν παραρρυή πρὸς 1
30 τὴν ἀρτηρίαν. Εάν δὲ τι πλημμελθῆ παρὰ τὴν
tοιαύτην κίνησιν καὶ προσφερομένης τῆς τροφῆς
ἀναπνεύσῃ τις, βήχας καὶ πυγμοῦς ποιεῖ, καθάπερ
εὑρηται. οὕτω δὲ καλῶς μεμηχάνηται καὶ ἡ ταύτης
καὶ ἡ τῆς γλώττης κίνησις, ὥστε τῆς τροφῆς ἐν μὲν
τῷ στόματι λεαινομένης, παρ' αὐτῇ δὲ διούσης,
tὴν μὲν ὀλυγάκις ὑπὸ τοὺς ὁδόντας πίπτειν, εἰς δὲ
tὴν ἀρτηρίαν σπάνιον τι παραρρεῖν.

665 a

Οὐκ ἔχει δὲ τὰ λεχθέντα ξώα τὴν ἐπιγλωττίδα
dia τὸ ξηρᾶς εἶναι τὰς σάρκας αὐτῶν καὶ τὸ δέρμα
σκληρὸν, ὥστε οὐκ ἂν εὐκίνητον ἢν τὸ τοιοῦτον
μόριον αὐτῶν ἐκ τοιαύτης σαρκοῦς καὶ ἐκ τοιοῦτος
δέρματος συνεστηκός, ἀλλ' αὐτής τῆς ἀρτηρίας
tῶν ἐσχάτων θάσσων ἐγίνετ' ἄν ἡ συναγωγή τῆς ἐκ
tῆς οὐκελας σαρκός ἐπιγλωττίδος, ἦν ἔχουσι τὰ
τριχωτά.

Δι' ἦν μὲν οὖν αὐτίαν τὰ μὲν ἔχει τῶν ξώων τὰ δ' οὐκ ἔχει, ταῦτ' εἰρήσθω, καὶ διότι τῆς ἀρτηρίας τὴν
φαυλότητα τῆς θέσεως ἱατρευκέν ἡ φύσις, μηχανή-
σαμένη τὴν καλουμένην ἐπιγλωττίδα. κεῖται δ' ἐμπροσθεὶν ἡ φάρυγξ τοῦ οἰσοφάγου ἡ ἀνάγκης. ἤ
μὲν γὰρ καρδία ἐν τοῖς ἐμπροσθεὶν καὶ ἐν μέσω
κεῖται, ἐν ἡ τὴν ἀρχὴν φαμεν τῆς ξώης καὶ πάσης
κινήσεως τε καὶ αἰσθήσεως (ἐπὶ τὸ καλοῦμενον γὰρ
ἐμπροσθεὶν ἡ αἰσθήσις καὶ ἡ κίνησις· αὐτῶ γὰρ τῷ
λόγῳ τούτῳ διώρισται τὸ ἐμπροσθεὶν καὶ ὀπίσθεν),
ὅ δὲ πλεύμων κεῖται οὐ ἡ καρδία καὶ περὶ ταύτην,
ἡ δ' ἀναπνοὴ διὰ τοῦ τούτου καὶ διὰ τῆς ἀρχῆς τῆν
ἐν τῇ καρδίᾳ ἐνυπάρχοναν. ἤ δ' ἀναπνοὴ γίνεται
tοῖς ξώοις διὰ τῆς ἀρτηρίας· ὥστε ἐπεὶ τὴν καρδίαν

1  τρὸς ΠΣ:  παρὰ vulg.
anything coming in by mistake into the windpipe. If there is any error in this movement, or if you breathe in while you are taking food, coughing and choking results, as I have said. But the movement of the epiglottis and of the tongue has been so neatly contrived that while the food is being masticated in the mouth and is passing over the epiglottis, the tongue seldom gets in the way of the teeth, and hardly ever does any food slip into the windpipe.

I mentioned some animals that have no epiglottis. This is because their flesh is dry and their skin hard; and thus if they had one, it would not move easily, because it would have to be made out of constituents of this sort. It is quicker to contract the edges of the windpipe itself than it would be to close an epiglottis, if, as in the hairy creatures, it were made out of the same sort of flesh as the rest of their bodies.

This will suffice to show why some animals have an epiglottis and some not; how Nature has contrived it so as to remedy the unsatisfactory position of the windpipe in front of the oesophagus. Still, the windpipe is bound by necessity to be in this position for the following reason. The heart is situated in the middle of the body and in the fore part of it; and in the heart, we hold, is the principle of life and of all movement and sensation. Both of these activities take place in the direction we call forwards: that is the very principle which constitutes the distinction between before and behind. The lung is situated in the region of the heart, and surrounding it. Now breathing takes place for the sake of the lung and the principle which is situated in the heart: and the breath passes through the windpipe. So, since the

2 τοῦτον SUY: τοῦτο vulg. 

231
ἐν τοῖς ἐμπροσθεν πρώτην ἀναγκαῖον κεῖσθαι, καὶ τὸν φάρυγγα καὶ τὴν ἀρτηρίαν πρότερον ἀναγκαῖον κεῖσθαι τοῦ οἰσοφάγου· τὰ μὲν γὰρ πρὸς τὸν πλεῦμον τείνει καὶ τὴν καρδίαν, ὁ δὲ εἰς τὴν κοιλίαν. Ὅλως δὲ ἀεὶ τὸ βέλτιον καὶ τιμωτέρον, ὅπου μηδὲν μείζον ἔτερον ἔμποδίζει, τοῦ μὲν ἀνω καὶ κάτω ἐν τοῖς μάλλον ἐστὶν ἄνω, τοῦ δ’ ἐμπροσθεν καὶ ὀπίσθεν ἐν τοῖς ἐμπροσθεν, τοῦ δεξιοῦ δὲ καὶ ἀριστεροῦ ἐν τοῖς δεξιοῖς.

Καὶ περὶ μὲν αὐχένοις τε καὶ οἰσοφάγου καὶ ἀρτηρίας εὑρήται, ἐπόμενον δ’ ἐστὶ περὶ σπλάγχνων εἰπέν.

IV. Ταύτα δ’ ἐστὶν ἵδια τῶν ἐναίμων, καὶ τοῖς μὲν ἄπαντ’ ὑπάρχει, τοῖς δ’ οὐχ ὑπάρχει. τῶν δ’ ἀναίμων οὐδέν έχει σπλάγχνον. Δημόκριτος δ’ ἐσείκεν οὐ καλῶς διαλαβεῖν περὶ αὐτῶν, εἰπερ ψήθη διὰ μικρότητα τῶν ἀναίμων ζωῆς ἄδηλα εἶναι ταύτα. συνισταμένων γὰρ εὐθέως τῶν ἐναίμων καὶ πάμπαν ὀντων μικρῶν ἐνδηλα γίνεται καρδία τε καὶ ἡπερ’ φαίνεται γὰρ ἐν μὲν τοῖς φωίς ἐνίοτε τριτάιοις

665 b οὕσι στιγμῆς ἐχοντα μέγεθος, πάμμικρα δὲ καὶ ἐν τοῖς ἐκβολίμοις τῶν ἐμβρύων. ἔτι δ’ ὡσπερ τῶν ἐκτός μορίων οὐ πάσι τῶν αὐτῶν χρήσις, ἀλλ’ ἐκάστοις ἑδρα πεπόρισται πρὸς τε τοὺς βίους καὶ τὰς κινήσεις, οὕτω καὶ τὰ ἐντός ἄλλα πέφυκεν ἄλλοις.

Τὰ δὲ σπλάγχνα τῶν αἰματικῶν ἐστὶν ἰδία, διὸ καὶ συνέστηκεν αὐτῶν ἐκαστὸν εἰς αἰματικῆς ὑλῆς. δήλου δ’ ἐν τοῖς νεογνοῖς τούτων αἰματωδέστερα γὰρ καὶ μέγιστα κατὰ λόγον διὰ τὸ εἶναι τὸ εἶδος

* Limited by Aristotle to blood-like viscera only.
PARTS OF ANIMALS, III. III.–IV.

heart must of necessity be situated in the front place of all, both the larynx and the windpipe, which lead to the lung and the heart, must of necessity be situated in front of the oesophagus which leads merely to the stomach. Speaking generally, unless some greater object interferes, that which is better and more honourable tends to be above rather than below, in front rather than at the back, and on the right side rather than on the left.

We have now spoken of the neck, the oesophagus, and the windpipe, and our next topic is the viscera.

IV. Only blooded animals have viscera. Some, but not all, have a complete set of them. As no bloodless animals have them, Democritus must have been wrong in his ideas on this point, if he really supposed that the viscera in bloodless creatures are invisible owing to the smallness of the creatures themselves. Against this we can put the fact that the heart and the liver are visible in blooded animals as soon as they are formed at all, that is, when they are quite small: in eggs they are visible, just about the size of a point, sometimes as early as the third day, and very small ones are visible in aborted embryos. Further, just as each animal is equipped with those external parts which are necessary to it for its manner of life and its motion, and no two animals require exactly the same ones, so it is with the internal parts: they vary in the various animals.

Viscera, then, are peculiar to the blooded animals, and that is why each one of the viscera is formed of blood-like material. This is clearly to be seen in the new-born offspring of blooded animals; in them the viscera are more blood-like, and at their largest in
The first observer after Aristotle to realize the disparity in the relative sizes of the parts with time was Leonardo da Vinci (A.D. 1452–1518).
PARTS OF ANIMALS, III. iv.

proportion: this is because the nature of the material and its bulk are especially obvious at the first stage of a creature's formation. The heart is present in all blooded animals, and the reason for this has been already stated: It is obviously necessary for all blooded creatures to have blood, and as blood is a fluid, there must of necessity be a vessel to hold it, and it is evidently for this purpose that Nature has contrived the blood-vessels. And these blood-vessels must have a source—one source (one is always better than many where it is possible), and this source is the heart. This is certain, because the blood-vessels come out of the heart and do not pass through it; and again, the heart is homogeneous and in character identical with the blood-vessels. Furthermore, the place in which it is set is the place of primacy and governance. It is in a central position, and rather in the upper part of the body than the lower, and in front rather than at the back; Nature always gives the more honourable place to the more honourable part, unless something more important prevents it. What I have just said is seen most clearly in the case of man, yet in other animals the heart tends in a similar way to be in the centre of the "necessary body," i.e. the portion of it which is terminated by the vent where the residues are discharged. The limbs vary in the various animals, and cannot be reckoned among the parts that are "necessary" for life, which is why animals can lose them and still remain alive; and obviously they could have limbs added to them without being killed.

Those who suppose that the source of the blood-vessels is in the head are wrong, because: (1) this involves holding that there are many sources,
30 τόπω ψυχρῶ. δηλοὶ δὲ δύσριγος ὡν, ὃ δὲ περὶ τὴν καρδίαν τοῦναντίον. ὥσπερ δ' ἐλέχθη, διὰ μὲν τῶν ἄλλων σπλάγχνων διέχουσιν αἱ φλέβες, διὰ δὲ τῆς καρδίας οὐ διατείνει φλέβι· οθεν καὶ δῆλον ὅτι μόριον καὶ ἀρχὴ τῶν φλεβῶν ἐστὶν ἡ καρδία. καὶ τούτ' εὐλόγως· μέσον γὰρ τὸ τῆς καρδίας ἐστὶ
35 σῶμα πυκνὸν καὶ κοίλον πεφυκὸς, ἐτι δὲ πλῆρες

666 a αἵματος ὡς τῶν φλεβῶν ἐντεύθεν ἡγιμένων, κοίλον μὲν πρὸς τὴν ὑποδοχὴν τοῦ αἵματος, πυκνὸν δὲ πρὸς τὸ φυλάσσειν τὴν ἀρχὴν τῆς θερμότητος. ἐν ταύτῃ γὰρ μόνη τῶν σπλάγχνων καὶ τοῦ σώματος
5 αἵμα ἀνευ φλεβῶν ἐστὶν, τῶν δ' ἄλλων μορίων ἔκαστον ἐν ταῖς φλεβῶν ἔχει τὸ αἵμα. καὶ τούτ' εὐλόγως· ἐκ τῆς καρδίας γὰρ ἐποχετεύεται [καὶ]1 εἰς τὰς φλέβας, εἰς δὲ τὴν καρδίαν οὐκ ἄλλοθεν· αὕτη γὰρ ἐστὶν ἀρχὴ καὶ πηγὴ τοῦ αἵματος ἡ ὑποδοχὴ πρώτη. ἐκ τῶν ἀνατομῶν δὲ κατάδηλα μᾶλλον
taúta, καὶ ἐκ τῶν γενέσεων· εὐθέως γὰρ ἐστὶν ἐναίμων πρώτῃ γινομένῃ τῶν μορίων ἀπάντων. ἔτι
δ' αἱ κυνήσεις τῶν ἡδέων καὶ τῶν λυπηρῶν καὶ
ὅλως πάσης αἰσθήσεως ἐντεῦθεν ἀρχόμεναι φαι-
νονται καὶ πρὸς ταύτην περαίνουσαι. οὔτω δ' ἔχει
καὶ κατὰ τὸν λόγον, ἀρχήν γὰρ εἰναι δεὶ μίαν, ὅπως
15 ενδέχεται· εὐφυεστατος δὲ τῶν τόπων ὁ μέσος, ἐν
gὰρ τὸ μέσον καὶ ἐπὶ πᾶν ἐφικτὸν ὁμοίως ἡ παρα-
πλησίως. ἔτι δ' ἐπεὶ οὔτε τῶν ἀναίμων οὔθεν

1 καὶ om. Z.

a Or "traverse." The connotation of this term seems to vary.
236
scattered about; and (2) it involves placing them in a cold region (its intolerance of cold proves this). The region round the heart, on the other hand, is warm. And (3) as has been said already, the blood-vessels run all through the other viscera, whereas none passes through the heart; which clearly shows that the heart forms part of the blood-vessels and is their source. Which is reasonable enough; since the centre of the heart is a body of dense and hollow structure, and this is full of blood; it is hollow to form a receptacle for the blood; dense to guard the source of heat; and the store of blood is obviously there because that is the starting-point of the blood-vessels. In none other of the viscera and in no other part of the body is there blood and yet no blood-vessels; in each of the other parts the blood is contained in blood-vessels. And this too is reasonable, as the blood is conveyed and conducted away from the heart into the blood-vessels, whereas none is thus conveyed into the heart from elsewhere, for the heart is itself the source and spring of the blood, or the first receptacle of it. All this, however, is more clearly brought out in Dissections and Formative Processes, where it is shown that the heart is the first of all the parts to be formed and has blood in it straightway. Further, all motions of sensation, including those produced by what is pleasant and painful, undoubtedly begin in the heart and have their final ending there. This is in accord with reason; since, wherever possible, there must be one source only; and the best situation for that is the centre, because there is only one centre, and the centre is equally (or nearly equally) accessible from every direction. Again, as every bloodless part, and the
AJISTOTLE

666 a

αἰσθητικῶν οὔτε τὸ αἷμα, δὴλον ὡς τὸ πρῶτον ἔχον ὡς ἐν ἀγγείῳ δ' ἔχον ἄναγκαιον εἶναι τὴν ἄρχην.

Οὐ μόνον δὲ κατὰ τὸν λόγον οὖτως ἔχειν φαίνεται, ἀλλὰ καὶ κατὰ τὴν αἴσθησιν. ἐν γὰρ τοῖς ἐμβρύωις εὐθέως ἡ καρδία φαίνεται κινουμένη τῶν μορίων καθάπερ εἰ ζῴων, ὡς ἄρχη τῆς φύσεως τοῖς ἐναίμοις οὕσα. μαρτύριον δὲ τῶν εἰρημένων καὶ τὸ πάσι τοῖς ἐναίμοις ὑπάρχειν αὐτὴν· ἄναγκαιον γὰρ αὐτοῖς ἔχειν τὴν ἄρχην τοῦ αἷματος. ὑπάρχει δὲ καὶ τὸ ἥπαρ πάσι τοῖς ἐναίμοις· ἀλλ' οὐθεὶς ἂν ἀξιώσειν αὐτὸ ἄρχην εἶναι οὔτε τοῦ ὅλου σώματος οὔτε τοῦ αἷματος· κεῖται γὰρ οὐδαμῶς πρὸς ἀρχοειδή θέσιν, ἔχει δ' ὦσπερ ἀντίζυγον ἐν τοῖς μάλιστ' ἀπηκριβω- μένοις τὸν σπλήνα. ἔτι δ' ὑποδοχὴν αἷματος οὐκ ἔχει ἐν ἑαυτῷ καθάπερ ἡ καρδία, ἀλλ' ὦσπερ τὰ λοιπὰ ἐν φλεβὶ. ἔτι δὲ τείνει δι' αὐτοῦ φλέψ, δι" ἐκείνης δ' οὐδεμία· πασῶν γὰρ τῶν φλεβῶν ἐκ τῆς καρδίας αἱ ἄρχαι. ἔπει οὖν ἀνάγκη μὲν θάτερον τούτων ἄρχην εἶναι, μὴ ἔστι δὲ τὸ ἥπαρ, ἀνάγκη τῆς καρδίας εἶναι καὶ τοῦ αἷματος ἄρχην. τὸ μὲν γὰρ ζῴον αἰσθήσει ὃρισται, αἰσθητικῶν δὲ πρῶτον τὸ πρῶτον ἐναίμον, τοιούτοι δ' ἡ καρδία· καὶ γὰρ

666 b ἄρχη τοῦ αἷματος καὶ ἐναίμον πρῶτον.

"Εστὶ δ' αὐτῆς τὸ ἄκρον δεῖ καὶ στερεώτερον,

1 δ' Θ.: ἐξ vulg.; μοξ ἐκείνου EUYZ.

blood itself as well, is without sensation, it is clear
that the part where the blood is present first, and
which holds it as in a receptacle, must of necessity be
the source.

This reasoning is supported by the evidence of
the senses. In embryos, as soon as they are formed,
the heart can be seen moving before any of the
other parts, just like a living creature; which
shows that it is the source of their nature in all
blooded animals. Another piece of evidence to
support this is that all blooded creatures have a
heart: why? because they are bound to have a
source for their blood. All blooded creatures, it is
true, have a liver too; but no one would care to
maintain that the liver is the source either of the
blood or of the whole body, because it is nowhere near
the place of primacy and governance, and, also, in
the most highly finished animals it has something
to counterbalance it, as it were, viz. the spleen.
Again, the liver has no receptacle for blood in itself
as the heart has: like the rest of the viscera, it keeps
its blood in a blood-vessel. Again, a blood-vessel
runs all through it, whereas no blood-vessel runs
through the heart: all blood-vessels have their source
from the heart and begin there. Since, therefore, of
necessity the source must be one of these two, the
heart or the liver, and as it is not the liver, it must of
necessity be the heart which is the source of the blood
just as it is of the rest. An animal is defined by the
fact that it possesses sensation: and the part of the
body to have sensation first is the part that has blood
in it first—in other words, the heart, which is the
source of the blood and the first part to have it.

The apex of the heart is sharp and more solid than
At De respir. 478 b 3. And see the next note.

Instead of towards the breast. The meaning of this passage is made clear by Hist. An. 507 a 2 ff. In all animals, says Aristotle, the "apex" of the heart points forwards, and in most animals "forwards" is towards the breast. Fishes
the rest, and it lies towards the breast, and altogether in the fore part of the body so as to prevent it from getting cooled: for in all animals the breast has comparatively little flesh on it, while the back is well supplied and so gives the heat of the body ample protection on that side. In animals other than man the heart is in the centre of the region of the breast; in man it inclines slightly to the left side so as to counteract the cooling there, for in man the left side is much colder than in other creatures. I have said already that the placing of the heart is the same in fishes as in other animals, though it appears to be different, together with the reasons for the apparent difference. In fishes its apex is turned towards the head; but in them the head is "forwards," because the head is in the line of direction in which they move.

The heart has in it an abundance of sinews, which is reasonable enough, as the motions of the body have their origin there; and as these are performed by contraction and relaxation, the heart needs the sinews to serve it and to give it strength. We have said already that the heart is like a living creature inside the body that contains it.

In all cases that we have examined the heart is boneless, except in horses and a certain kind of ox. In these, owing to its great size, the heart has a bone for a support, just as the whole body is supported by bones.

In the large animals, the heart has three cavities, in the smaller ones, two only; and in no species has it less than one. The reason for this has been given: there appear to be an exception to this rule, but only because in them "forwards" is towards the head.
καρδίας καὶ υποδοχήν τοῦ πρώτου αἵματος. (ὅτι
dὲ πρῶτον ἐν τῇ καρδίᾳ γίνεται τὸ αἴμα, πολλάκις
eἱρήκαμεν.) δὶὰ δὲ τὸ τάς ἀρχηγοὺς φλέβας δύο
eἶναι, τὴν τε μεγάλην καλουμένην καὶ τὴν ἀορτήν,
ἐκατέρας δ' οὖσας ἀρχής τῶν φλεβῶν, καὶ δια-
φορὰς ἔχουσών, περὶ δὲν ύστερον ἐροῦμεν, βέλτιον
καὶ τὰς ἀρχὰς αὐτῶν κεχωρίσθαι· τούτῳ δ' ἂν εἰη
dιφυοὺς ὄντος τοῦ αἵματος καὶ κεχωρισμένου.
dιόπερ ἐν οἷς ἐνδέχεται, δὺ εἰσὶν ὑποδοχαί. ἐν-
dέχεται δ' ἐν τοῖς μεγάλοις· τούτων γὰρ ἔχουσί καὶ
ἀι καρδίαι μέγεθος. ἔτι δὲ βέλτιον τρέτι εἰναι τὰς
kοιλίας, ὅπως ἦ μία ἀρχή κοινή· τὸ δὲ μέσον καὶ
περιττὸν ἀρχή· ὡστε μεγέθους δεῖ μείζονος αὐτάς
ἀεὶ, διόπερ αἰ μέγισται τρεῖς ἔχουσι μόναι.

Τούτων δὲ πλείστων μὲν αἴμα καὶ θερμότατον
ἔχουσιν αἰ δεξιά (διὸ καὶ τῶν μερῶν θερμότερα τὰ
δεξιά), ἐλάχιστον δὲ καὶ ψυχρότερον αἰ ἀριστεράι,
μέσον δ' αἰ μέσαι τῷ πλήθει καὶ θερμότητι, καθα-
ρώτατον δ' δεῖ γὰρ τὴν ἀρχὴν ὅτι μάλιστ' ἥρεμεῖν,
τοιαύτῃ δ' ἂν εἰη καθαροῦ τοῦ αἵματος ὄντος, τῷ
πλήθει δὲ καὶ θερμότητι μέσου.

'Ἐχουσὶ δὲ καὶ διάρθρωσῖν τινα αἴ καρδίαι παρα-
πλησίαν ταῖς ῥαφαῖς. οὐκ εἰσὶ δὲ συναφεῖς ὡς
tinos ἐκ πλειόνων συνθέτου, ἀλλὰ καθάπερ εἴπομεν,
diathrōswsei mállos. εἰσὶ δὲ τῶν μὲν αἰσθητικῶν
ἀρθρωδέστεραι, τῶν δὲ νωθροτέρων ἀναρθρότεραι,
must be some place in the heart which will be a receptacle for the blood when first formed. (As we have stated several times, blood is first formed in the heart.) Now there are two chief blood-vessels, the so-called Great Blood-vessel, and the Aorta; each of these is the source of other blood-vessels; and the two differ from each other (this will be discussed later); hence it is better for them to have separate sources. This result can be obtained by having two separate supplies of blood, and thus we find two receptacles wherever this is possible, as in the larger animals which of course have large hearts. But it is better still to have three cavities, and then there is an odd one in the middle which can be a common source for the other two; since, however, this requires the heart to be particularly large, only the very largest hearts have three cavities.

Of these cavities it is the right-hand one which contains the most blood and the hottest (that is why the right side of the body is hotter than the left); the left-hand cavity contains least blood, and it is colder. The blood in the middle cavity is intermediate both in amount and heat, although it is the purest of them all; this is because the source must remain as calm as possible, and this is secured when the blood is pure, and intermediate in its amount and heat.

The heart has also a sort of articulation, which resembles the sutures of the skull. By this I do not mean to say that the heart is a composite thing, consisting of several parts joined together, but an articulated whole, as I said. This articulation is more distinct in animals whose sensation is keen, and less distinct in the duller ones, such as swine. There are
καθάπερ αἱ τῶν ὑών. αἱ δὲ διαφοραὶ τῆς καρδίας κατὰ μέγεθός τε καὶ μικρότητα καὶ σκληρότητα τε καὶ μαλακότητα τείνουσιν πη καὶ πρὸς τὰ ἦθη· τὰ μὲν γὰρ ἀναισθητὰ σκληρὰν ἔχει τῇν καρδίαν καὶ πυκνῆν, τὰ δὲ αἰσθητικὰ μαλακωτέραν, καὶ τὰ μὲν μεγάλας ἔχουσα τὰς καρδίας δειλά, τὰ δὲ ἐλάσσος καὶ μέσας θαρραλεώτερα (τὸ γὰρ συμβαίνον πάθος ὑπὸ τοῦ φοβείσθαι προὐπάρχει τούτοις διὰ τὸ μῆ ἀνάλογον ἔχειν τὸ θερµὸν τῇ καρδίᾳ, μικρὸν δ’ ὅν ἐν μεγάλοις ἀµαυρούσθαι, καὶ τὸ αἱµα ψυχρότερον εἶναι). μεγάλας δὲ τὰς καρδίας ἔχουσι λαγώς, ἐλαφος, μῦσ, ὑαινα, ὄνος, πάρδαλις,¹ γαλῆ, καὶ τάλλα σχεδον πάνθ’ ὁσα φανερῶς δειλὰ ἡ διὰ φόβον κακούργα.

Παραπλησίως δὲ καὶ ἐπὶ τῶν φλεβῶν καὶ ἐπὶ τῶν κοιλίων ἔχει· ψυχραί γὰρ αἱ μεγάλαι φλέβες καὶ κοιλίαι. ὡσπερ γὰρ ἐν μικρῷ καὶ ἐν μεγάλῳ οἰκήματι τὸ ἴσον πῦρ ἢςον ἐν τοῖς μείζοσι θερµαίνει, οὕτω καὶ τούτως τὸ θερµὸν· ἀγγεία γὰρ καὶ ἡ φλέβη καὶ ἡ κοιλία. ἐτὶ δ’ αἱ ἀλλότριαι κινήσεις ἐκαστὸν τῶν θερμῶν καταψύχουσιν, ὡς δὲ ταῖς εὐρυχωρεστέραις τὸ πνεῦμα πλεῖον καὶ ἐνισχύει μάλλον· διὸ τῶν μεγαλοκοιλίων οὐδὲν οὐδὲ τῶν μεγαλοφλεβῶν πιὸν ἐστι κατὰ σάρκα, ἀλλὰ πάντα ἡ τὰ πλείοτα τῶν τοιούτων ἀδηλόφλεβα καὶ µικρο- κοιλία φαίνεται.

Μόνον δὲ τῶν σπλάγχνων καὶ ὅλως τῶν ἐν τῷ

¹ πάρδαλις] δορκάλις Platt.
other differences in the heart; some hearts are large, some small, some are hard, some soft; and these tend by some means to influence the creature's temperament. Illustrations of this are: animals whose powers of sensation are small have hearts that are hard and dense, those whose sensation is keen have softer ones; and those with large hearts are cowardly, those with small or moderate-sized ones, courageous (this is because in the former class the affection which is normally produced by fear is present to begin with, as their heat is not proportionate to the size of their heart, but is small and therefore hardly noticeable in the enormous space that it occupies; so that their blood is comparatively cold). The following creatures have large hearts: the hare, the deer, the mouse, the hyena, the ass, the leopard, the marten, and practically all other animals whose cowardice is either outright or else betrayed by their mischievous behaviour.

Similar conditions obtain in the blood-vessels and the cavities of the heart: if they are large, they are cold. The effect of the same-sized fire is less in a large room than in a small one; and the same applies to the heat in these receptacles, the blood-vessels and the cavities. Further, extraneous motions have a cooling effect upon hot things; and the more roomy a receptacle is, the greater the amount of air (or _pneuma_) in it and the stronger its effect. Thus we find that no animal which has large cavities or large blood-vessels has fat flesh, and conversely, that all (or most) fat animals have indistinguishable blood-vessels and small cavities.

The heart is the only one of the viscera—indeed

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*a Cf. 650 b 27. See also 692 a 20.*
667 a

οὐ πάθος οὐδὲν ὑποφέρει, καὶ τούτ’ εὐλόγως· φθειρομένης γὰρ τῆς ἄρχης οὐκ ἔστιν εἶς οὐ γένοιτ’ ἀν βοήθεια τοῖς ἄλλοις ἐκ ταύτης ἡρτημένοις. σημείον δὲ τοῦ μηθὲν ἐπιδέχεσθαι πάθος τὴν καρδιὰν τὸ ἐν μηδενὶ τῶν θυμομένων ἐρείων ἀφθαί τοιοῦτον πάθος περὶ αὐτὴν ὥσπερ ἐπὶ τῶν ἄλλων ὀπλάγχων. οὐ τε γὰρ νεφρὸι πολλάκις φαίνονται λίθων μεστοὶ καὶ 5 φυμάτων καὶ δοθηνῶν καὶ τὸ ἦπαρ, ὁσαύτως δὲ καὶ ὁ πλεύμων, μάλιστα δ’ ὁ ὀπλήν. πολλὰ δὲ καὶ ἄτερα παθήματα συμβαίνοντα περὶ αὐτὰ φαίνεται, ἦκιστα δὲ τοῦ μὲν πλεύμωνος περὶ τὴν ἄρτηρίαν, τοῦ δ’ ἦπατος περὶ τὴν σύναψιν τῇ μεγάλῃ φλεβᾷ, καὶ τούτ’ εὐλόγως· ταύτη γὰρ μάλιστα κοινωνοῦσι τῇ καρδίᾳ. οὐσα δὲ διὰ νόσον καὶ τοιαύτα πάθη φαίνεται τελευτῶντα τῶν ζῶν, τούτως ἀνατεμνομένους φαίνεται περὶ τὴν καρδίαν νοσώδη πάθη.

Καὶ περὶ μὲν τῆς καρδίας, πολὰ τις, καὶ τίνος ἐνεκεν καὶ διὰ τίν’ αἰτίαν ὑπάρχει τοῖς ἐχουσιν, τοσαῦτ’ εἰρήσθω.

667 b

V. Ἐπόμενον δ’ ἂν εἴη περὶ τῶν φλεβῶν εἰπεῖν, τῆς τε μεγάλης καὶ τῆς ἀορτῆς· αὕτη γὰρ ἐκ τῆς καρδίας πρῶται δέχονται τὸ αἷμα, αἱ δὲ λοιπὰ τούτων ἀποφυάδες εἰσίν. ὅτι μὲν οὖν τοῦ αἵματος χάριν εἰσὶν, πρῶτερον εἰρηταί· τὸ τε γὰρ ὑγρὸν ἀπαν 20 ἀγγείου δεῖται, καὶ τὸ φλεβῶν γένος ἀγγείου, τὸ δ’ 246
the only part in the whole body—which cannot withstand any serious affection. This is readily understood: the other parts depend upon the heart, and when this source itself is ailing, there is no place whence they can obtain succour. A proof that the heart cannot put up with any affection is this: Never has the heart in a sacrificial victim been observed to be affected in the way that the other viscera sometimes are. Very often the kidneys are found to be full of stones, growths, and small abscesses; so is the liver, and the lung, and especially the spleen. Many other affections are observed in these organs; but in the lung they occur least often in that portion which is nearest the windpipe, and in the liver in that portion which is nearest its junction with the Great Blood-vessel. This is readily understood: those are the places where they are most closely in communication with the heart. Those animals, however, which die as the result of disease, and affections such as I have mentioned, when cut open are seen to have diseased affections of the heart.

We have now spoken of the heart: we have said what its nature is, what purpose it serves, and why it is present; and that will suffice.

V. I suppose that the next subject for us to discuss is the Blood-vessels, that is, the Great Blood-vessel and the Aorta. It is these into which the blood goes first after it leaves the heart, and the other blood-vessels are merely branches from these. We have already said that these blood-vessels are present for the sake of the blood: fluid substances always need a receptacle, and the blood-vessels generally are the receptacles which hold the blood. We may
αἷμα ἐν ταύταις: δἰοτι δὲ δῦο καὶ ἀπὸ μιᾶς ἀρχῆς καθ᾽ ἀπαν τὸ σῶμα διατείνουσι, λέγωμεν.

Τοῦ μὲν οὖν εἷς μίαν ἀρχὴν συντελεῖν καὶ ἀπὸ μιᾶς αὐτον τὸ μίαν ἔχειν πάντα τὴν αἰσθητικὴν ψυχὴν ἐνεργεία, ὡστε καὶ τὸ μόριον ἐν τὸ ταύτην ἔχον πρώτως (ἐν μὲν τοῖς ἑναίμοις κατὰ δύναμιν καὶ κατ᾽ ἐνέργειαν, τῶν δ’ ἑναίμων ἐνίοις κατ᾽ ἐνέργειαν μόνον), διὸ καὶ τὴν τοῦ θερμοῦ ἀρχὴν ἀναγκαίον ἐν τῷ αὐτῷ τόπῳ εἶναι: αὐτὴ δ’ ἐστὶν αἰτία καὶ τῷ αἵματι τῆς ὑγρότητος καὶ τῆς θερμοτητος. διὰ μὲν οὖν τὸ ἐν ἐνὶ εἶναι μορίῳ τὴν αἰσθητικὴν ἀρχὴν καὶ τὴν τῆς θερμότητος καὶ ἡ τοῦ αἵματος ἀπὸ μιᾶς ἐστὶν ἀρχῆς, διὰ δὲ τὴν τοῦ αἵματος ἑνότητα καὶ ἡ τῶν φλεβῶν ἀπὸ μιᾶς.

Δύο δ’ εἰσὶ διὰ τὸ τὰ σώματα εἶναι διμερῆ τῶν ἑναίμων καὶ πορευτικῶν· ἐν πάσι γὰρ τούτοις διώρισται τὸ ἔμπροσθεν καὶ τὸ ὀπισθον καὶ τὸ δεξιόν καὶ τὸ ἀριστερόν καὶ τὸ ἀνω καὶ τὸ κάτω.

ὁσοὶ δὲ τιμιώτερον καὶ ἡγεμονικῶτερον τὸ ἐμ-

668 a προσθεν τὸν ὀπισθον, τοσούτω καὶ ἡ μεγάλη φλέβῃ τῆς ἀορτῆς· ἡ μὲν γὰρ ἐν τοῖς ἐμπροσθεν, ἡ δ’ ἐν τοῖς ὀπισθαν κεῖται, καὶ τὴν μὲν ἀπαντ’ ἔχει τὰ ἑναίμα φανερῶς, τὴν δ’ ἐνα μὲν ἀμυνδρῶς ἐνα δ’ ἀφανῶς.

Τοῦ δ’ εἰς τὸ πᾶν διάδεδοσθαι τὸ σῶμα τὰς 5 φλεβὰς αὐτον τὸ παντὸς εἶναι τοῦ σώματος ὑλὴν τὸ αἷμα, τοῖς δ’ ἑναίμοις τὸ ἀνάλογον, ταῦτα δ’ ἐν

<sup>a</sup> And potentially many; cf. 682 a 4 ff.
now go on to explain why there are two of these blood-vessels, why they begin from a single source, and why they extend all over the body.

The reason why finally they both coincide in one source and also begin from one source is this. The sensory Soul is, in all animals, one actually; therefore the part which primarily contains this Soul is also one (one potentially as well as actually in the blooded animals, but in some of the bloodless animals it is only actually one), and for this reason the source of heat also must of necessity be in the selfsame place. But this concerns the blood, for this source is the cause of the blood’s heat and fluidity. Thus we see that because the source of sensation and the source of heat are in one and the same part, the blood must originate from one source too; and because there is this one origin of the blood, the blood-vessels also must originate from one source.

The blood-vessels are, however, two in number, because the bodies of the blooded creatures that move about are bilateral: we can distinguish in all of them front and back, right and left, upper and lower. And just as the fore part is more honourable and more suited to rule than the back part, so is the Great Blood-vessel pre-eminent over the Aorta. The Great Blood-vessel lies in front, while the Aorta is at the back. All blooded creatures have a Great Blood-vessel, plainly visible; but in some of them the Aorta is indistinct and in others it cannot be detected.

The reason why the blood-vessels are distributed all over the body is that blood (and in bloodless creatures, its counterpart) is the material out of which the whole body is constructed, and blood-vessels (and their counterparts) are the channels in
flebì kai τῷ ἀνάλογον κεῖσθαι. πῶς μὲν οὖν τρέφεται τὰ ζώα καὶ ἐκ τίνος καὶ τίνα τρόπον ἀναλαμβάνουσιν ἐκ τῆς κοιλίας ἐν τοῖς περὶ γενέσεως λόγοις μᾶλλον ἀρμόζει σκοτεῖν καὶ λέγειν.

10 [Συνισταμένων δὲ τῶν μορίων ἐκ τοῦ αἵματος, καθάπερ εἴπομεν, εὐλόγως ἢ τῶν φλεβῶν ρύσις διὰ παντὸς τοῦ σώματος πέφυκεν; δεὶ γάρ καὶ τὸ αἷμα διὰ παντὸς καὶ παρὰ πᾶν εῖναι, εὕπερ τῶν μορίων ἐκαστὸν ἐκ τούτου συνέστηκεν.]

"Εοικε δ’ ὡσπερ ἐν τε τοῖς κήποις αἱ ύδραγγύαι κατασκευάζονται ἀπὸ μιᾶς ἀρχῆς καὶ πηγῆς εἰς πολλοὺς ὄχετοὺς καὶ ἄλλους ἂεὶ πρὸς τὸ πάντη μεταδιδόναι, καὶ ἐν ταῖς οἰκοδομίαις παρὰ πᾶσαν τῇ τῶν θεμελίων ὑπογραφῆν λίθοι παραβέβληται, διὰ τὸ τὰ μὲν κηπευόμενα φύεσθαι ἐκ τοῦ ύδατος, τοὺς δὲ θεμελίους ἐκ τῶν λίθων οἰκοδομεῖσθαι, τὸν αὐτὸν τρόπον καὶ ἡ φύσις τὸ αἷμα διὰ παντὸς ὑχέτευκε τοῦ σώματος, ἐπειδὴ παντὸς ὕλη πέφυκε τούτο. γίνεται δὲ κατάδηλον εἰν τοῖς μάλιστα καταλεπτυσμένοις· οὕθεν γὰρ ἄλλο φαίνεται παρὰ τὰς φλέβας, καθάπερ ἔπι τῶν ἀμπελίνων τε καὶ συκίων φύλλων καὶ ὥσ’ ἄλλα τοιαύτα· καὶ γὰρ τούτων αὐανομένων φλέβες λείπονται μόνον. τούτων δ’ αὗτων ὧτι τὸ αἷμα καὶ τὸ ἀνάλογον τούτων δυνάμει σῶμα καί σάρξ ἢ τὸ ἀνάλογον ἔστιν· καθάπερ οὖν

1 ll. 10-13, quae praecedentia ll. 4-7 repetunt, secludenda.
2 αὐανομένων attice Bekker.

This seems to be an unnecessary repetition of the last sentence but one.

250
which this material is carried. As regards the manner in which animals are nourished, the source of the nourishment, and the processes by which they take it up from the stomach, it is more appropriate to consider these subjects and to discuss them in the treatise on *Generation*.

[But since the parts of the body are composed out of blood, as has been said, it is easy to see why the course of the blood-vessels passes throughout the whole body. The blood must be everywhere in the body and everywhere at hand if every one of the parts is constructed out of it.]

The system of blood-vessels in the body may be compared to those water-courses which are constructed in gardens: they start from one source, or spring, and branch off into numerous channels, and then into still more, and so on progressively, so as to carry a supply to every part of the garden. And again, when a house is being built, supplies of stones are placed all alongside the lines of the foundations. These things are done because (a) water is the material out of which the plants in the garden grow, and (b) stones are the material out of which the foundations are built. In the same way, Nature has provided for the irrigation of the whole body with blood, because blood is the material out of which it is all made. This becomes evident in cases of severe emaciation, when nothing is to be seen but the blood-vessels: just as the leaves of vines and fig-trees and similar plants, when they wither, leave behind nothing but the veins. The explanation of this is that the blood (or its counterpart) is, potentially, the body (that is, flesh—or its counterpart). Thus, just as in the irrigation system the
668 a ἐν ταῖς ὀχετείαις αἱ μέγισται τῶν τάφρων δια-
μένουσιν, αἱ δ’ ἐλάχισται πρῶται καὶ ταχέως υπὸ
tῆς ἱλύσος ἄφαιζονται, πάλιν δ’ ἐκλειπούσης
30 φανεραί γίνονται, τὸν αὐτὸν τρόπον καὶ τῶν φλεβῶν
αἱ μὲν μέγισται διαμένουσιν, αἱ δ’ ἐλάχισται γί-
νονται σάρκες ἐνεργεία, δυνάμει δ’ εἰσὶν οὐδὲν
ήσουν φλέβες. διὸ καὶ σωζόμενων τῶν σαρκῶν
καθ’ ὁτίον αἷμα ἰεὶ διαρομένων· καίτοι αὖν μὲν
φλεβὸς οὐκ ἔστιν αἷμα, φλέβιον δ’ οὔδὲν δὴλον,
35 ὤσπερ οὖθ’ ἐν τοῖς ὀχετοῖς αἱ τάφροι πρὶν ἡ τὴν
668 b ἱλὺν ἔξαιρεθήναι.

Ἐκ μειζόνων δ’ εἰς ἐλάσσους αἱ φλέβες ἂεὶ
προέρχονται ἐως τὸν γενέσθαι τοὺς πόρους ἐλάσ-
σους τῆς τοῦ αἵματος παχύτητος: δι’ ὅτι ὑπὸ τῶν
μὲν αἵματι δίδοσι οὐκ ἔστι, τῶ δὲ περιττώματι τῆς
ὕγρας ἰκμάδος, ὅν καλοῦμεν ἱδρώτα, καὶ τούτο
5 διαθερμανθέντος τοῦ σώματος καὶ τῶν φλεβῶν
ἀναστομωθέντων. ἥδη δὲ τισών ἱδρωσία συνέβη
αἵματῶδει περιττώματι διὰ καχεξίαν, τοῦ μὲν
σώματος ρυάδος καὶ μανοῦ γενομένου, τοῦ δ’ αἵ-
ματος ἔξυγρανθέντος δι’ ἀπεφί, ἀδυνατούσης τῆς
ἐν τοῖς φλεβίοις θερμότητος πέσσειν δι’ ὀλγότητα.
10 (εὔρητα γὰρ ὅτι πᾶν τὸ κοινὸν γῆς καὶ ὑδατὸς
παχύνεται πεσσόμενον, ἢ δὲ τροφῆ καὶ τὸ αἷμα
μικτὸν ἐξ ἀμφοῖν.) ἀδυνατεὶ δὲ πέσσειν ἡ θερμότης
οὐ μόνον διὰ τῆς αὐτῆς ὀλγότητα ἀλλὰ καὶ διὰ
πλῆθος καὶ ὑπερβολὴ τῆς εἰσφερομένης τροφῆς.

1 φλέβιον Bekker.

a Could Aristotle have seen a case of haematorporphyria?
PARTS OF ANIMALS, III. v.

biggest channels persist whereas the smallest ones quickly get obliterated by the mud, though when the mud abates they reappear; so in the body the largest blood-vessels persist, while the smallest ones become flesh in actuality, though potentially they are blood-vessels as much as ever before. Accordingly we find that, as long as the flesh is in a sound condition, wherever it is cut, blood will flow; and although no blood-vessels are visible, they must be there (because we cannot have blood without blood-vessels)—just as the irrigating channels are there right enough, but are not visible until they are cleared of mud.

The blood-vessels get progressively smaller as they go on until their channel is too small for the blood to pass through. But, although the blood cannot get through them, the residue of the fluid moisture, which we call sweat, can do so, and this happens when the body is thoroughly heated and the blood-vessels open wider at their mouths. In some cases, the sweat consists of a blood-like residue a: this is due to a bad general condition, in which the body has become loose and flabby, and the blood watery owing to insufficient concoction, which in its turn is due to the weakness and scantiness of the heat in the small blood-vessels. (We have already said that all compounds of earth and water are thickened by concoction, and this category includes food and blood.) The heat may, as I say, be in itself too scanty to be able to cause concoction, or it may be that it is scanty in comparison with the amount of food that enters the body, if

γίνεται δὲ πρὸς ταύτην ὀλίγη. ἡ δ’ ὑπερβολὴ
dισοτή: καὶ γὰρ τῷ ποσῷ καὶ τῷ ποιῳ: οὐ γὰρ πᾶν
ὁμοίως εὑπεπτον. (βεί δὲ μάλιστα τὸ αίμα κατὰ
touς εὐρυχωρεστάτους τῶν πόρων: διόπερ ἐκ τῶν
μυκτήρων καὶ τῶν οὐλων καὶ τῆς ἔδρας, ἐνιότε δὲ
καὶ ἐκ τοῦ στόματος αἰμορροίδες ἀπονοι γίνονται,
καὶ οὐχ ὠσπερ ἐκ τῆς ἀρτηρίας μετὰ βίας.)

20 Διεστώσαι δ’ ἀνωθεν ἢ τε μεγάλη φλεψ καὶ ἡ
ἀορτή, κάτω δ’ ἐναλλάσσουσαι συνέχουσι τὸ σῶμα.
προιόουσαι γὰρ σχίζονται κατὰ τὴν διφύσων τῶν
κώλων, καὶ ἡ μὲν ἐκ τοῦ ἐμπροσθεν εἰς τοῦπισθεν
προέρχεται, ἡ δ’ ἐκ τοῦ ὀπισθεν εἰς τοὐμπροσθεν,
καὶ συμβάλλουσιν εἰς ἐν· ὠςπερ γὰρ ἐν τοῖς πλεκο-
μένοις ἐγγίνεται τὸ συνεχὸς μάλλον, οὕτω καὶ διὰ
τῆς τῶν φλεβῶν ἐναλλάξεως συνδεῖται τῶν σωμά-
tων τὰ πρόσθια τοῖς ὀπισθεν. ὁμοίως δὲ καὶ ἀπὸ
tῆς καρδίας ἐν τοῖς ἀνω τόποις συμβαίνει. τὸ δὲ
μετ’ ἀκριβείας ὡς ἔχουσιν αἱ φλέβες πρὸς ἀλλήλας,
30 ἐκ τε τῶν ἀνατομῶν δεὶ θεωρεῖν καὶ ἐκ τῆς ζωικῆς
ἰστορίας.

Καὶ περὶ μὲν φλεβῶν καὶ καρδίας εἰρήσθω,
περὶ δὲ τῶν ἀλλῶν σπλάγχνων σκεπτέον κατὰ τὴν
αὐτὴν μέθοδον.

VI. Πλεύμονα μὲν οὖν ἔχει διὰ τὸ πεζὸν εἶναι τι
gένος τῶν ζώων. ἀναγκαίον μὲν γὰρ γίνεσθαι τῷ
35 θερμῷ κατά ἁφεὼν, ταύτης δὲ δεῖται θύραθεν τὰ
ἐναίμα τῶν ζώων· θερμότερα γὰρ. τὰ δὲ μὴ ἐναίμα

a The posterior vena cava.
this is excessive; and this excess may be due either to the quantity of it or (since some substances are less patient of concoction than others) to its quality. (Haemorrhage occurs most where the passages are widest, as from the nostrils, the gums and the fundament, and occasionally from the mouth. At these places it is not painful; when, however, it occurs from the windpipe, it is violent.)

The Great Blood-vessel and the Aorta, which in the upper part are some distance from each other, lower down change sides, and thus hold the body compact. That is to say, when they reach the place where the legs diverge, they divide into two, and the Great Blood-vessel goes over to the back from the front, and the Aorta to the front from the back; and thus they unite the body together, for this changing over of the blood-vessels binds together the front and the back of the body just as the crossing of the strands in plaiting or twining makes the material hold together more stoutly. A similar thing occurs in the upper part of the body, where the blood-vessels that lead from the heart are interchanged. For an exact description of the relative disposition of the blood-vessels, the treatises on Anatomy and the Researches upon Animals should be consulted.

We have now finished our discussion of the heart and the blood-vessels, and we must go on to consider the remaining viscera on the same lines.

VI. First the Lung. The reason why any group of Lung. animals possesses a lung is because they are land-creatures. It is necessary to have some means for cooling the heat of the body; and blooded animals are so hot that this cooling must come from outside
καὶ τῷ συμφύτῳ πνεύματι δύναται καταψύχειν. ἀνάγκη δὲ καταψύχειν ἐξοθεν ἢ ὑδατι ἢ ἀέρι. διόπερ τῶν μὲν ἱχθύων οὐδεὶς ἔχει πλεύμονα, ἀλλ' ἀντὶ τούτου βράγχια, καθάπερ εἰρηται ἐν τοῖς περὶ 5 ἀναπνοῆς, ὑδατι γὰρ ποιεῖται τὴν καταψύξιν· τὰ δ' ἀναπνέοντα τῷ ἀέρι, διόπερ πάντα τὰ ἀναπνέοντα ἔχει πλεύμονα. ἀναπνεῖ δὲ τὰ μὲν πεζά πάντα, ἔνα δὲ καὶ τῶν ἐνύδρων, οἷον φάλαινα καὶ δελφίς καὶ τὰ ἀναφυσώντα κήτη πάντα· πολλά γὰρ τῶν ζῴων ἐπαμφοτερίζει τὴν φύσιν, καὶ τῶν τε πεζῶν καὶ τῶν ἀέρα δεχόμενων διὰ τὴν τοῦ σώματος κράσιν ἐν υγρῷ διάτελεῖ τὸν πλείστον χρόνον, καὶ τῶν ἐν τῷ ύγρῷ μετέχει τοσοῦτον ἐναὶ τῆς πεζῆς φύσεως ὅστ' ἐν τῷ πνεύματι αὐτῶν εἰναι τὸ τέλος τοῦ ζην.

Τοῦ δ' ἀναπνεῶν ὁ πλεύμων ὄργανόν ἐστι, τὴν μὲν 15 ἀρχὴν τῆς κινήσεως ἔχουν ἀπὸ τῆς καρδίας, ποιῶν δ' εὐρυχωρίαν τῇ εἰσόδῳ τοῦ πνεύματος διὰ τὴν αὐτοῦ συμφοτήτα καὶ τὸ μέγεθος· αἱρομένον μὲν γὰρ εἰσρεῖ τὸ πνεῦμα, συνιόντος δ' ἐξερχεῖται πάλιν. τὸ δὲ πρὸς τὴν ἀλοιν εἰναι τὸν πλεύμονα τῆς καρδίας οὐκ εἰρήται καλῶς· ἐν ἀνθρώπῳ τε γὰρ συμβαίνει μόνον ὃς εἰπεῖν τὸ τῆς πτήσεως διὰ τὸ μόνον ἐν ἐλπίδι γίνεσθαι καὶ προσδοκία τοῦ μέλλοντος, ἀπέχει τ' ἐν τοῖς πλείστοις πολὺν τόπον καὶ κεῖται τὴν θέσιν ἀνωτέρω τοῦ πλεύμωνος, ὥστε μηδὲν συμβάλλεσθαι τὸν πλεύμονα πρὸς τὴν ἀλοιν τῆς καρδίας.

Διαφέρει δ' ὁ πλεύμων πολὺ τοῖς ζῴοις. τὰ μὲν

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*a* See above, on 659 b 17.  
*b* 476 a 6.  
*c* See above, on 650 b 19 ff.  
*d* This view is expressed by Timaeus in Plato's *Timaeus*, 70c.

256
them, though the bloodless ones can do their own cooling by means of the connate pneum.a Now external cooling must be effected either by water or by air. This explains why none of the fishes has a lung. They are water-cooled, and instead of a lung they have gills (see the treatise on Respiration). Animals that breathe, on the other hand, are air-cooled, and so they all have a lung. All land-animals breathe; so do some of the water-animals (e.g. the whale, the dolphin, and all the spouting cetacea). This is not surprising, for many animals are intermediate between the two: some that are land-animals and breathe spend most of their time in the water owing to the blend in their bodies; and some of the water-animals partake of the nature of land-animals to such an extent that the limiting condition of life for them lies in their breath.

Now the organ of breathing is the lung. It has its source of motion in the heart, and it affords a wide space for the breath to come into because it is large and spongy: when the lung rises up, the breath rushes in, and when it contracts the breath goes out again. The theory that the lung is provided as a cushion for the throbblings of the heart is not correct. This leaping of the heart is practically not found except in man, and that is because man is the only animal that has hope and expectation of the future. Besides, in most animals the heart is a long way off from the lung and lies well above it, and so the lung cannot be of any assistance in absorbing the throbblings of the heart.

There are many differences in the lung. Some

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a In quadrupeds the lung is above the heart, but not in man, owing to the difference of posture.
669 a

25 γὰρ ἐναίμον ἔχει καὶ μέγαν, τὰ δ’ ἐλάττω καὶ σομφόν, τὰ μὲν ζωτόκα διὰ τὴν θερμότητα τῆς φύσεως μείζω καὶ πολύαιμον, τὰ δ’ ζωτόκα ξηρὸν καὶ μικρόν, δυνάμενον δὲ μεγάλα διώκανθαι ἐν τῷ ἐμφυσάσθαι, ὁσπερ τὰ τετράποδα μὲν ζωτόκα δὲ τῶν πεζῶν, οίνον οἶ τε σαῦροι καὶ αἱ χελώναι καὶ πάν τὸ τουοῦτον γένος, ἔτι δὲ πρὸς τούτοις ἡ τῶν πτηνῶν φύσις καὶ καλομέμενων ὑρνίθων. πάντων γὰρ τούτων σομφός ὁ πλεύμων καὶ ὀμοῖος ἀφράτικα καὶ γὰρ ὁ ἀφράτος ἐκ πολλοῦ μικρὸς γίνεται συγχεόμενος, καὶ ὁ τούτων πλεύμων μικρὸς καὶ ὑμενώδης.

30 διὸ καὶ ἀδύφα καὶ ἀληγόποτα ταῦτα πάντα, καὶ δύναται πολὺν ἐν τῷ ύγρῷ ἀνέχεσθαι χρόνον ἀτε γὰρ ὁλίγον ἐχοντα θερμὸν ἴκανως ἐπὶ πολὺν χρόνον καταψυχεῖται ὦπ’ αὐτῆς τῆς τοῦ πλεύμονος κινήσεως, ὅντος ἀερώδους καὶ κενοῦ. 1

(Συμβέβηκε δὲ καὶ τὰ μεγέθη τούτων ἐλάττω τῶν ζώων ὡς ἐπιπαλεῖν εἰπεῖν· τὸ γὰρ θερμὸν αὐξητικῶν, ἡ δὲ πολυαιμία θερμότητος σημεῖον. ἐτὶ δ’ ὀρθοὶ

5 τὰ σῶματα μᾶλλον, διόπερ ἀνθρωπος μὲν τῶν ἀλλῶν ὁρθότατον, τὰ δὲ ζωτόκα τῶν ἀλλῶν τετραπόδων· οὐδὲν γὰρ ὀμοίως τρωγλοδυτεί τῶν ζωοτόκων, οὐτ’ ἀποικοὺς ὀυτὲ πεζεύον.)

669 b Ὅλως μὲν οὖν ὁ πλεύμων ἐστὶν ἀναπνοῆς χάριν, ἀναμίσος δὲ καὶ τουοῦτος γένους τινὸς ἐνεκεν ζώων·

10 ἀλλ’ ἀνώνυμον τὸ κοινὸν ἐπ’ αὐτῶν, καὶ οὐχ ὁσπερ

1 οὖτος . . . κενοῦ Thurot: οὐσίας . . . κενῆς vulg.

258

a Cf. 653 a 30 ff.
animals have a large lung, which contains blood; others a small one and spongy. In the Vivipara it is large and has much blood in it because these creatures have a hot nature: in the Ovipara it is dry and small, but it can expand to a great size when inflated: examples of these are: among land-animals, the oviparous quadrupeds like the lizards, tortoises, and all such creatures, and in addition to these the tribe of winged things, the birds. All these have a spongy lung, which, like froth, runs together and contracts from a large volume into a small one. So it counts as small; and also it is membranous. As a result, all these creatures are not much subject to thirst, and drink but little; and also they can bear to remain a long time under the water: this is because their heat is scantly and can therefore be sufficiently cooled over a long period by the mere motion of the lung, which is void and air-like.

(Consequently, one may add, in general these creatures are smaller in size than the majority of animals, as growth is promoted by heat, and a plentiful supply of blood is a sign that heat is present. Furthermore, heat tends to make the body upright, a which explains why man is the most upright among the animals and the Vivipara the most upright among the quadrupeds. And there are no viviparous creatures, either with or without feet, so fond of creeping into holes as the Ovipara are.)

The lung, then, is present for the sake of the breathing: this is its function always. Sometimes, to serve the purpose of a particular group, it is bloodless, and such as has been described above. There is no common name which is applied to all animals that have lungs. But there ought to be: because
ο ὁρνις ὅνομασται ἐπὶ τινὸς γένους. διὸ ὦσπερ τὸ ῥυμιθι εἶναι ἐκ τινὸς ἔστι, καὶ ἐκεῖνων ἐν τῇ οὐσίᾳ ὑπάρχει τὸ πλεύμονα ἔχειν.

VII. Δοκεῖ δὲ τῶν σπλάγχνων τὰ μὲν εἶναι μονοφυή, καθάπερ καρδία καὶ πλεύμων, τὰ δὲ διφυή, καθάπερ νεφροί, τὰ δ’ ἀπορεῖται ποτέρως ἔχει. φανεῖ γὰρ ἂν ἐπαμφοτερίζειν τούτοις τὸ ἥπαρ καὶ ὁ σπλήν καὶ γὰρ ὡς μονοφυὲς ἐκάτερον, καὶ ὡς ἄνθ’ ἐνός δύο παραπλησίων ἔχοντα τὴν φύσιν. ἐστὶ δὲ πάντα διφυὰ. τὸ δ’ αἰτίων ἢ τοῦ σώματος διάστασις διφυῆς μὲν οὐσά, πρὸς μίαν δὲ συντελοῦσα ἀρχὴν τὸ μὲν γὰρ ἄνω καὶ κάτω, τὸ δ’ ἐμπρόσθεν καὶ ὀπισθεν, τὸ δὲ δεξιὸν καὶ ἀριστερὸν ἔστιν. διόπερ καὶ οὗ ἐγκέφαλος βούλεται διμερῆς εἶναι πάσι καὶ τῶν αἰσθητηρίων ἐκαστον. κατὰ τὸν αὐτὸν δὲ λόγον ἡ καρδία ταῖς κοιλίαις. ὦ δὲ πλεύμων ἐν γε 1 τοῖς ᾲστόκοις τοσοῦτον διέστηκεν

20 ὥστε δοκεῖν δῦ’ ἔχειν αὐτὰ πλεύμονας. οἱ δὲ νεφροὶ καὶ παντὶ δήλοις κατὰ δὲ τὸ ἥπαρ καὶ τὸν σπλῆνα δικαίως ἂν τις ἀπορήσειεν. τούτου δ’ αἰτίων ὅτι ἐν μὲν τοῖς εὖ ἀνάγκης ἔχουσι σπλήνα δόξειεν ἂν οἶον νόθον εἶναι ἥπαρ ὁ σπλῆν, ἐν δὲ τοῖς μη εὖ ἀνάγκης ἔχουσιν, ἀλλὰ πάμμικρον ὦσπερ

30 σημεῖου χάριν, ἐναργῶς διμερῆς τὸ ἥπαρ ἔστιν, καὶ τὸ μὲν (μεῖζον) 2 εἰς τὰ δεξιά, τὸ δ’ ἐλαττων εἰς ταριστερὰ βούλεται τὴν θέσιν ἔχειν. οὐ μὴν ἀλλὰ καὶ ἐν τοῖς ᾲστόκοις ἦττων μὲν ἢ ἑτὶ τούτων φανερῶν, ἐνώς δὲ [κάκεις] ὦσπερ ἐν τισὶ 3 ζωοτόκοις ἐπιδήλως διέστηκεν, οἶον κατὰ τινὰς τόπους οἱ δασύποδες δῦο

1 γε Peck: τε vulg. 2 μεῖζον coniceram; maior pars Σ. 3 seclusi: ὦσπερ ἐν τισί om. EY: κάκεινων coni. Th.
the possession of a lung is one of their essential characteristics, just as there are certain characteristics which are included in the essence of a "bird," the name which is applied to another such class.

VII. Some of the viscera appear to be single (e.g. the heart and the lung); others double (e.g. the kidneys); and some it is difficult to place under either heading. The liver and the spleen apparently are intermediate; they can be considered either as each being a single organ, or else as two organs taking the place of one and having a similar character. In fact, however, all of them are double. And the reason for this is that the structure of the body is double, though its halves are combined under one source. We have upper and lower halves, front and back halves, right and left halves. Thus even the brain as well as each of the sense-organs tends in all animals to be double; so does the heart—it has cavities. In the Ovipara the lung is so much divided that they appear to have two lungs. The kidneys are obviously double; but there is fair room for hesitation about the liver and spleen. This is because in those animals which of necessity have a spleen, the spleen looks rather like a bastard liver, while in those which have a spleen though not of necessity—i.e. a very small one, as it were by way of a token—the liver is patently double, and the larger part of it tends to lie towards the right, the smaller towards the left. Still, there are cases even among the Ovipara where this division is less distinct than in those just described, while in some Vivipara the division is unmistakable—e.g. in some districts
669 b
35 δοκοῦσαι ἦπατ' ἔχειν, καθάπερ τῶν ἱχθύων ἐτεροί τε τινες καὶ οἱ σελαχώδεις.

670 a
Διὰ δὲ τὸ τὴν θέσιν ἔχειν τὸ ἦπαρ ἐν τοῖς δεξιοῖς µᾶλλον ἡ τοῦ σπληνὸς γέγονε φύσις, ὡστ' ἀναγκαῖον µὲν πώς, µὴ λιᾷ δ' εἶναι πᾶσι τοῖς ζῷοις.
Τοῦ µὲν οὖν δικυρὶ ἡν φύσιν εἶναι τῶν σπλάγχνων αὐτίων, ὡσπερ εἰποµεν, τὸ δ' εἶναι τὸ δεξιὸν καὶ τὸ ἀριστερόν· ἐκάτερον γὰρ ζητεῖ τὸ ὦµοιον, ὡσπερ καὶ αὐτὰ βούλεται παραπλησίαν καὶ διδύμην ἔχειν τὴν φύσιν, καὶ καθάπερ ἐκεῖνα δίδυµα µὲν, συνήρτηται δ' εἰς ἐν, καὶ τῶν σπλάγχνων ὦµοίως ἐκατον.

"Εστι δὲ σπλάγχνα τα κάτω τοῦ υποζώµατος κοινῇ µὲν πάντα τῶν φλεβῶν χάρῳ, ὅπως οὖσαι µετέωροι µένωσι τῷ τούτων συνδέσμω πρὸς τὸ σώµα. καθάπερ ἀγκυραῖ γὰρ βεβληνται πρὸς τὸ σώµα διὰ τῶν ἀποτεταµένων µορίων· ἀπὸ µὲν τῆς µεγάλης φλεβὸς πρὸς τὸ ἦπαρ καὶ τὸν σπλήνα, τούτων γὰρ τῶν σπλάγχνων ἡ φύσις οἶον ἥλιοι πρὸς τὸ σώµα προσλαµβάνουσιν αὐτήν, εἰς µὲν τὰ
15 πλάγια τοῦ σώµατος τῷ θ' ἦπαρ καὶ ὁ σπλήν τῆς φλέβα τῆς µεγάλην (ἀπὸ ταύτης γὰρ εἰς αὐτὰ µόνον διατείνουσι φλέβες), εἰς δὲ τὰ ὀπίσθεν οἱ νεφροί πρὸς δ' ἐκείνους οὐ µόνον ἀπὸ τῆς µεγάλης φλεβὸς ἀλλὰ καὶ ἀπὸ τῆς ἀορτῆς τεῦνε φλέψ εἰς ἐκάτερον.

Ταύτα δὴ συµβαίνει διὰ τούτων τὴν συντάσσει τῶν ζώων· καὶ τὸ µὲν ἦπαρ καὶ ὁ σπλήν βοηθεῖ πρὸς τὴν πέψιν τῆς τροφῆς (ἐναιµα γὰρ οὔτα θερ-

1 καὶ καθάπερ ΡΖ: καὶ om. vulg.

262
hares appear to have a couple of livers; so do certain fishes, especially the cartilaginous ones.\(^a\)

The spleen owes its existence to the liver being placed somewhat over to the right-hand side of the body: this makes the spleen a necessity in a way, though not an urgent one, for all animals.

Thus, the reason why the viscera are double in their formation is, as we have said, that the body is two-sided, having right and left. Each of the two aims at similarity, just as the sides themselves strive to have a similar nature, and to be as like as twins; and just as the sides, though dual, are conjoined together into a unity, so also it is with the several viscera.

The viscera which are below the diaphragm are all of them present for the sake of the blood-vessels, in order that the latter may have freedom of carriage and at the same time be attached to the body by means of the viscera, which act as a bond. Indeed, there are, as it were, anchor-lines thrown out to the body through the extended parts: e.g. from the Great Blood-vessel to the liver and to the spleen, for these viscera act, as it were, like rivets and fasten it to the body; that is to say, the liver and the spleen fasten the Great Blood-vessel to the sides of the body (since blood-vessels pass to them from it alone), while the kidneys fasten it to the rear parts. And to the kidneys—to each of them—there is a blood-vessel passing not only from the Great Blood-vessel but also from the Aorta.

These advantages, then, accrue to the animal organism from the lower viscera. Liver and spleen also assist in the concoction of the food, since they both

\(^a\) Sharks, etc.
μὴν ἔχει τὴν φύσιν), οἱ δὲ νεφροὶ πρὸς τὸ περίττωμα τὸ εἰς τὴν κύστιν ἀποκρινόμενον.

Καρδία μὲν οὖν καὶ ἦπαρ πᾶσιν ἀναγκαίᾳ τοῖς ἱππαῖς, ἢ μὲν διὰ τὴν τῆς θερμότητος ἀρχήν (δεῖ γὰρ εἶναι τινα οἶνον ἑστίαν, ἐν ᾗ κείσεται τῆς φύσεως τὸ ξωπυροῦν, καὶ τούτω εὐφύλακτον, ὧσπερ ἀκρόπολις οὖσα τοῦ σώματος), τὸ δὲ ἦπαρ τῆς πέψεως χάριν. πάντα δὲ δεῖται τὰ ἐναίμα δυών τοῦτοι, διόπερ ἔχει πάντα τὰ ἐναίμα δύο τὰ σπλάγχνα ταῦτα. ὥσα δ' ἀναπνεῖ, καὶ πλεύμονα τρίτον.

Ὁ δὲ σπλήν κατὰ συμβεβηκός ἐξ ἀνάγκης ὑπ-ἀρχεῖ τοῖς ἔχοσιν, ὦσπερ καὶ τὰ περιττώματα, τό τ' ἐν τῇ κοιλίᾳ καὶ τό περὶ τὴν κύστιν. διόπερ ἐν τισιν ἐκλείπει κατὰ τὸ μέγεθος, ὡσπερ τῶν τε πτερωτῶν εἶνοις, ὅσα θερμήν ἔχει τὴν κοιλίαν, οἶον

περιστερά, ἱέραξ, ἴκτινος, καὶ ἐπὶ τῶν ψωτόκων δὲ καὶ τετραπόδων ὁμοίως (μικρὸν γὰρ πάμπαν ἔχοσιν), καὶ πολλοῖς τῶν λεπιδωτῶν· ἀπέρ καὶ κύστιν οὐκ ἔχει διὰ τὸ τρέπεσθαι τὸ περίττωμα διὰ μανῶν τῶν σαρκῶν εἰς πτερὰ καὶ λεπίδας. ὅ γὰρ

σπλήν ἀντισπᾷ ἐκ τῆς κοιλίας τᾶς ἰκμάδας τᾶς περιττευούσας, καὶ δύναται συμπέτευει αἰματώδης ὑών. ἂν δὲ τὸ περίττωμα πλεῖον ἢ ἢ ἀλγόθερμος ὁ σπλήν, νοσακερὰ γίνεται πλήρης ² ὁ ὀξύα ³ τροφής· καὶ διὰ τὴν ἐνταῦθα παλέρρουαν τῆς υγρότητος πολ-λοίς αἱ κοιλίαι σκληραὶ γίνονται σπληνύσων, ὥσ-

1 ταῦτα P: ταῦτα μόνον vulg.
2 πλήρης EYZ: πλήρη vulg.
3 ὁ ὀξύα Peck.

264
have blood in them and so are hot. The kidneys assist in connexion with the residue which is excreted into the bladder.

Now the heart and the liver are necessary to all animals. The heart is necessary because there must be a source of heat: there must be, as it were, a hearth, where that which kindles the whole organism shall reside; and this part must be well guarded, being as it were the citadel of the body. The liver is necessary for the sake of effecting concoction. All blooded creatures must have these two viscera, and that is why these two are always present in them. A third, the lung, is present in those animals that breathe.

But the spleen, where present, is present of necessity in the sense of being an incidental concomitant, as are the residues in the stomach and in the bladder. So in some animals the spleen is deficient in size, as in certain birds which have a hot stomach, e.g. the pigeon, the hawk, and the kite; the same applies to the oviparous quadrupeds (all of these have an extremely small spleen) and to many of the scaly creatures. These animals just mentioned also lack a bladder, because their flesh is porous enough to enable the residues formed to pass through it and produce feathers and scales. For the spleen draws off the residual humours from the stomach and in virtue of its blood-like nature can assist in the concoction of them. If, however, the residue is too bulky or the spleen has too little heat, the stomach gets full of nourishment and becomes diseased. And in many cases, when the spleen is ailing, the stomach becomes hardened owing to the fluid which runs back into it. This happens with
tās ὑγρότητας. οἷς δὲ ὀλίγη περίττωσις γίνεται, καθάπερ τοῖς ὀρνεοῖς καὶ τοῖς ἴχθυσι, τὰ μὲν οὐ μέγαν ἔχει, τὰ δὲ σημείου χάριν. καὶ ἐν τοῖς τετράποσι δὲ τοῖς ὄστοκοις μικρὸς καὶ στυφρὸς καὶ νεφρώδης ὁ σπλήν ἔστι διὰ τὸ τὸν πλεύμονα σομφὸν εἶναι καὶ ὀλυγοποτεῖν καὶ τὸ περιγινόμενον περίττωμα τρέπεσθαι εἰς τὸ σῶμα καὶ τὰς φολίδας, ὥσπερ εἰς τὰ πτερὰ τοῖς ὀρνισιν.

Ἐν δὲ τοῖς κύστιν ἔχουσι καὶ τὸν πλεύμονα ἐναλμόν ὕγρόσ ἔστι διὰ τὴν εἰρημένην αὐτίαν καὶ διὰ τὸ τὴν φύσιν τὴν τῶν ἀριστερῶν ὅλως ὕγροτέραν εἶναι καὶ ψυχροτέραν. διήρηται γὰρ τῶν ἐναντίων ἐκαστοῦ πρὸς τὴν συγγενῆ συστοιχίαν, οἷον δεξιόν ἐναντίον ἁριστερῷ καὶ θερμὸν ἐναντίον ψυχρῷ· καὶ σύστοιχα γὰρ ἀλλήλους εἰσὶ τὸν εἰρημένου τρόπον.

Οἱ δὲ νεφροὶ τοῖς ἔχουσιν οὐκ ἔξ ἀνάγκης ἀλλὰ τοῦ εὕ καὶ καλῶς ἔνεκεν ὑπάρχουσιν τῆς γὰρ περιττώσεως χάριν τῆς εἰς τὴν κύστιν ἀδροίζομένης εἰσὶ κατὰ τὴν ἰδίαν φύσιν, ἐν δὲ τὴν πλείον ὑπόστημα γίνεται τὸ τοιοῦτον, ὡς βέλτιον ἀποδιδῷ ἢ κύστις τὸ αὐτῆς ἔργον.

Ἐπεὶ δὲ τῆς αὐτῆς ἕνεκα χρείας τοὺς τε νεφροὺς συμβεβήκεν ἔχειν τὰ ἔδα καὶ τὴν κύστιν, λεκτέουν περὶ κύστεως νῦν, ὑπερβάντας τὸν ἐφεξῆ ὁτὼν μορίων ἀριθμῶν· περὶ γὰρ φρενῶν οὐδὲν πώ δι-

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\* The reference to the "columns" or "double list" is not clear. There was a Pythagorean συστοιχία; this and other συστοιχίαι are mentioned in Ross’s note on his translation of Met. 986 a 23.

\* i.e. left and cold are both in the same column; right and hot are both in the other column.
those who make water excessively: the fluids are drawn back again into the stomach. But in animals where the amount of residue produced is small, as in birds and fishes, the spleen is either small or present simply by way of a token. In the oviparous quadrupeds, too, the spleen is small and compact, and like a kidney, because the lung is spongy and the animals drink little, and also because the residue which is produced is applied for the benefit of the body itself and of the scaly plates which cover it, just as in birds it is applied for the benefit of the feathers.

In those animals, however, which possess a bladder, and whose lung contains blood, the spleen is watery. The reason already given partly explains this. Another is that the left side of the body is generally more watery and colder than the right. As we know, the opposites are divided up into two columns, so that each is classed with those that are akin to it, e.g. right is in the opposite column to left, and hot to cold; and thus some of them stand together in the same column, as I have just indicated.

Kidneys are present in some animals, but not of necessity; they are present to serve a good purpose; that is to say, their particular nature enables them to cope with the residue which collects in the bladder, in those cases where this deposit is somewhat abundant, and to help the bladder to perform its function better.

Since the bladder is present in animals to serve precisely the same purpose as the kidneys, we must now say something about it. This will involve a departure from the serial order in which the parts actually come, for we have said nothing so far about
κύστιν. δ’ οὐ πάντ’ ἔχει τὰ ζώα, ἀλλ’ ἐοικεν ἡ φύσις βουλομένη ἀποδιδόναι τοῖς ἔχουσιν τὸν πλεύμονα ἕναμον μόνον, τούτοις δ’ εὐλόγως. διὰ γὰρ τὴν ὑπεροχὴν τῆς φύσεως, ἦν ἔχουσιν ἐν τῷ μορίῳ τούτῳ, διψητικά τε ταῦτα ’ἐστὶ μάλιστα τῶν ζώων, καὶ δεῖται τροφῆς οὐ μόνον τῆς ἔηρας ἀλλὰ καὶ τῆς υγρᾶς πλεύνονος, ὥστ’ ἔξ ἀνάγκης καὶ περίττωμα γίνεσθαι πλεύνω καὶ μὴ τοσοῦτον μόνον ὅσον ὑπὸ τῆς κοιλίας πέττεσθαι καὶ ἐκκρίνεσθαι μετὰ τοῦ ταύτης περιττώματος. ἀνάγκη τοῖνυν εἶναι τῷ δεκτικόν καὶ τοῦτον τοῦ περιττώματος. διόπερ ὅσα πλεύμονα ἔχει τοιοῦτον, ἀπαντ’ ἔχει κύστιν. ὅσα δὲ μὴ τοιοῦτον, ἀλλ’ ἡ ὀλυγόποτα ἐστὶ διὰ τὸ πλεύμονα ἔχειν σομφόν, ἡ ὅλως τὸ ύγρὸν προσφέρεται οὐ ποτοῦ χάριν ἀλλὰ τροφῆς, οὐν τὰ ἐντομα καὶ οἱ ἱχθύες, ἐτὶ δὲ πτεροτά ἐστιν ἡ λεπιδωτὰ ἡ φολιδωτά, ταῦτα δ’ ὀλυγότητα τε τῆς τοῦ ὕγρου προσφορᾶς καὶ διὰ τὸ τρέπεσθαι εἰς ταῦτα τὸ περιγυνόμενον τοῦ περιττώματος οὐδὲν ἔχει τούτων κύστιν, πλὴν αἱ χελώναι τῶν φολιδωτῶν, καὶ ἐνταῦθ’ ἡ φύσις κεκολάβωται μόνον· αὕτιον δ’ ὅτι αἱ μὲν θαλάτται σαρκώδη καὶ ἕναμον ἔχουσι τὸν πλεύμονα καὶ ὁμοιον τῷ βοείῳ, αἱ δὲ χερσαίαι μείζω ἡ κατὰ λόγον. ἔτι δὲ διὰ τὸ ὀστρακώδες καὶ πυκνὸν εἶναι τὸ περιέχον οὐ διαπνέοντος τοῦ ύγροῦ διὰ μανῶν τῶν σαρκῶν, οἶνον τοῖς ὄρνυσι καὶ τοῖς ὄφεσι καὶ τοῖς ἀλλοις τοῖς φολιδωτοῖς, ὑπό-
the diaphragm, though this is one of the parts that are near the viscera.

VIII. The bladder is not present in all animals: Nature seems to have intended only those animals which have blood in their lung to have a bladder. And this is quite reasonable, when we remember that such animals have an excess of the natural substance which constitutes the lung, and are therefore more subject to thirst than any others; i.e. they need a larger amount of fluid food as well as of the ordinary solid food, and the necessary result of this is that a larger amount of residue also is produced, too large in fact for all of it to be concocted by the stomach and excreted with its own proper residue; hence it is necessary to have some part that will receive this additional residue. This shows us why all animals which have blood in their lung possess a bladder too. As for those whose lung is spongy and which therefore drink little, or which take fluids not as something to drink but as food (e.g. insects and fishes), or which are covered with feathers or scales or scaly plates, not one of these has a bladder, owing to the small amount of fluid which they take and owing to the fact that the surplus residue goes to form feathers or scales or scaly plates, as the particular case may be. Exceptions to this are the Tortoises: though scaly-plated they have a bladder. In them the natural formation has simply been stunted. The cause of this is that in the sea-varieties the lung is fleshy and contains blood, and is similar to the lung of the ox; while in the land-varieties it is disproportionately large. And whereas in birds and snakes and the other scaly-plated creatures the moisture exhalles through the porous flesh, in these it
ARISTOTLE

στασις γίνεται τοσαύτη ὡστε δεῖσθαι τὴν φύσιν αὐτῶν ἔχειν τι μόριον δεκτικὸν καὶ ἀγγειώδες. κύστιν μὲν οὖν ταῦτα μόνον τῶν τοιούτων ἔχει διὰ ταύτην τὴν αἰτίαν, ἢ μὲν θαλάσσια μεγάλην, αἱ δὲ χερσαίαι μικρὰν πάμπαν.

IX. 'Ομοίως δ' ἔχει καὶ περὶ νεφρῶν. οὐδὲ γὰρ νεφρῶς οὔτε τῶν πτερωτῶν καὶ λεπιδωτῶν οὐδὲν ἔχει οὔτε τῶν φολιδωτῶν, πλὴν αἱ θαλάσσιαι χελώναι καὶ αἱ χερσαίαι· ἀλλ' ὡς τῆς εἰς τοὺς νεφρῶς τεταγμένης σαρκὸς οὐκ ἔχουσις χώραν ἀλλὰ διεσπαρμένης εἰς πολλὰ, πλατέα νεφροειδῆ ἐν ἐνίοις τῶν ὄρνιθων ἐστίν. ἢ δ' ἐμὸς οὔτε κύστιν οὔτε νεφρῶς ἔχει· διὰ τὴν μαλακότητα γὰρ τοῦ χελώνιου εὐδιάπνουν γίνεται τὸ υγρόν. ἢ μὲν οὖν ἐμὸς διὰ ταύτην τὴν αἰτίαν οὐκ ἔχει τῶν μορίων ουδέτερον· τοῖς δ' ἄλλοις ζῴοις τοῖς ἔχουσιν ἐν-

αμον, ὥσπερ ἐφηται, τὸν πλεύμονα πᾶσι συμβεβηκεν ἔχειν νεφροὺς. καταχρηται γὰρ ἡ φύσις ἀμα τῶν τε φλεβῶν χάριν καὶ πρὸς τὴν τοῦ υγρού περιττόματος ἐκκρισιν· φέρει γὰρ εἰς αὐτοὺς πόρος ἐκ τῆς μεγάλης φλεβῶς.

'Εχοσι δ' οἱ νεφροὶ πάντες κολλοῦν, ἤ πλεῖον ἢ ἐλαττον, πλὴν ὡς τῆς φώκης· οὔτων δ' ομοίως τοῖς βοείοις ὁντες στερεώτατοι πάντων εἰσίν. ομοίως δὲ καὶ οἱ τοῦ ἀνθρώπου τοῖς βοείοις· εἰσὶ γὰρ ὥσπερ συγκείμενοι ἐκ πολλῶν νεφρῶν μικρῶν καὶ οὐχ ὀμαλεῖς, ὥσπερ οἱ τῶν προβάτων καὶ τῶν ἄλλων τῶν τετραπόδων. διὸ καὶ τὸ ἀρρώστημα τοῖς

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a Greek, “hemys.” This description, which does not fit
cannot do so, because the integument which surrounds them is dense, like a shell; and so the excretion is produced in such quantities that the Tortoises need some part which shall act as a vessel to receive it. That, then, is why they are the only animals of the kind which have a bladder. In the sea-tortoise it is large, in the land-tortoise quite small.

IX. Much the same may be said of the kidneys as of the bladder. Kidneys are not present in any of the animals that have feathers or scales or scaly plates, except the two sorts of tortoises just mentioned. In some birds, however, there are flat kidney-shaped objects, as if the flesh that was allotted to form the kidneys had found no room for its proper function and had been scattered to form several organs. The *Emys* has neither bladder nor kidneys: this is because it has a soft shell which allows the moisture to transpire freely through it. But, as I said before, all the other animals whose lung contains blood have kidneys, since Nature makes use of them for two purposes: (1) to subserve the blood-vessels; and (2) to excrete the fluid residue. (A channel leads into them from the Great Blood-vessel.)

There is always a hollow (*lumen*), varying in size, in the kidneys, except in the seal, whose kidneys are more solid than any others and in shape resemble those of the ox. Human kidneys too resemble those of the ox: they are, as it were, made up out of a number of small kidneys, and have not an even surface like those of the sheep and other quadrupeds. Thus, when once an ailment attacks the human any animal now known as *Emys*, seems to be that of some freshwater tortoise.

*b* This is not true of the normal adult, but it is true of the foetus.
ΑΡΙΣΤΟΤΛΕ

671 b

10 ἀνθρώποις δυσαπάλλακτον αὐτῶν ἦστιν, ἡν ἀπαξ νοσήσωσιν· συμβαίνει γάρ ὡσπερ πολλοὺς νεφροῦς νοσοῦντων χαλεπώτεραν εἶναι τὴν ἰασιν ἢ τῶν ἕνα νοσοῦντων.

'Ὁ δὲ ἀπὸ τῆς φλεβὸς τείνων πόρος οὐκ εἰς τὸ κοῖλον τῶν νεφρῶν κατατελεύτα, ἀλλ' εἰς τὸ σῶμα καταναλίσκεται τῶν νεφρῶν· διότι ἐν τοῖς κοιλοῖς αὐτῶν οὐκ ἐγγίνεται αἷμα, οὐδὲ πῆγνυται τελευτώντων. ἐκ δὲ τοῦ κοῖλον τῶν νεφρῶν φέροντι πόροι ἁναίμοι εἰς τὴν κύστιν δύο νεανικοί, ἐξ ἐκατέρου εἰς, καὶ ἀλλοι ἐκ τῆς ἀορτῆς ἰσχυροῦ καὶ συνεχέις. ταῦτα δὲ ἔχει τὸν τρόπον τούτον ὅπως ἐκ μὲν τῆς φλεβὸς τὸ περίττωμα τῆς υγρότητος βαδίζῃ εἰς τοὺς νεφροὺς, ἐκ δὲ τῶν νεφρῶν ἡ γινομένη ὑπόστασις διηθομένων τῶν υγρῶν διὰ τοῦ σώματος τῶν νεφρῶν εἰς τὸ μέσον συρρέγγει, οὐ τὸ κοῖλον οἱ πλεῖστοι ἔχουσιν αὐτῶν (διὸ καὶ δυσωδέστατον τότῳ τῶν σπλάγχνων ἐστὶν). ἐκ δὲ τοῦ μέσου διὰ τούτων τῶν πόρων εἰς τὴν κύστιν ἦδη μάλλον ὡς περίττωμα ἀποκρίνεται. καθάρωρμεται δ' ἡ κύστις ἐκ τῶν νεφρῶν τεῖνουσι γάρ, ὡσπερ εἴρηται, πόροι ἰσχυροῦ πρὸς αὐτήν.

Οἱ μὲν οὖν νεφροὶ διὰ ταῦτα τὰς αἰτίας εἰςί, καὶ τὰς δυνάμεις ἔχουσι τὰς εἰρημένας.

Eύ πάσι δὲ τοῖς ἔχουσι νεφροὺς ὃς δεξιὸς ἀνωτέρω τοῦ ἀριστεροῦ ἦστιν· διὰ γὰρ τὸ τὴν κίνησιν εἶναι ἐκ τῶν δεξιῶν καὶ ἰσχυρότεραν διὰ ταῦτα εἶναι τὴν

* The ureters.
PARTS OF ANIMALS, III. ix.

kidneys, the trouble is not easily removed, because it is as though the patient had many kidneys diseased and not one only; and so the cure is more difficult to effect.

The channel which runs from the Great Blood-vessel to the kidneys does not debouch into the hollow part of the kidneys, but the whole of what it supplies is spent upon the body of the kidneys; thus no blood goes into the hollows, and at death none congeals there. From the hollow part of the kidneys two sturdy channels a lead into the bladder, one from each; these contain no blood. Other channels come from the Aorta to the kidneys; these are strong, continuous ones. This arrangement is on purpose to enable the residue from the moisture to pass out of the blood-vessel into the kidneys, and so that when the fluid percolates through the body of the kidneys the excretion that results may collect into the middle of the kidneys, where the hollow is in most cases. (This explains, incidentally, why the kidney is the most ill-scented of all the viscera.) From the middle of the kidney the fluid is passed off through the aforesaid channels into the bladder; by which time it has practically taken on the character of excremental residue. The bladder is actually moored to the kidneys: as has been stated, there are strong channels extending from them to it.

We have now given the causes for which the kidneys exist, as well as their character and functions.

The right kidney is always higher up than the left. The reason for this is that as motion always begins on the right-hand side, the parts that are on that side are stronger than those on the other; and owing to this
ARISTOTLE

671 b

φύσιν τήν τῶν δεξιῶν, δεὶ προσδοποιήσασθαι διὰ τήν κύνησιν πρὸς τὸ ἀνώ ταῦτα1 τὰ μόρια μᾶλλον, ἐπεὶ καὶ τὴν ὄφραν τὴν δεξιὰν ἀἱρουσι μᾶλλον καὶ ἐπικεκαμμένην ἔχουσι τῆς ἀριστερᾶς μᾶλλον. καὶ διὰ τὸ ἀνεσπάσθαι ἀνώτερον τῶν δεξιῶν νεφρῶν τὸ ἥπαρ ἀπτεται τοῦ δεξιοῦ νεφροῦ ἐν πᾶσιν· ἐν τοῖς

672 a δεξιοῖς γὰρ τὸ ἥπαρ.

'Εχουσι δ' οἱ νεφροὶ μάλιστα τῶν σπλάγχνων πιμελήν, εξ ἀνάγκης μὲν διὰ τὸ διηθείον τὸ περίττωμα διὰ τῶν νεφρῶν· τὸ γὰρ λειτομένων αἵμα καθαρὸν ὁν εὐπεπτόν ἔστι, τέλος δ' εὐπεφθαί

5 αἰματικῆς πιμελῆ καὶ στέαρ ἔστιν. (ὡσπερ γὰρ ἐν τοῖς πεπυρωμένοις ἡγροῖς, οἷον τῇ τέφρᾳ, ἐγκαταλείπεται τι πῦρ, οὕτω καὶ ἐν τοῖς πεπεμμένοις ἡγροῖς· ἐγκαταλείπεται γὰρ τῇ τῆς εἰργασμένης θερμότητος μόριον. διόπερ τὸ λιπαρὸν κούφον ἔστι καὶ ἐπιπολάζει ἐν τοῖς ἡγροῖς.) ἐν αὐτοῖς μὲν οὖν ὃ ἐν γίνεται τοῖς νεφροῖς διὰ τὸ πυκνὸν εἶναι τὸ σπλάγχνον, ἐξὼ δὲ περιόσταται πιμελῆ μὲν ἐν τοῖς πιμελῶδεσι, στέαρ δ' ἐν τοῖς στεατῶδεσι· ἡ δὲ διαφορὰ τούτων εἰρήται πρὸτερον ἐν ἐτέροις.

'Εξ ἀνάγκης μὲν οὖν πιμελῶδεις γίνονται διὰ ταύτην τὴν αἰτίαν ἐκ τῶν συμβαινόντων εξ ἀνάγκης τοῖς ἔχουσι νεφροὺς, ἐνεκα δὲ σωτηρίας καὶ τοῦ θερμῆν εἶναι τὴν φύσιν τὴν τῶν νεφρῶν. ἔσχατοι τε γὰρ οὗτοι ἀλέας δέονται πλείονος· τὸ μὲν γὰρ νῦνον σαρκῶδες ἔστιν, ὅπως ἵπποβολὴ τοῖς περὶ

1 ταῦτα Peck: πάντα vulg.

* See Book II. ch. v.
motion they are bound to make their way upwards before the ones on the left. Thus people raise the right eyebrow more than the left, and it is more arched. A result of this drawing up of the right kidney is that in all animals the liver, which is on the right side of the body, is in contact with it.

The kidneys contain more fat than any other of the viscera. This is partly a necessary consequence upon the percolation of the residue through the kidneys: in other words, the blood which gets left behind there is easy of concoction because it is pure, and when blood undergoes complete concoction the final products are lard and suet. (A parallel is to be found in the case of solid substances which have undergone combustion: e.g. a certain amount of fire gets left behind in ash. So, in fluid substances which have undergone concoction: some portion of the heat which has been generated remains behind. That is why oily substances are light and come to the top of fluids.) This fat is not formed actually in the kidneys themselves, because they are so dense: it collects outside them. In some it has the form of lard, in others the form of suet, according to the character of the animal. (The difference between the two has been explained already in another connexion.)

This formation of lard, then, about the kidneys is the necessary consequence upon the conditions which necessarily obtain in animals that possess kidneys. But there is another reason for its formation, and that is, on purpose to safeguard the kidneys themselves and to preserve their natural heat. The kidneys are the outermost of all the viscera, and therefore they need more warmth. Whereas the back is liberally supplied with flesh, which enables it to act as a
672a
tήν καρδίαν σπλάγχνους, ἢ δ’ ὁσφὺς ἄσαρκος
(ἄσαρκοι γὰρ αἱ καμπαὶ πάντων). ἀντὶ σαρκὸς οὐν
ἡ πιμελὴ πρόβλημα γίνεται τοῖς νεφροῖς. ἔτι δὲ
diaκρίνουσι καὶ πέπτουσι τήν υγρότητα μᾶλλον
πίνοντες οὖντες. τὸ γὰρ λιπαρὸν θερμόν, πέπτει δ’ ἡ
θερμότης.

Διὰ ταύτας μὲν οὖν τὰς αἰτίας οἱ νεφροὶ πιμελώ-
δεις εἰσίν, ἐν πάσι δὲ τοῖς ζῶοις ὁ δεξίως ἀπιμελώ-
terός ἐστιν. αἰτίου δὲ τὸ τῆν φύσιν ἔχον ἐίναι
25 τῆν τῶν δεξιῶν καὶ κινητικωτέραν. ἡ δὲ κίνησις
ἐναντία· τήκει γὰρ τὸ πῖον μᾶλλον.

Τοῖς μὲν οὖν ἄλλοις ζῶοις συμφέρει τε τοὺς
νεφροὺς ἔχειν πίνακας, καὶ πολλάκις ἔχουσιν ὅλους
περίπλεως· τὸ δὲ πρόβατον ὅταν τούτο πάθη
ἀποθνῄσκει. ἀλλ’ ἂν καὶ πάντα πίνοντες ὅσιν, ὅμως
30 ἐλλείπει τι, ἀν μὴ κατ’ ἀμφιτέρους, ἀλλὰ κατὰ τὸν
dεξιόν.1 αἰτίου δὲ τοῦ μόνον ἡ μάλιστα τοῦτο
συμβαίνειν ἐπὶ τῶν προβάτων, ὅτι τοῖς μὲν πιμε-
λώδεσιν υγρὸν τὸ πῖον, ὡς’ οὐχ ὁμοίως ἐγκατα-
κλειόμενα τὰ πνεύματα πολεῖ τὸν πόνον. τοῦ δὲ
σφακελισμοῦ τούτ’ αἰτίον ἐστιν· διὸ καὶ τῶν ἀν-
35 θρώπων τοῖς πονοῦσι τοὺς νεφροὺς, καὶ περὶ τοῦ πικα-
νεσθαι συμφέροντος, ὅμως ἂν λίαν γίνονται πίνοντες,
οὔτε ἑπατηρόφοροι συμβαίνουσιν. τῶν δ’ ἄλλων
672b τοῖς στεατώδεσιν ἤτοι τοὺς πυκνὸν τὸ στέαρ ἢ τοῖς
προβάτοις. καὶ τὸ πλήθει πολὺ τὰ πρόβατα ὑπερ-
βάλλει· γίνεται γὰρ περίνεφρα τάχιστα τῶν ζῴων
τὰ πρόβατα πάντων. ἐγκατακλειομένης οὐν τῆς
υγρότητας καὶ τῶν πνευμάτων διὰ τὸν σφακελισμὸν

1 ἂλλ’ ἂν ... δεξιόν post eisín l. 23 transponit Thurot.
protection for the viscera about the heart, the loin, in common with all parts that bend, is not so supplied; and this fat we have been speaking of serves as a safeguard to the kidneys in place of flesh. Further, the kidneys are better able to secrete and to concoct the fluid if they are fat, because fat is hot and heat causes concoction.

These are the reasons why the kidneys are fat. In all animals, however, the right kidney has less fat than the left. This is because the right-hand side is dry and solid and more adapted for motion than the left; and motion is an enemy to fat, because it tends to melt it.

Now it is an advantage to all animals to have fat kidneys, and often they are completely filled with fat. The sheep is an exception: if this happens to a sheep it dies. But even if the kidneys are as fat as can be, there is always some portion which is clear of fat, if not in both kidneys, at any rate in the right one. The reason why this happens solely (or more especially) to sheep is as follows. Some animals have their fat in the form of lard, which is fluid, and thus the wind cannot so easily get shut up within and cause trouble. When this happens, however, it causes rot. Thus, too, in the case of human beings who suffer from their kidneys, although it is an advantage for them to be fat, yet if they become unduly fat, pains result which prove fatal. As for the animals whose fat is in the form of suet, none has such dense suet as the sheep has; and moreover, in the sheep the amount of it is much greater; the fact that they get fat about the kidneys much more quickly than any other animal shows this. So when the moisture and the wind get shut up within, rot is produced, which rapidly kills
672 b

5 ἀναιροῦνται ταχέως· διὰ γὰρ τῆς ἀορτῆς καὶ τῆς φλεβὸς εὐθὺς ἀπαντᾷ τὸ πάθος πρὸς τὴν καρδίαν· οὐ δὲ πόροι συνεχεῖς ἀπὸ τούτων τῶν φλεβῶν εἰσὶ πρὸς τοὺς νεφρῶν.

Περὶ μὲν οὖν τῆς καρδίας καὶ πλεύσμονος εἴρηται, καὶ περὶ ἡπατος καὶ σπληνὸς καὶ νεφρῶν. Χ. τυγ- χάνει δὲ ταῦτα κεχωρισμένα ἄλληλων τῷ διαζώ- ματι. τούτῳ δὲ τὸ διάζωμα καλοῦσι τινες φρένας· ὃ διορίζει τὸν τε πλεύσμονα καὶ τὴν καρδίαν. καλεῖται δὲ τούτῳ τὸ διάζωμα ἐν τοῖς ἐναίμοις, ὥσπερ καὶ εἴρηται, φρένες. ἔχει δὲ πάντα τὰ ἑναίμα αὐτὸ, καθάπερ καρδίαν καὶ ἱππαρ. τούτου δ’ αἴτιον ὅτι τοῦ διορισμοῦ χάριν ἔστι τοῦ τε περὶ τὴν κοιλίαν τόπου καὶ τοῦ περὶ τὴν καρδίαν, ὡς ἡ τῆς αἰσθητικῆς ψυχῆς ἀρχή ἀπαθῆς ἢ καὶ μὴ ταχὺ καταλαμβάνεται διά τὴν ἀπὸ τῆς τροφῆς γνωμονήν ἀναθυμίας καὶ τὸ πλήθος τῆς ἐπεισάκτου θερ- μότητος. ἐπὶ γὰρ τούτο διέλαβεν ἡ φύσις, οἶνον παρουκοδόμημα ποιήσασα καὶ φραγμὸν τὰς φρένας, καὶ διείλε τὸ τε τιμιώτερον καὶ τὸ ἀτιμότερον ἐν οἷς ἐνδέχεται διείλειν τὸ ἄνω καὶ κάτω· τὸ μὲν γὰρ ἄνω ἔστιν οὗ ἔνεκεν καὶ βέλτιον, τὸ δὲ κάτω τὸ τούτου ἔνεκεν καὶ ἄναγκαιον, τὸ τῆς τροφῆς δεκτικὸν.

"Εστὶ δὲ τὸ διάζωμα πρὸς μὲν τὰς πλευρὰς σαρκωδέστερον καὶ ἱχυρότερον, κατὰ μέσον δ’ ὑμενωδέστερον· οὕτω γὰρ πρὸς τὴν ἱσχὺν καὶ τὴν τάσιν χρησιμώτερον. διότι δὲ πρὸς τὴν θερμότητα τῆς κάτωθεν οἶνον παραφυάδες εἰσί, σημειοῦ ἐκ τῶν 278
the sheep off. The disease makes its way directly to
the heart through the Aorta and the Great Blood-
vessel, since there are continuous passages leading
from these to the kidneys.

We have now spoken of the heart and the lung;
and also of the liver, the spleen and the kidneys.

X. These two sets of viscera are separated from each other by the diazoma, which some call the
phrenes (diaphragm). This divides off the heart and
the lung. In blooded animals it is called phrenes, as
I have said. All blooded creatures have one, just as
they all have heart and liver. The reason for this
is that the diaphragm serves to divide the part round the stomach from the part round the heart,
to ensure that the source of the sensory Soul may be
unaffected, and not be quickly overwhelmed by the
exhalation that comes up from the food when it is
eaten and by the amount of heat introduced into the
system. For this purpose, then, Nature made the
division, and constructed the phrenes to be, as it were,
a partition-wall and a fence; and thus, in those
creatures where it is possible to divide the upper
from the lower, she divided off the nobler parts
from the less noble ones; for it is the upper which is "better," that for the sake of which the lower ex-
ists, while the lower is "necessary," existing for the
sake of the upper, by acting as a receptacle for the
food.

Towards the ribs the diaphragm is fleshier and
stronger, while in the middle it is more like a mem-
brane: this makes it more serviceable as regards
strength and extensibility. An indication to show
why there are, as it were, "suckers," to keep off the
heat which comes up from below, is provided by
συμβαίνοντων· ὅταν γὰρ διὰ τὴν γειτνίασιν ἐλκύσωσιν ύγρότητα θερμήν καὶ περιττωματικήν, εὕθες ἐπιδήλως ταράττει τὴν διάνοιαν καὶ τὴν αἰσθησίαν, διὸ καὶ καλοῦνται φρένες ὡς μετέχουσαι τι τοῦ φρονεῖν. αἱ δὲ μετέχουσι μὲν οὐδὲν, ἐγγὺς δὲ οὖσαι τῶν μετεχόντων ἐπίθηκον ποιούσι τῇ μεταβολῇ τῆς διανοίας. διὸ καὶ λεπταῖ κατὰ μέσον εἰσίν, οὗ μόνον εξ ἀνάγκης, ὅτι σαρκώδεις οὖσαι τὰ πρὸς τὰς πλευρὰς ἀναγκαῖον εἶναι σαρκωδεστέρας, ἀλλ' ἐν ὅτι οὐκείστης μετέχουσιν ἱκμάδος· σαρκώδεις γὰρ ἄν οὖσαι καὶ ἔχον καὶ ἐλκὸν μᾶλλον ἱκμάδα πολλήν. ὅτι δὲ θερμαίνομεναι ταχέως ἐπίθηκον ποιοῦσι τῇ αἰσθησίαν, σημαίνει καὶ τὸ περὶ τοὺς γελωτὰς συμβαίνον· γαργαλιζόμενοι τε γὰρ ταχὺ γελώσι, διὰ τὸ τῆς κύνης ἀφικνεῖσθαι ταχὺ πρὸς τὸν τόπον τοῦτον, θερμαίνομενον ὅρεμα ποιεῖν ὃμως ἐπίθηκον καὶ κινεῖν τὴν διάνοιαν παρὰ τὴν προαίρεσιν. τοῦ δὲ γαργαλίζεσθαι μόνον ἀνθρωπον αὖτιν ἡτὶ λεπτότης τοῦ δέρματος καὶ τὸ μόνον γελαν τῶν ξώων ἀνθρωπον. ὅ δὲ γαργαλίζομος γέλως ἐστὶ διὰ κυνήσεως τοιαύτης τοῦ μορίου τοῦ περὶ τῆς μασχάλην.

Συμβαίνειν δὲ φασι καὶ περὶ τὰς ἐν τοῖς πολέμοις πληγάς εἰς τὸν τόπον τὸν περὶ τὰς φρένας γέλωτα διὰ τὴν ἐκ τῆς πληγῆς γυνομένην θερμότητα. τοῦτο

1 θερμαίνομενον Peck: θερμαίνουσι vulg.: -ουσα SZ: -ουσαν PUY.

2 κυνήσεως Langkavel.

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The Risus Sardonicus: see Allbutt and Rolleston, A System of Medicine (1910), viii. 642.

280
what actually happens: whenever, owing to their proximity, they draw up the hot residual fluid, this at once causes a recognizable disturbance of the intelligence and of sensation. And that is why they are called *phrenes* : as if they took a part in the act of thinking (*phronein*). This of course they do not do; but their proximity to those organs which do so take part makes the change of condition in the intelligence recognizable. That, too, is why the *phrenes* are thin in the middle; this is not due entirely to necessity (though as they are fleshy to begin with, the parts of them nearest the ribs must of necessity be more fleshy still); there is another reason, which is, to enable them to have as little moisture in them as possible, since if they had been wholly of flesh they would have tended to draw to themselves and to retain a large quantity of moisture. Another indication that it is when heated that they quickly make the sensation recognizable is afforded by what happens when we laugh. When people are tickled, they quickly burst into laughter, and this is because the motion quickly penetrates to this part, and even though it is only gently warmed, still it produces a movement (independently of the will) in the intelligence which is recognizable. The fact that human beings only are susceptible to tickling is due (1) to the fineness of their skin and (2) to their being the only creatures that laugh. Tickling means, simply, laughter produced in the way I have described by a movement applied to the part around the armpit.

It is said that when in war men are struck in the part around the diaphragm, they laugh on account of the heat which arises owing to the blow.
γὰρ μᾶλλον ἐστιν ἀξιοπίστων ἀκοῦσαι λεγόντων ἢ
tό περὶ τὴν κεφαλήν, ὡς ἀποκοπέσα φθέγγεται
15 τῶν ἀνθρώπων. λέγονσι γὰρ τινὲς ἔπαγόμενοι καὶ
tὸν Ὀμήρον, ὡς διὰ τοῦτο ποιήσαντο
φθεγγομένη δὲ ἀρα τοῦ γε κάρη κοινήσουν
ἐμίχηθι,
ἀλλ’ οὐ φθεγγομένου. περὶ δὲ Ἀρκαδίαν’ οὕτω
tό τοιοῦτον διεπίστευσαν ὡστε καὶ κρίσιν ἔποιη-
σαντο περὶ τινὸς τῶν ἐγχωρίων. τοῦ γὰρ ἱερέως
20 τοῦ ὀπλοσμίου Διὸς ἀποθανόντος, ὑφ’ ὁτου δὲ ἀδή-
λον ὄντος, εἰφασάν τινες ἀκοῦσαι τῆς κεφαλῆς
ἀποκεκομμένης λεγοῦσης πολλάκις
ἐπ’ ἄνδρος ἄνδρα Κερκιδᾶς ἀπέκτεινεν·
dιὸ καὶ ξητήσαντες ὡς ὄνομα ἦν ἐν τῷ τόπῳ
Κερκιδᾶς, ἔκριναν. ἀδύνατον δὲ φθέγγεσθαι κεχω-
ρισμένης τῆς ἀρτηρίας καὶ ἀνευ τῆς ἐκ τοῦ πλευ-
25 μονος κινῆσεως. παρά τε τοὺς βαρβάρους, παρ’
οίς ἀποτέμνουσι ταχέως τὰς κεφαλάς, οὐδὲν πο
τοιοῦτον συμβέβηκεν. ἐτὶ δ’ ἐπὶ τῶν ἄλλων ζώων
διὰ τῶν αἰτίαν οὐ γίνεται; [τὸ μὲν γὰρ τὸν γέλω-
τος πληγεισον τῶν φρενῶν εἰκότως, οὐδὲν γὰρ γελά
τῶν ἄλλων: προϊέναι δὲ ποι τὸ σῶμα τῆς κεφαλῆς
80 ἀφηρμενής οὐδὲν ἀλουν, ἐπεὶ τὰ γ’ αναιμα καὶ

1 Ἀρκαδίαν Z, probat J. Schaefer de Jove apud Cares culto,
pp. 370 sq.: Καρίαν vulg.: καρ .. αν E: καρ P.
2 δὲ ἀδήλου ὄντος Peck: δὲ δὴ ἀδήλως vulg.: codd. varia.

Iliad, x. 457 and Od. xxii. 329. In both places the
text of Homer has φθεγγομένου (“As he spake . . .”).

The Berlin text here reads “Caria,” but the Oxford ms.
Z reads “Arcadia.” A cult of Zeus ἱπλόσμιος is attested
only for Methydrion, a town in Arcadia, and the name
Kerkidas is found in Arcadia, not in Caria. (See A. B.
282
This may be so; and those who assert it are more credible than those who tell the tale of how a man's head speaks after it is cut off. Sometimes they cite Homer in support, who (so they say) was referring to this when he wrote

As it spake, his head was mingled with the dust

(Not

As he spake, his head was mingled with the dust.)

In Arcadia this kind of thing was at one time so firmly believed that one of the inhabitants was actually brought into court on the strength of it. The priest of Zeus *hoplosmios* had been killed, but no one knew who had done it. Certain persons, however, affirmed that they had heard the man's head, after it had been cut off, repeating the following line several times

'Twas Kerkidas did slaughter man on man.

So they set to work and found someone in the district who bore this name and brought him to trial. Of course, speech is impossible once the windpipe has been severed and no motion is forthcoming from the lung. And among the barbarians, where they cut heads off with expedition, nothing of this sort has taken place so far. Besides, why does it not occur with the other animals? [For (a) the story about the laughter when the diaphragm has been struck is plausible, for none of the others laughs; and (b) that the body should go forward some distance after the head has been cut off, is not at all absurd, since bloodless animals at any rate actually go on

ΑΡΙΣΤΟΤΕΛΟΣ

673 a

[δ]εν χρόνον. δεδήλωται δὲ περὶ τῆς αἰτίας αυτῶν ἐν ἑτέροις.]

Türkiye μὲν οὐν ἐνεκέν ἐστὶν ἔκαστον τῶν σπλάγχων, εἰρηται γέγονε δ' ἐξ ἀνάγκης ἐπὶ τοῖς ἐντὸς πέρασι τῶν φλεβῶν, ἐξιέναι τε γὰρ ἱκμάδα ἀναγκαίον, καὶ ταύτην αἰτιατικήν, ἐξ ἣς συνισταμένης καὶ πηγυμενής γίνεσθαι τὸ σῶμα τῶν σπλάγχων, διόπερ αἰτιατικά, καὶ αὐτοῖς μὲν ὁμοίαν ἔχουσι τὴν τοῦ σώματος φύσιν, τοῖς δ' ἀλλοις ἀνομοίαν.

XI. Πάντα δὲ τὰ σπλάγχνα ἐν ὑμένι ἐστὶν. προσβολῆς τε γὰρ δεῖ πρὸς τὸ ἀπαθῆ εἶναι, καὶ ταύτης ἑλαφρᾶς, ὁ δ' ὑμὴ τῆς φύσιν τοιοῦτοι πυκνὸς μὲν γὰρ ὅστ' ἀποστέγειν, ἁσάρκος δὲ ὡστε μὴ ἔλκειν μηδ' ἔχειν ἱκμάδα, λεπτὸς δ' ὡς κοῦφος ἢ καὶ μηδὲν ποιητή βάρος. μέγιστοι δὲ καὶ ἵσχυρότατοι τῶν ὑμένων εἰσιν οἳ τε περὶ τῆς καρδίας καὶ περὶ τὸν ἐγκέφαλον, εὐλόγως ταῦτα γὰρ δεῖται πλείστης φυλακῆς. ἢ μὲν γὰρ φυλακῆς περὶ τὰ κύρια, ταῦτα δὲ κύρια μάλιστα τῆς ζωῆς.

XII. Ἐχουσι δ' ἐνα μὲν τῶν ζώων πάντα τὸν ἀριθμὸν αὐτῶν, ἐνα δ' οὖ πάντα· ποῖα δὲ ταῦτα καὶ διὰ τίν' αἰτίαν, εἰρήται πρότερον. καὶ τῶν ἐχόντων δὲ ταῦτα διαφέρουσιν· οὐ γὰρ ὁμοίας οὔτε τὰς καρδίας ἔχουσι πάντα τὰ ἐχοντα καρδίαν, οὔτε τῶν ἄλλων ὡς εἰπέων οὔδεν. τὸ τε γὰρ ἦπαρ τοῖς μὲν πολυπχιδές ἐστι τοῖς δὲ μονοψεθερον, πρῶτον

1 codd. edd. varia; corrupta et inepta seclusi.
living for a long time. The reason for these phenomena has been explained elsewhere.]

We have now said what is the purpose for which each of the viscera is present; but also they have been formed of necessity at the inner ends of the blood-vessels, because moisture, i.e. moisture of a blood-like nature, must of necessity make its way out there, and, as it sets and solidifies, form the substance of the viscera. That, too, is why they are blood-like in character, and why the substance of all of them is similar, though different from that of the other parts.

XI. All the viscera are enclosed in membranes. Membranes. Some covering is needed to ensure their safety, and it must be a light one. These conditions are fulfilled by a membrane, which is close-textured, thus making a good protection; does not consist of flesh, and therefore does not draw in moisture or retain it; is thin, therefore light, and causes no burden. The biggest and strongest membranes are those round the heart and the brain, which is natural enough, as it is always the controlling power which has to be protected; therefore the heart and the brain, which have the supreme controlling power over the life of the body, need the most protection.

XII. Some animals possess a full complement of viscera, some do not. We have already stated what animals have less than the full number, and the reason. But also, the same viscera are different in the various animals that have them. For instance, the heart is not identical in all the animals which have a heart; nor is any other of the viscera. The liver illustrates this: in some it is split into several parts, in some almost undivided. This variation of form is
ARISTOTLE

673 b

αὐτῶν τῶν ἐναίμων καὶ ζωοτόκων· ἔτι δὲ μᾶλλον καὶ πρὸς ταύτα καὶ πρὸς ἄλληλα διαφέρει τά τε τῶν ἱχθύων καὶ τῶν τῶν ὑποκρίμων. τὸ δὲ τῶν ὑποκρίμων μάλιστα προσεμφέρεται τῷ τῶν ἐκτῶν ἡματικά καθαρόν γάρ καὶ ἐναίμων τὸ χρώμα αὐτῶν ἑστὶ καθάπερ κάκεινων. αὕτων δὲ τά σώματα τούτων εὐπνοοῦστα εἰναι καὶ μὴ πολλὴν ἔχειν φαύλην περίττωσι. διόπερ ἐνια καὶ

25 οὐκ ἔχει χολήν τῶν ζωοτόκων· τὸ γὰρ ἡπαρ συμβάλλεται πολὺ μέρος πρὸς εὐκρασίαν τοῦ σώματος καὶ ύγειαν· ἐν μὲν γάρ τῷ αἵματι μάλιστα τὸ τούτων τέλος, τὸ δ' ἡπαρ αἵματικώτατον μετὰ τὴν καρδίαν τῶν σπλάγχνων. τά δὲ τῶν τεταρτοῦσιν καὶ φωτόκων καὶ τῶν ἱχθύων ἐνοχρῶ τῶν πλείστων, ἔνιοι δὲ καὶ φαύλα παντελῶς, ὡσπερ καὶ τά σώματα φαύλης τετύχηκε κράσεως, οἶνον φρύνης καὶ χελώνης καὶ τῶν ἄλλων τῶν τοιούτων.

Σπλήνα δ' ἔχει τά μὲν κερατοφόρα καὶ δίχαλα στρογγύλον, καθαπερ αἷς καὶ πρόβατον καὶ τῶν ἄλλων έκαστον, εἰ μὴ τι διὰ μέγεθος εὔαυξέστερον

674 a ἔχει κατὰ μήκος, οἶνον ὅ τοι βοῶς πέπονθεν· τά δὲ πολυσχίδη πάντα μακρόν, οἶνον ὅς καὶ ἀνθρωπος καὶ κύων, τά δὲ μόνων μεταξὺ τούτων καὶ μικτόν· τῇ μὲν γάρ πλατύν ἐχει τῇ δὲ στενόν, οἶνον ἄποπος καὶ ὅρευς καὶ ὅνος.

XIII. Οὐ μόνον δὲ διαφέρει τά σπλάγχνα τῆς σαρκός τῶν ὑγκων τῶν σώματος, ἄλλα καὶ τῶν τῆς μὲν ἐξω τά δ' ἔσω τῆς θέσιν ἔχειν. αὕτων δ' ὅτι

1 <τῶν> Peck. 2 τῆν ESUYZ: τὰ vulg.

a See above, on 650 b 24. Cf. 677 a 19 ff.

286
found first of all even among the viviparous blooded animals; but it is more noticeable among the fishes and oviparous quadrupeds, whose livers differ not only from those of the Vivipara, but also from each other's. In birds, the liver very closely resembles that of the Vivipara: in both, its colour is pure and blood-like. The reason for which is, that their bodies give a very free passage to the breath, which means that they retain very little foul residue; hence, indeed, some of the Vivipara have no gall-bladder, and this is largely due to the very considerable assistance given by the liver in maintaining a good blend and healthiness in the body. This is because the purpose which these viscera serve lies chiefly in the blood, and after the heart the liver contains more blood than any other of the viscera. In most of the oviparous quadrupeds and the fishes the liver is yellowish, and in some of them it is altogether bad-looking, on a par with the bad blend of the rest of their bodies. This happens in the toad, the tortoise, and the like.

As for the spleen: In horned animals that have cloven hoofs it is rounded: e.g. in the goat, the sheep, and similar animals; unless greatness of size has made it grow out at some point lengthways, as in the case of the ox. In all the polydactylous animals the spleen is long, as in the pig, in man, and in the dog. In animals with solid hoofs the spleen is intermediate between the two and has the characteristics of both: in one place it is broad, in another narrow, as exemplified in the horse, the mule, and the ass.

XIII. Now the viscera differ from the flesh not only in the bulkiness of their mass, but also in their situation, for the flesh is on the outside of the body, while they are inside. The reason for this is that


674 a

tὴν φύσιν ἔχει κοινωνοῦσαν ταῖς φλεβὶ, καὶ τὰ μὲν τῶν φλεβῶν χάριν, τὰ δ’ οὐκ ἀνευ φλεβῶν ἔστιν.

XIV. Ὑπὸ δὲ τὸ ὑπόξωμα κεῖται ἡ κοιλία τοῖς ξύοις, τοῖς μὲν ἔχουσιν οἰσοφάγον ἢ τελευτᾷ τοῦτο τὸ μόριον, τοῖς δὲ μὴ ἔχουσιν εὖθὺς πρὸς τῷ στόματι. τῆς δὲ κοιλίας ἐχόμενον τὸ καλούμενον ἐντερον.

Δὴ ἢν δ’ αἰτίαν ἔχει ταύτα τὰ μόρια τῶν ζῷων ἐκαστὸν, φανερὸν πάσιν. καὶ γὰρ δὲξασθαι τὴν εἰσελθοῦσαν τροφὴν καὶ τὴν ἐξικμασμένην ἀναγ- καίον ἐκπέμψαι, καὶ μὴ τὸν αὐτὸν τόπον εἶναι τῆς τ’ ἀπέπτον καὶ τοῦ περιττώματος, εἶναι τε τινα δεὶ τόπον ἐν διε μεταβάλλει. τὸ μὲν γὰρ τὴν εἰσ- ελθοῦσαν ἔξει μόριον, τὸ δὲ τὸ περίττωμα τὸ ἄχρη- στον· ὥσπερ δὲ χρόνος ἐτερος ἐκατέρω τούτων, ἀναγκαίον διειληφθαι καὶ τοῖς τόποις. ἀλλὰ περὶ 20 μὲν τούτων ἐν τοῖς περὶ τὴν γένεσιν καὶ τὴν τροφὴν οἰκειότερός ἐστιν ὁ διορισμός· περὶ δὲ τῆς διαφοράς τῆς κοιλίας καὶ τῶν συντελῶν μορίων νῦν ἐπι- σκεπτέον.

Oὐτε γὰρ τοῖς μεγέθεσιν οὔτε τοῖς εἴδεσιν ὅμοιας ἔχουσιν ἀλλήλοις τὰ ζῶα· ἀλλ’ ὅσα μὲν ἐστὶν αὐτῶν ἀμφώδοντα τῶν ἐναίμων καὶ τῶν ζωοτόκων, μίαν ἐχει κοιλίαν, οἰνὸν ἄνθρωπος καὶ κύων καὶ λέων καὶ τάλλα ὡσα πολυδάκτυλα, καὶ ὡσα μῶνυχα, οἰνὸν ἵππος, ὀρέυς, ὄνος, καὶ ὡσα δίχαλα μὲν ἀμφώδοντα δέ, οἰνὸν ὑς, πλῆν εἰ 1 τι διὰ μέγεθος τοῦ σώματος


* See De gen. an. Bk. II. chh. 6 and 7.

288
their nature shares that of the blood-vessels: some of them exist for the sake of the blood-vessels, others do not exist apart from the blood-vessels.

XIV. Below the diaphragm is the Stomach, which is placed where the oesophagus ends (if there is an oesophagus; if not, immediately next to the mouth). Next after the stomach and continuous with it is what is called the Gut.

It must be obvious to everyone why all animals have these parts. It is a necessity for them to have some receptacle for the food they take in, and to expel it again when its moisture has been extracted from it; and there must be two different places for these two things—the unconcocted food and the residue; there must also be another place in which the change from one to the other is effected. Two receptacles, then, one for the incoming food, one for the residue which is no more use—as there is a separate time for these so there must be a separate place. However, it will be more appropriate to go into these matters in our treatise on Generation and Nutrition. At the present we must consider the variations that are to be found in the stomach and its subsidiary parts.

The stomach differs both in size and appearance in different animals. Those of the blooded Vivipara which have front teeth in both jaws have one stomach; e.g. man, the dog, the lion, and the other polydactyls; so also those that have solid hoofs, e.g. the horse, the mule, the ass; and those which although they are cloven-hoofed have front teeth in both jaws, e.g. the pig. These rules apply unless the size of the frame and the character of the food
674 a

καὶ τὴν τὴς τροφῆς δύναμιν, οὕτων οὐκ ἐὑπεπτον ἀλλ' ἀκανθώδη καὶ ξυλικῆν, ἔχει πλείους, οἰον κάμηλος, ὠσπερ καὶ τὰ κερατοφόρα· τὰ γὰρ κερατοφόρα οὐκ ἐστὶν ἀμφώδοντα. διὰ τούτο δὲ καὶ ἡ κάμηλος οὔ των ἀμφώδοντων ἐστὶν, ἀκέρατος οὖσα, διὰ τὸ ἀναγκαιότερον εἶναι αὐτῇ τὴν κοιλίαν ἔχειν τοιαύτην ἢ τοὺς προσθίους ὅδοντας. Ὁστ' ἐπεὶ ταύτην ὀμοίαν ἔχει τοῖς μῆ ἀμφώδουσι, καὶ τὰ περὶ τοὺς ὅδοντας ὀμοίως ἔχει αὐτῇ, ὥς οὖνδὲν ὅντας προέργουν. ἀμα δὲ καὶ ἐπεὶ ἡ τροφή ἀκανθώδης, τὴν δὲ γλώτταν ἀνάγκη σαρκώδη εἶναι, πρὸς σκληρότητα τοῦ οὐρανοῦ κατακέχρηται τῷ ἐκ τῶν ὅδοντων γεώδει ἡ φύσις. καὶ μηρυκάζει δ' ἡ κάμηλος ὠσπερ τὰ κερατοφόρα, διὰ τὸ τὰς κοιλίας ὀμοίας ἔχειν τοῖς κερατοφόροις. τούτων δ' ἐκαστον πλείους ἔχει κοιλίας, οἰον πρόβατον, βοῦς, αἰξ, ἐλαφος, καὶ τάλλα τὰ τοιαύτα τῶν ζώων, ὡς ἐπειδῇ τῆς ἐργασίας ἐλλείψει περὶ τὴν τροφὴν ἢ λειτουργία ἢ τοῦ στόματος διὰ τὴν ἐνδειαν τῶν ὅδοντων, ἢ τῶν κοιλιῶν ἐτέρα πρὸς ἐτέρας δέχεται τὴν τροφήν, ἢ μὲν ἀκατέργαστον, ἢ δὲ κατεργασμένην μάλλον, ἢ δὲ πάμπαν, ἢ δὲ λείαν. διὸ τὰ τοιαύτα τῶν ζώων πλείους ἔχει τόπους καὶ μόρια. 15 καλοῦνται δὲ ταύτα κοιλία καὶ κεκυρφαλος καὶ ἔχινος καὶ ἴνυστρον. ὁν δ' ἔχει τρόπον ταύτα πρὸς

674 b

1 δέχεται Peck: δεχομένη vulg.
modify them: for instance, if the food is thorny and woody and therefore not easy to concoct, in which case the animal has several stomachs, e.g. the camel; so also have the horned animals, as they have not front teeth in both jaws. Thus also the camel has not the two rows of front teeth either, although it has no horns; this is because it is more necessary for the camel to have several stomachs than to have all these front teeth. So, as it resembles the animals which lack the upper front teeth in that it has several stomachs, therefore the arrangement of its teeth is that which normally accompanies the multiple stomachs: in other words, it lacks these front teeth, as they would be no use to it. And also, as its food is thorny, and as the tongue has of necessity to be of a fleshy character, Nature has made use of the earthy matter saved from the missing teeth to make the roof of the mouth hard. Again, the camel ruminates as the horned animals do, because it has stomachs that resemble theirs. Every one of the horned animals (such as the sheep, the ox, the goat, the deer, and the like) has several stomachs; and the purpose of them is this: Since the mouth is deficient in teeth, the service which it performs upon the food is deficient; and so one stomach after another receives the food, which is quite untreated when it enters the first stomach, more treated in the next, completely treated in the next, and a smooth pulp in the next. And that is why these animals have several such places or parts, the names of which are (1) the paunch (rumen), (2) the net or honeycomb-bag (reticulum), (3) the manyplies (omasum), (4) the reed (abomasum). For the relation of these to each other

a Or, true stomach.

k 2 291
Ἀλλὰ λα τῇ θέσει καὶ τοῖς ἐδεσίν, ἐκ τε τῆς ἱστορίας τῆς περὶ τὰ ζώα δεῖ θεωρεῖν καὶ ἐκ τῶν ἀνατομῶν.

Διὰ τῆς αὐτῆς δ' αἰτίαν καὶ τὸ τῶν ὄρνιθων γένος ἔχει διαφοράν περὶ τὸ τῆς τροφῆς δεκτικὸν 20 μόριον. ἐπεί γὰρ οὐδὲ ταύτα ὄλος τὴν τοῦ στόματος ἀποδίδωσι λειτουργίαν (ἀνόδοντα γάρ) καὶ οὖθ' ὦ διαφήμισι οὖθ' ὦ λεανεὶ τὴν τροφῆν ἔχουσι, διὰ τοῦτο τὰ μὲν πρὸ τῆς κοιλίας ἔχουσι τὸν καλούμενον πρόλοβον ἀντὶ τῆς τοῦ στόματος ἐργασίας, οἱ δὲ τὸν οἰσοφάγον πλατών, ἢ πρὸ τῆς κοιλίας 25 αὐτοῦ μέρος τί ὀγκώδες ἐν ὧ προδησαυρίζοισι τὴν ἀκατέργαστον τροφήν, ἢ τῆς κοιλίας αὐτῆς τι ἐπανεσθηκός, οἱ δ' αὐτὴν τὴν κοιλίαν ἵσχυταν καὶ σαρκώδη πρὸς τὸ δύνασθαι πολύν χρόνον θησαυρίζειν καὶ πέπτειν ἄλειαντον οὕσαν τὴν τροφήν. τῇ δυνάμει γὰρ καὶ τῇ θερμότητῃ τῆς κοιλίας ἡ φύσις 30 ἀναλαμβάνει τὴν τοῦ στόματος ἐνδειαν. εἰςί δὲ τινες οἱ τούτων οὐδὲν ἔχουσιν, ἄλλα τῶν πρόλοβον 1 μακρόν, ὅσα μακροσκελή καὶ ἔλεια, διὰ τὴν τῆς τροφῆς ύγρότητα. αὐτίον δ' ὅτι ἡ τροφή πάσι τούτως εὑλέαντος, ὡστε συμβαίνειν διὰ ταύτα τῶν τοιούτων τὰς κοιλίας εἶναι ύγρὰς [διὰ τὴν ἀπειθιαν καὶ τὴν τροφήν].

675 a Τὸ δὲ τῶν ἰχθυῶν γένος ἔχει μὲν ὀδὸντας, τούτους δὲ καρχαρόδοντας σχεδόν ὡς εἰπεῖν πάντες 3. ὀλίγον γὰρ τί ἐστι γένος τὸ μὴ τοιοῦτον, οἶον ὁ καλούμενος σκάρος, ὡς δὴ καὶ δοκεῖ μηρυκάζειν

2 secludenda.
3 πάντς Ogle: πάντας vulg.

a At 507 a 36 ff. b The gizzard. c Ogle reads “oesophagus.”

292
as regards position and appearance, the *Researches upon Animals* and the treatises on *Anatomy* should be consulted.

The same reason as has just been described accounts for the difference which presents itself in birds in the part which receives the food. Birds, like the other animals, do not get the full service from the mouth in dealing with the food—since they have no teeth at all, and they have nothing with which to bite up or grind down the food; and so some of them have, before the stomach, what is called the crop, to perform the work instead of the mouth. Others have a broad oesophagus; or their oesophagus has a bulge in it, just before it reaches the stomach, in which they keep a preliminary store of untreated food; or some part of the stomach itself sticks out. Others have a strong and fleshy stomach which is thus able to store the food up for a long period and to concoct it although it has not been ground down; thus Nature makes up for the deficiency of the mouth by means not only of the heat of the stomach but also by its special character. Other birds have none of these devices, but a long crop, because their food is moist: these are the long-legged marsh birds. The reason for this is that the food which all of these take is easily ground down, and the result is that the stomachs of birds of this sort are moist [owing to the uncoected and moist state of the food].

The tribe of fishes have teeth: practically all have saw-teeth. There is one small group to which this does not apply, e.g. the Scarus, as it is called, and it seems reasonable to suppose that this is why

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\(^d\) The parrot-fish; see above, 662 a 7.
5 εὐλόγως διὰ ταύτα μόνος· καὶ γὰρ τὰ μὴ ἄμφωδοντα κερατοφόρα δὲ μηνυκαζεὶ. ὦξείς δὲ πάντας ἔχουσιν, ὦστε διελείν μὲν δύνανται, φαύλως δὲ διελείν· ἐνδιατρίβειν γὰρ οὐχ οἶον τε χρονίζοντας· διόπερ οὐδὲ πλατεῖς ἔχουσιν ὀδόντας, οὐδέ ἐνδέχε-ται λεαίνειν· μάτην ἀν οὐν εἶχον. ἔτι δὲ στόμαχον
10 οἱ μὲν ὅλως οὐκ ἔχουσιν, οἱ δὲ βραχύν. ἀλλὰ πρὸς τὴν βοήθειαν τῆς πέψεως οἱ μὲν ὀρνιθώδεις ἔχουσιν τὰς κοιλίας καὶ σαρκώδεις, οἶον κεστρέιες, οἱ δὲ πολλοὶ παρὰ τὴν κοιλίαν ἀποφυάδας πυκνᾶς, ἵνα ταύταις ὄσπερ ἐν προλακκίωσι θησαυρίζοντες συσσήπωσι καὶ πέπτωσι τὴν τροφὴν. ἔχουσι δὲ ἑναντίως οἱ ἱχθύες τοῖς ὀρνισι τὰ ἀποφυάδας· οἱ μὲν γὰρ ἱχθύες ἀνω πρὸς τῇ κοιλίᾳ, τῶν δὲ ὀρνιθῶν οἱ ἔχουσι ἀποφυάδας κατώ πρὸς τῷ τελεί τοῦ ἐντέρου. ἔχουσι δὲ ἀποφυάδας ἐναὶ καὶ τῶν ἐως-τόκων ἐντερικὰς κατῷ διὰ τὴν αὐτήν αἰτίαν.

Τὸ δὲ τῶν ἱχθύων γένος ἀπαν, διὰ τὸ ἐνδεικτέρως
20 ἔχειν τὰ περὶ τὴν τροφῆς ἐργασίαν, ἀλλὰ ἀπεπτα διαχωρεῖν, λαίμαργον πρὸς τὴν τροφήν ἔστι, καὶ τῶν ἄλλων δὲ πάντων ὅσα εὐθυνετερα- ταχείας γὰρ γινομένης τῆς διαχωρισμοῦ, καὶ διὰ ταύτα βραχείας οὐές τῆς ἀπολαύσεως, ταχείαν ἀναγκαίον γίνεσθαι πάλιν καὶ τὴν ἐπιθυμίαν.

25 Τὰ δὲ ἄμφωδοντα ὅτι μὲν μικρὰν ἔχει κοιλίαν εἴρηται πρότερον· εἰς διαφορὰς δὲ πίπτουσι δύο πάσαι σχεδόν· τὰ μὲν γὰρ τῇ τῆς κυνὸς ὀμοίαν

1 πάντας S: πάντες vulg.

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a Probably some kind of mullet.
b “Caecal appendages” (Ogle), or “alimentary sacs.”
c The vermiform appendix.
PARTS OF ANIMALS, III. xiv.

it alone ruminates, for horned animals which have no teeth in the upper jaw also ruminate. All teeth in fish are sharp; this enables them to bite up their food, though somewhat unsatisfactorily; this is because they cannot spend long over mastication; hence they neither have flat teeth nor may they grind the food down; therefore it would be idle to have the teeth. Furthermore, some fishes have no gullet at all, others have a short one; but, in order to assist the process of concoction, some of them, like the Kestreus, have fleshy stomachs, similar to those of birds; the majority, however, have a large number of appendages by the side of the stomach, in which to store up the food as it might be in additional cellars and there putrefy it up and concoct it. The appendages of fishes are, however, quite different from those of birds. In fishes they are fairly high up beside the stomach, whereas when present in birds they are down below at the end of the gut. Some of the Vivipara also have appendages of this latter kind, and their purpose is the same.

The whole race of fishes is gluttonous for food, because their equipment for reducing it is defective, as a result of which most of it passes through unconcocted. Of all, those which have a straight intestine are especially gluttonous, since the food passes through quickly, which means that their enjoyment of it is brief, and therefore in its turn the desire for food must come on again very quickly.

I have already said that in animals with front teeth in both jaws the stomach is small. These stomachs fall into two main classes. Some have a stomach resembling that of the dog, some that of
675 a

ἐξουσι κοιλίαν, τὰ δὲ τῇ τῆς ύσ. ἐστὶ δ’ ἢ μὲν τῆς ύσ. μεῖζων καὶ τινας ἐξουσια μετρίας πλάκας πρὸς τὸ χρονιωτέραν γίνεσθαι τὴν πέψιν, ἢ δὲ τῆς κυνὸς μικρὰ τὸ μέγεθος καὶ οὐ πολὺ τοῦ ἐντέρου ὑπερβάλλουσα καὶ λεία τὰ ἐντός. μετὰ γὰρ τὴν κοιλίαν ἢ τῶν ἐντέρων ἐγκεῖται φύσις πάσι τοῖς ζῴοισ. ἔχει δὲ διαφοράς πολλάς, καθάπερ ἡ κοιλία, καὶ τοῦτο τὸ μόριον. τοῖς μὲν γὰρ ἀπλοῦν ἐστὶ καὶ ὁμοίως ἀναλυόμενον, τοῖς δ’ ἀνόμοιοι· ἐνίοισ μὲν γὰρ εὐρύτερον τὸ πρὸς τῇ κοιλία, τὸ δὲ πρὸς τῷ τέλει στενότερον διόπερ αἱ κύνες μετὰ πόνου προϊένται τὴν τουατήν περιττωσίν, τοῖς δὲ πλεῖσσιν ἀνωθέν στενότερον, πρὸς τῷ τέλει δ’ εὐρύτερον.

Μεῖζω δὲ καὶ ἀναδιπλώσεις ἐξουστα πολλάς τὰ τῶν κερατοφόρων ἐστὶ, καὶ οἱ ὁγκοὶ τῆς κοιλίας τούτων μεῖζους καὶ τῶν ἐντέρων διὰ τὸ μέγεθος.

675 b

πάντα γὰρ ὡς εἶπεν μεγάλα τὰ κερατοφόρα διὰ τὴν κατεργασίαν τὴν τῆς τροφῆς. πᾶσι δὲ τοῖς μὴ εὐθυνετέροις προϊόνερον εὐρύτερον γίνεται τὸ μόριον τούτο, καὶ τὸ καλούμενον κόλον ἐξουσί, καὶ τοῦ ἐντέρου τυφλὸν τί καὶ ὁγκόδες, εἰτ’ ἐκ τοῦτον πάλιν στενότερον καὶ εἰλιγμένον. τὸ δὲ μετὰ τοῦτο εὐθυ πρὸς τὴν ἔξοδον διατείνει τοῦ περιττόματος, καὶ τοῖς μὲν τούτῳ τὸ μόριον, ὁ καλούμενος ἀρχός, κισσώδης ἐστὶ, τοῖς δ’ ἀπίμελος. πάντα δὲ ταῦτα μεμηχάνηται τῇ φύσει πρὸς τὰς ἀρμοττούσας ἐργασίας περὶ τὴν τροφήν καὶ τοῦ γυνομένου περιττόματος. προϊόντι γὰρ καὶ καταβαίνοντι τῷ περιττόματι εὐρυχωρία γίνεται, καὶ πρὸς τὸ μεταβάλλειν ἵσταμένω τοῖς εὐχιλοτέροις

1 στενότερον his vulg. 2 προϊόν Peck: προϊόνων vulg. 3 στενότερον SU: στενότερον vulg.
the pig. The pig’s stomach is larger than the dog’s, and it has some folds of medium size, so as to prolong the time of concoction. The dog’s is small in size—not much bigger indeed than the gut, and its inner surface is smooth. The gut has its place next after the stomach in all animals. Like the stomach, this part too presents many various forms. In some animals it is simple and similar throughout its length, when uncoiled; in others it is not similar throughout. Thus, in some it is wider near the stomach, and narrower towards the end (that is why dogs find difficulty in discharging their excrement); in the majority, however, it is narrower at the top, and wider at the end.

In the horned animals, the intestines are longer and have many convolutions; and their bulk (as well as the bulk of the stomach) is greater, owing to the size of the animal: horned animals being, on the whole, large in size because of the ample treatment which their food receives. Except in those animals where it is straight the intestine gets wider as it proceeds, and they have what is called the colon and the blind and swollen part of the gut\(^a\); and then after that point it gets narrower again and convoluted. After this, it goes on in a straight line to the place where the residue is discharged; and in some this part (which is called the anus) is supplied with fat, in others it is devoid of fat. All these parts have been devised by Nature to suit their appropriate functions in treating the food and in dealing with the residue produced. As the residue proceeds on its way and goes downwards, it finds a wider space where it remains in order to undergo transformation; this is what

\(^a\) The caecal dilatation.
675 b

τῶν ζώων καὶ πλείονος δεσμεύοντος τροφῆς, διὰ τὸ μέγεθος ἢ τὴν θερμότητα τῶν τόπων. εἰτ’ ἐντεῦθεν πάλιν, ὥσπερ ἀπὸ τῆς ἄνω κοιλίας δεχεται στενότερον ἐντερον, οὗτος ἐκ τοῦ κώλου καὶ τῆς εὐρυχωρίας ἐν τῇ κάτω κοιλίᾳ πάλιν εἰς στενότερον ἐρχεται καὶ εἰς τὴν ἐλικα τὸ περίττωμα ἐξικμασμένον πάμπαν, ὅπως ταμιεύηται ἡ φύσις καὶ μὴ ἄθροος ἢ ἡ ἔξοδος τοῦ περίττώματος.

"Ὅσα μὲν όνοι εἶναι δεὶ τῶν ζώων σωφρονέστερα πρὸς τὴν τῆς τροφῆς ποίησιν εὐρυχωρίας μὲν οὐκ ἔχει μεγάλας κατὰ τὴν κάτω κοιλίαν, ἐλικας δ’ ἔχει πλείους καὶ οὖκ εὐθυνέτερὰ ἔστων. ἤ μὲν γὰρ εὐρυχωρία ποιεῖ πλήθους ἐπιθυμίαν, ἢ δ’ εὐθύτητις ταχυτήτα ἐπιθυμίας· διόπερ ὅσα τῶν ζώων ἢ ἀπλασ ἔχει ἡ εὐρυχώρους τὰς ὑποδοχὰς, τὰ μὲν εἰς πλήθος γαστρίμαργα τὰ δ’ εἰς τάχος ἔστων.

Ἐπεὶ δ’ ἐν τῇ ἄνω μὲν κοιλίᾳ κατὰ τὴν πρώτην ἐξοδον τῆς τροφῆς νεαρὰν ἀναγκαῖον εἶναι τὴν τροφήν, κατ’ ὅ προϊόνσαν κοπρώδη καὶ ἐξικμασμένην, ἀναγκαῖον εἶναι τι καὶ τὸ μεταξὺ, ἐν ὃ μεταβάλλει καὶ οὔτ’ ἐτί πρόσφατος οὔτ’ ἥδη κόπρος. διὰ τοῦτο πάντα τὰ τοιαῦτα ζώα τὴν καλουμένην ἔχει νήστων καὶ ἐν τῷ μετὰ τὴν κοιλίαν ἐντέρω τῷ λεπτῷ· τούτο γὰρ μεταξὺ τῆς τ’ ἄνω, ἐν ἢ τὸ ἀπεπτων, καὶ τῆς κάτω, ἐν ἢ τὸ ἀχρηστὸν ἥδη περίττωμα. γίνεται δ’ ἐν πάσι μὲν, δήλη δ’ ἐν τοῖς

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1 στενότερον bis Langkavel.

**Notes:**

- a i.e. the "stomach."
- b i.e. the "large intestine."
happens in the animals which need and take more food owing either to their size or to the heat of these parts of the body. After this, just as it goes into a narrower part of the intestine after it leaves the upper gut, so also it goes into a narrower channel after the colon or wide part of the lower gut, and into the spiral coil; into these the residue passes when its juices have been completely exhausted. In this way Nature is enabled to keep the material in store, and the residue is prevented from passing out all at the same moment.

In those animals, however, which have to be more controlled in their feeding, there are no great wide spaces in the lower gut, but their intestine is not straight, as it contains many convolutions. Spaciousness in the gut causes a desire for bulk of food, and straightness in the intestine makes the desire come on again quickly. Hence, animals of this sort are gluttonous: those with simple receptacles eat at very short intervals of time, those with spacious ones eat very large quantities.

Since the food in the upper gut, when it has just entered, must of necessity be fresh, and when it has proceeded further downwards must have lost its juices and be practically dung, the organ which lies between the two must of necessity be something definite, in which the change is effected, where food is no longer fresh and not yet dung. Therefore all animals of this sort have what is called the \textit{jejunum}, which forms part of the small intestine, which is next to the stomach. That is to say, it has its place between the upper gut, where the unconcocted food is, and the lower gut, where the now useless residue is. All these animals have the \textit{jejunum}, but
This seems to mean that when the animal is fasting the two receptacles do not bulge, and so the *jejenum* is visible; and though after the animal has fed you might expect to see the *jejenum*, because it should be full of food which is being
it is apparent only in the larger ones, and in them only when they are fasting, not when they have recently been eating, for when they are fasting, there is an interspace between the two receptacles, whereas when they have been eating, the time taken by the change is short.\textsuperscript{a} In females the \textit{jejunum} can have its place in any part of the upper intestine; in males it is placed immediately before the caecum and the lower gut.

XV. What goes by the name of Rennet is present \textit{Rennet} in all animals which have a multiple stomach; the hare is the only animal with a single stomach which has it. In the former class the rennet is not in the paunch\textsuperscript{b} nor in the \textit{reticulum}, nor in the \textit{abomasum} (the last of the stomachs); but in the stomach between the last one and the first ones, \textit{i.e.} the so-called \textit{omasum} (manyplyes).\textsuperscript{c} All these animals have rennet because their milk is so thick; similarly, the single-bellied animals have no rennet, because their milk is thin. This also explains why the milk of horned animals coagulates, while that of the hornless does not. As for the hare, it has rennet because it feeds on herbs with fig-like juice; and this juice can coagulate the milk in the stomach of sucklings. I have stated in the \textit{Problems}\textsuperscript{d} why, in the animals that have many stomachs, the rennet is formed in the manyplyes.

transmuted inside it (see above, 675 b 32), it is not visible, because the change is effected so rapidly.

\textsuperscript{a} In females the \textit{jejunum} can have its place in any part of the upper intestine; in males it is placed immediately before the caecum and the lower gut.

\textsuperscript{b} Lit. "the great stomach."

\textsuperscript{c} All these animals have rennet because their milk is so thick; similarly, the single-bellied animals have no rennet, because their milk is thin. This also explains why the milk of horned animals coagulates, while that of the hornless does not. As for the hare, it has rennet because it feeds on herbs with fig-like juice; and this juice can coagulate the milk in the stomach of sucklings. I have stated in the \textit{Problems}\textsuperscript{d} why, in the animals that have many stomachs, the rennet is formed in the manyplyes.

\textsuperscript{d} No such reference can be found.
Τὸν αὐτὸν δὲ τρόπον ἔχει τὰ περὶ τὰ σπλάγχνα καὶ τὴν κοιλίαν καὶ τῶν εἰρημένων μορίων ἐκαστὸν τοῖς τετραπόσι μὲν ὑστόκοις δὲ τῶν ἤών καὶ τοῖς ἀποσιν, οἶνον τοῖς ὄφεσιν. καὶ γὰρ ἢ τῶν ὄφεων φύσις ἐστὶ συγγενής τούτων· ὁμοῖα γὰρ ἐστὶ σαύρῳ μακρῷ καὶ ἄποδι. τούτως δὲ καὶ τοῖς ἰχθύσι πάντα παραπλήσια, πλην τὰ μὲν ἔχει πλεύμονα διὰ τὸ πεζεύειν, οἰ δ᾽ οὐκ ἔχουσιν, ἀλλὰ βράγχια ἀντὶ τοῦ πλεύμονος. κύστιν δ᾽ οὖθ᾽ οἱ ἰχθύες ἔχουσιν οὐτὲ τούτων οὐδὲν πλῆθος χελώνης· τρέπεται γὰρ εἰς τὰς φολίδας τὸ υγρὸν ὀλυγοπότων ὄντων διὰ τὴν ἀναμόρτητα τοῦ πλεύμονος, καθάπερ τοῖς ὑρνισιν εἰς τὰ πτερά. καὶ ἐπιλευκαίνει δὲ τὸ περὶττωμα πᾶσι καὶ τούτοις, ὅπερ καὶ τοῖς ὑρνισιν, διότι ἐν τοῖς ἔχουσι κύστιν ἐξελθόντος τοῦ περὶττωματος ὕφισταται ἀλμυρὸς γεώδης ἐν τοῖς ἀγγεῖοις· τὸ γὰρ γλυκύ καὶ πότιμον ἀναλίσκεται διὰ κοιφότητα εἰς τὰς σάρκας.

Τῶν δ᾽ ὄφεων οἱ ἐχεῖς πρὸς τοὺς ἄλλους ἔχουσι τὴν αὐτὴν διαφορὰν ἢν καὶ ἐν τοῖς ἰχθύσι τὰ σελάχη πρὸς τοὺς ἄλλους· ἔωςτοκοῦσι γὰρ ἔξω καὶ τὰ σελάχη καὶ οἱ ἐχεῖς, ἐν αὐτοῖς ὑστοκήσαντα πρῶτον. μονοκοιλία δὲ πάντα τὰ τοιαύτα ἐστιν,

1 μακρῷ Y: μακρῷ ή vulg. 2 διότι Ogle: διότερ vulg.
What has been said already on the subject of the viscera, the stomach, and each of the other parts mentioned, applies to the footless creatures (such as the Serpents) as well as to the oviparous quadrupeds. Indeed, the Serpents are akin to these: for a serpent is like a long and footless lizard. A third class in which all these parts are similar is the Fishes: the only difference is that the first two classes are land-creatures and therefore have a lung, whereas fishes have no lung but gills instead. Fishes have no bladder, nor has any of these creatures (except the tortoise); the reason is that they drink little (because their lung is bloodless), and the moisture in them is diverted to the horny scales, just as in birds it is diverted to the feathers. And in all these creatures, as in birds, the residue \(^a\) is white on the surface, since in those animals that have a bladder, when the residue has been voided an earthy salt deposit settles in the vessels, the sweet and non-briny portion, owing to its lightness, being used up upon the flesh.

The Vipers have the same peculiarity among the Serpents as the Selachia have among the Fishes. Both of them are externally viviparous, though they first produce their ova internally. All these

\(^a\) See Introduction, pp. 32 ff.
676 b

5 καθάπερ τάλλα τά ἀμφώδοντα· καὶ σπλάγχνα δὲ πάμπαν μικρά ἔχει, ὦσπερ τάλλα τὰ μὴ ἔχοντα κύστιν. οἱ δ' ὀφεὶς διὰ τὴν τοῦ σώματος μορφήν, οὕσαν μακρὰν καὶ στενήν, καὶ τὰ σχήματα τῶν σπλάγχνων ἔχουσι διὰ ταῦτα μακρὰ καὶ τοῖς τῶν ἄλλων ζώων ἀνόμοια, διὰ τὸ καθάπερ ἐν τύπῳ τὰ
10 σχήματι αὐτῶν πλασθῆναι διὰ τὸν τόπον.

'Επίπλοον δὲ καὶ μεσεντέριον καὶ τὰ περὶ τὴν τῶν ἐντέρων φύσιν, ἔτι δὲ τὸ διάζωμα καὶ τὴν καρδίαν πάντ' ἔχει τὰ ἑναίμα τῶν ζώων, πλεύμονα δὲ καὶ ἄρτηριαν πάντα πλήν τῶν ἰχθύων. καὶ τὴν θέσιν δὲ τῆς ἄρτηριάς καὶ τοῦ οἰσοφάγου πάντα τὰ ἔχοντα ὅμοιος ἔχει διὰ τὰς εἰρημένας αἰτίας πρότερον.

II. Ἡ ἔχει δὲ καὶ χολήν τὰ πολλὰ τῶν ἑναίμων ζώων, τὰ μὲν ἐπὶ τῷ ἦπατι, τὰ δ' ἀπηρτημένην ἐπὶ τοῖς ἐντέροις, ωσοὶ οὕσαν οὐχ ἦττον ἐκ τῆς κάτω κοιλίας τὴν φύσιν αὐτῆς. δὴ λοι δὲ μάλιστ' ἐπὶ τῶν ἰχθύων· οὕτω γὰρ ἔχουσι τε πάντες, καὶ οἱ πολλοὶ πρὸς τοῖς ἐντέροις, ἔννοι δὲ παρ' ὅλον τὸ ἐντερον παρυφασμένην, οὗν ἡ ἁμια· καὶ τῶν ὀφεὼν οἱ πλείστοι τῶν αὐτῶν τρόπων. διὸ όπερ οἱ λέγοντες τὴν φύσιν τῆς χολῆς αἰσθήσεως τινος εἶναι χάρων οὐ καλῶς λέγοντες· φασὶ γὰρ εἶναι διὰ τοῦτο, ὡς τῆς ψυχῆς τὸ περὶ τὸ ἦπαρ μόριον δάκνουσα μὲν συνιστῇ, λυομένη δ' ἱλεων ποιή· τὰ μὲν γὰρ ὅλως

1 τοῖς PYZ et corr. U : om. vulg.

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a See 665 a 10 ff.

b See 650 a 14.

c This seems to refer to the views expressed in Plato, *Timaeus*, 71 d.

304
creatures have one stomach only, as do the other animals that have front teeth in both jaws. And their viscera are quite small, as are those of the other creatures which have no bladder. However, on account of the shape of the serpents' bodies, which is long and narrow, the shape of their viscera too is consequently long, thus differing from those of other animals. This is because the shape of them is fashioned, as though in a mould, on account of the space available for them.

All blooded animals have an omentum, a mesentery, and the whole intestinal equipment; also a diaphragm and a heart; and all but the fishes have a lung and a windpipe too. The relative positions of the windpipe and the oesophagus are the same in all of them. The reasons for this have been given already.

II. The majority of the blooded animals have a gall-bladder in addition. In some it is placed up against the liver; in others it is separate from the liver and placed against the intestines, indicating that equally in these its derivation is from the lower gut. This is clearest in the fishes, all of which have one, and in most of them it is placed against the intestines, though in some it runs along the whole length of the intestine, like a woven border, as in the Amia; a similar arrangement is found in most of the serpents. Hence, those who assert that the gall-bladder is present for the sake of some act of sensation are wrong. They say its purpose is as follows:—on the one hand (a) to irritate that part of the Soul which is around the liver, and so to congeal it; and on the other hand (b) by running free to make that part cheerful. This cannot be true; because some
This is true of quite a number of species, and as Aristotle says, the gall-bladder is specially variable in mice. In man, its absence is rare; and Aristotle's statement may well be derived from his observation of aborted embryos, in which the gall-bladder develops somewhat late.
animals have no gall-bladder at all, such as the horse, the mule, the ass, the deer, and the roe; and the camel has no distinct gall-bladder, but what would better be described as consisting of small biliary vessels. There is no gall-bladder in the seal, nor (among sea-animals) in the dolphin. Sometimes in the same group there are some animals which look as if they have one, and some as if they have none: This is true of the Mice; and also of the human species, as in some individuals the gall-bladder is placed against the liver and is obvious; while in some it is missing. The result of this has been a dispute concerning the group as a whole. Whatever an observer has found to be the condition of the individuals he happens to have seen, that he holds is true of every individual throughout the group. The same has occurred with regard to sheep and goats, most of which have a gall-bladder; but, whereas in some individuals it is so large that its excessive size is portentous (e.g. in Naxos), in others it is entirely absent (e.g. in a particular district of Chalcis, Euboea). A further point, already mentioned, is that in fishes the gall-bladder is separated from the liver by a good distance. Moreover, it is safe to say that Anaxagoras’s school is wrong in holding that the gall-bladder is the cause of acute diseases: they say that when it gets too full it spurs its liquid out into the lung and blood-vessels and sides. This must be wrong, because nearly everyone who suffers from these affections actually has no gall-bladder, and this would be proved if they were dissected. Besides, there is no comparison between the amount of bile which is present in these ailments and that which is emitted from the gall-bladder. No; it seems probable that, just as the
σῶμα γινομένη περίττωμα τί ἐστιν ἡ σύντηξις, 15 οὗτῳ καὶ ἡ ἐπὶ τῶν ἥπατι χολή περίττωμα εἶναι καὶ
οὐχ ἔνεκα τινος, ὥσπερ καὶ ἡ ἐν τῇ κοιλίᾳ καὶ
ἐν τοῖς ἐντέροις υπόστασις. καταχρῆται μὲν οὖν
ἐνίοτε ἡ φύσις εἰς τὸ ὠφέλιμον καὶ τοῖς περίττώ-
μασιν, οὐ μὴν διὰ τοῦτο δεῖ ἥπετέν πάντα ἕνεκα
tίνος. ἄλλα τινῶν ὄντων τοιούτων ἐτέρα εἰς ἀνάγκης
συμβαίνει διὰ ταῦτα πολλά.

Ὅσοις μὲν οὖν ἡ τοῦ ἥπατος σύστασις ύγιεινή
ἐστὶ καὶ ἡ τοῦ αἵματος φύσις γλυκεία ἡ εἰς τοῦτ'
ἀποκρυνομένη, ταῦτα μὲν ἡ πάμπαν οὐκ ἵσχε χολήν
ἐπὶ τοῦ ἥπατος, ἡ ἐν τισι φλεβίοις, ἡ τὰ μὲν τὰ δ' οὖ.
διὸ καὶ τὰ ἥπατα τὰ τῶν ἄχολων εὐχρω καὶ
γλυκερά ἐστιν ὡς ἔπιταν εἰπεῖν, καὶ τῶν ἐχόντων
χολήν τὸ ὑπὸ τῇ χολή τοῦ ἥπατος γλυκύτατον
ἐστίν. τῶν δὲ συνισταμένων ἐξ ἢπτον καθαροῦ
αἵματος τοῦτον ἐστίν ἡ χολή τὸ γινόμενον περίτ-
tωμα. ἐναντίον τε γὰρ τῇ τροφῇ τὸ περίττωμα
βούλεται εἶναι καὶ τῷ γλυκεί τὸ πικρόν, καὶ τὸ
αἵμα γλυκύ τὸ υγιαῖν. φανερὸν οὖν ὅτι οὐ τινὸς
ἐνεκα, ἄλλ' ἀποκάθαρμα ἐστὶν ἡ χολή. διὸ καὶ
χαριέστατα λέγουσι τῶν ἀρχαίων οἱ φάσκοντες
αἵτιον εἶναι τοῦ πλείω ἥπην χρόνον τὸ μῆ ἔχειν
χολήν, βλέψαντες ἐπὶ τὰ μῶνυχα καὶ τὰς ἐλάφους·
tαῦτα γὰρ ἄχολά τε καὶ ζῆν πολὺν χρόνον. ἐτὶ δὲ
cαὶ τὰ μῆ ἐωραμένα ὡς ἐκεῖνων ὅτι οὐκ ἔχει
χολήν, οἰον δελφίς καὶ κάμηλος, καὶ ταῦτα τυγ-
χάνει μακρόβια ὄντα. εὐλογον γὰρ τὴν τοῦ ἥπατος

1 τούτου Peck: τοῦτ' vulg.
bile elsewhere in the body is a residue or collique-
cence, so this bile around the liver is a residue
and serves no purpose—like the sediment pro-
duced in the stomach and the intestines. I agree
that occasionally Nature turns even residues to
use and advantage, but that is no reason for trying
to discover a purpose in all of them. The truth is
that some constituents are present for a definite
purpose, and then many others are present of
necessity in consequence of these.

We may say, then, that in animals whose liver is
healthy in its composition, and in which the blood
that supplies the liver is sweet, there is either no
gall-bladder at all by the liver, or else the bile is in
tiny vessels, or else in some these are present and in
some not. This is why the livers of gall-bladderless
animals are, generally, of a good colour and sweet;
and in those that have a gall-bladder the part of the
liver immediately below it is very sweet. But in those
animals which are formed out of blood which is less
pure, the bile is the residue of this; since "residue"
means that which is the opposite of "food," and
"bitter" the opposite of "sweet"; and healthy blood
is sweet. So it is evident that bile exists for no de-
finite purpose, but is merely an offscouring. So that
was an extremely neat remark which we find made
by some of the old authors, when they say that if you
have no gall in you your life will be longer. This
was a reference to animals with uncloven hoofs and
to deer, which have no gall-bladder, and are long-
lived. And also, certain other animals are long-lived,
such as the dolphin and camel, which, though un-
observed by them, have no gall-bladder. After all,
the liver is vital and indispensable for all blooded
ARISTOTLE

677 a

φύσιν, ἐπίκαιρον οὔσαν καὶ ἀναγκαίαν πάσι τοῖς
677 b ἐναίμοις ζωίσις, αἰτίαν εἶναι, ποιὰν τιν’ οὔσαν, τοῦ
ζην ἐλάττω ἡ πλείω χρόνον. καὶ τὸ τοῦτο μὲν τοῦ
σπλάγχνου εἶναι περίπτωμα τοιοῦτον, τῶν δ’ ἄλλων
μηδενός, κατὰ λόγον ἑστίν. τῇ μὲν γὰρ καρδία
toιουτον οὐδένα πλησίαζειν οἷον τε χυμὸν (οὔδὲν
gὰρ δέχεται βίαιον πάθος), τῶν δ’ ἄλλων οὐδὲν
σπλάγχνων ἀναγκαῖον ἑστὶ τοῖς ζωίσις, τὸ δ’ ἡπαρ
μόνον: διόπερ καὶ τοῦτο συμβαίνει περὶ αὐτὸ μόνον.
ἀποτὸν τε τὸ μὴ πανταχοῦ νομίζειν, ὅπου ἀν τις ἱδὴ
φλέγμα ἢ τὸ ὑπόστημα τῆς κοιλίας, περίπτωμα
eῖναι, ὤμοις δὲ δὴδον ὅτι καὶ χολὴν, καὶ μὴ
diaφέρεσθαι τοῖς τόποις.

Καὶ περὶ μὲν χολῆς, διὰ τίν’ αἰτίαν τὰ μὲν ἔχει
tὰ δ’ οὐκ ἔχει τῶν ζωίσις, εἰρηται, III. περὶ δὲ
μεσεντερίου καὶ ἐπιπλόσου λοιπὸν εἰπεῖς ταῦτα γὰρ
ἐν τῷ τόπῳ τοῦτῳ καὶ μετὰ τῶν μορίων ἑστὶ
tοιουτων.

15 “Εστὶ δὲ τὸ μὲν ἐπίπλοσον ὑμὴν τοῖς μὲν στεάρ
ἔχουσι στεατῶδης, τοῖς δὲ πιμελήν πιμελῶδης;
ποία δ’ ἑστίν ἐκάτερα τοιῶν, εἰρηται πρότερον.
ηρτηται δὲ τὸ ἐπίπλοσον ὤμοιος τοῖς τοῖς μονοκουλίως
καὶ τοῖς πολυκουλίοις ἀπὸ μέσης τῆς κοιλίας κατὰ
tὴν ὑπογεγραμμένην οἷον βαφὴν. ἔπεχε δὲ τὸ τε
20 λοιπὸν τῆς κοιλίας καὶ τὸ τῶν ἐντέρων πλήθος
ὀμοίως τοῖς ἐναίμοις, ἐν τῇ τοῖς πεζοῖς καὶ τοῖς
ἐνύδροις ζωίσις.

Ἡ μὲν οὖν γένεσις ἐξ ἀνάγκης συμβαίνει τοιαύτη
tου μορίου τούτου. ἔηρον γὰρ καὶ ὄγρον μύγματος
θερμαίνομενον τὸ ἐσχατον ἀεὶ δερματώδες γίνεται

1 ἢρκται SUYZ.
animals, and so it is quite reasonable to hold that the condition of it controls the length of its owner's life. And it is equally reasonable to hold that the liver produces a residue such as the bile although none of the other viscera does so. Take the heart: no such humour as bile could possibly come near the heart, because the heart cannot withstand any violent affection. Of the other viscera none is indispensable to an animal, except the liver only, and that is why this phenomenon occurs in connexion with the liver exclusively. And it would be absurd to say that phlegm and the sediment produced by the stomach are residues when found in some places but not in others; and clearly the same applies to bile: its locality makes no difference.

We have now spoken of the gall-bladder, and we have shown why some animals have it and why some have not. III. It remains to speak of the Mesentery and of the Omentum. These are in the same region and close to the parts we have just described.

The Omentum is a membrane, formed of suet or lard according to the animal in which it is. (We have already stated which animals contain suet and which lard.) Whether the animal has one stomach or many, the Omentum is always fastened to the middle of the stomach, on the line marked on it like a seam; and it covers the rest of the stomach and most of the intestines. This is so in all blooded creatures, land- and water-animals alike.

As for the necessary formation of this part, it occurs as follows. When a mixture containing solid substance and fluid is warmed up, the surface of it always becomes skin-like and membranous; and

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\( a \) At 651 a 26 ff.  
\( b \) See Introd. p. 22.
καὶ ὑμενώδες, ὦ δὲ τόπος οὗτος τουαύτης πλήρης
25 ἢστι τροφῆς. ἔτι δὲ διὰ πυκνότητα τοῦ ὑμένος τὸ
διηθομένου τῆς αἰματώδους τροφῆς ἀναγκαῖον
λιπαρὸν εἶναι (τοῦτο γὰρ λεπτότατον) καὶ διὰ τὴν
θερμότητα τῆς περὶ τῶν τόπων συμπεπτόμενον ἀντὶ
σαρκώδους καὶ αἰματώδους συστάσεως στεράρ γί-
νεσθαι καὶ πιμελήν. ἢ μὲν οὖν γένεσις τοῦ ἐπι-
30 πλόου συμβαίνει κατὰ τὸν λόγον τούτον, κατα-
χρήται δ’ ἢ φύσις αὐτῶ πρὸς τὴν εὐπεψίαν τῆς
tροφῆς, ὅπως ῥᾶν πέττη καὶ θάττον τὰ ζώα τὴν
tροφὴν· τὸ μὲν γὰρ θερμὸν πεπτικὸν, τὸ δὲ πῦὸν
θερμὸν, τὸ δ’ ἐπιπλοῦν πῦὸν. καὶ διὰ τοῦτ’ ἀπὸ
μέσης ἥρτηται τῆς κοιλίας, ὅτι τὸ ἐπέκεισα μέρος
35 συμπέπτεται τὸ παρακείμενον ἂπαρ. καὶ περὶ μὲν
τοῦ ἐπιπλοῦν ἦρτηται.

IV. Τὸ δὲ καλοῦμενον μεσεντέρων ἢστι μὲν ὑμήν,
diastei δὲ συνεχὲς ἀπὸ τῆς τῶν ἐντέρων παρα-
678 a τάσεως εἰς τὴν φλέβα τὴν μεγάλην καὶ τὴν ἀορτὴν,
πλῆρες ὁν φλεβῶν πολλῶν καὶ πυκνῶν, αἱ τεῖνοντων
ἀπὸ τῶν ἐντέρων εἰς τε τὴν μεγάλην φλέβα καὶ τὴν
ἀορτὴν. τὴν μὲν οὖν γένεσιν εὖ ἀνάγκης οὕσαν
5 εὐρήσομεν ὅμοιος τοῖς ἄλλοις μορίοις3. διὰ τίνα δ’
αἰτιὰν ὑπάρχει τοῖς ἐναίμοις, φανερὸν ἐστὶν ἐπι-
σκοποῦσιν. ἐπεὶ γὰρ ἀναγκαῖον τὰ ζώα τροφῆν
λαμβάνειν θύραθεν, καὶ πάλιν ἐκ ταύτης γίνεσθαι
tὴν ἐσχάτην τροφῆν, εὖ ἂν ἤδη διαδίδοται εἰς τὰ
μόρια (τούτο δὲ τοῖς μὲν ἀναίμοις ἀνώνυμον, τοῖς δ’
1 ἀρκτικ EPSUYZ.
2 ἐπέκεια Peck : ὅτ’ ἐκεῖνο vulg.
3 <τοιούτου> μορίου Ogle : [μορίου] ὑμέσι Platt.
the place where the Omentum is full of nutriment of this very sort. Furthermore, owing to the thickness of the membrane, that portion of the blood-like nutriment which percolates through it must of necessity be fatty, because that is the finest in texture; and then owing to the heat in that part it will be concocted and so become suet or lard instead of some fleshy or blood-like substance. This, then, is the way in which the formation of the Omentum occurs. Nature, however, turns the Omentum to advantage in the concoction of the food, so as to enable the animal to concoct its food more easily and more quickly; for the Omentum is fat; fat things are hot, and hot things aid concoction. For this reason, too, the Omentum is fastened to the middle of the stomach; since as regards that part of the stomach which is beyond, the liver which is close by it assists it in concoction. So much for the Omentum.

IV. What is called the Mesentery is also a membrane; and it extends continuously from the line of extension of the intestines as far as the Great Blood-vessel and the Aorta. It is full of blood-vessels, which are many in number and closely packed together; and they extend from the intestines as far as the Great Blood-vessel and the Aorta. We shall find, as with the other parts, that the development and formation of the Mesentery is the result of necessity. As for its purpose in the blooded animals, that is clear enough to those who consider. Animals must of necessity take in nutriment from without; and, again, out of this the "ultimate nutriment" has to be made; and from this store the supply is distributed directly to the parts of the body. (In blooded animals this is called blood; there is no
ARISTOTLE

678 a

10 ἐναίμοις αἷμα καλεῖται), δεὶ τι εἶναι δὴ οὐ εἰς τὰς
φλέβας ἢ τῆς κοιλίας οἶνον διὰ ριζῶν πορεύεσται ἢ
tροφή. τὰ μὲν οὖν φυτὰ τὰς ρίζας ἔχει εἰς τὴν γην
(ἐκεῖθεν γὰρ λαμβάνει τὴν τροφὴν), τοῖς δὲ ἔρωις η
κοιλία καὶ ἡ τῶν ἐντέρων δύναμις γῇ ἑστὶν, ἐξ ἢς
dεῖ λαμβάνειν τὴν τροφὴν. διόπερ ἡ τοῦ μεσεν
15 τερίον φύσις ἐστὶν, οἰον ρίζας ἔχουσα τὰς δὴ αὐτῆς
φλέβας. οὐ μὲν οὖν ἔνεκα τὸ μεσεντέριον ἑστὶν,
εἰρηταὶ. τίνα δὲ τρόπον λαμβάνει τὴν τροφήν, καὶ
πῶς εἰσέρχεται διὰ τῶν φλεβῶν ἀπὸ τῆς ἑσχάτης
τροφῆς εἰς τὰ μόρια πάντα τὸ διαδιδόμενον εἰς τὰς
φλέβας, ἐν τοῖς περὶ τὴν γένεσιν τῶν ᾽ζων λέχθη-
20 σεται καὶ τὴν τροφήν.

Τὰ μὲν οὖν ἐναίμα τῶν ᾽ζων πῶς ἔχει μέχρι τῶν
διωρισμένων μορίων, καὶ διὰ τίνας αἰτίας, εἰρηταὶ.
περὶ δὲ τῶν εἰς τὴν γένεσιν συντελοῦσιν, οῖς δοκεῖ
dιαφέρειν τὸ βῆλυ τοῦ ἄρρητος, ἐχόμενον μὲν ἑστὶ
25 καὶ λοιπὸν τῶν εἰρημένων. ἀλλ’ ἐπειδῆ περὶ γενέ-
σεως λεκτέον, ἀρμόττον ἑστὶ καὶ περὶ τούτων ἐν τῇ
περὶ εἰκών θεωρία διελθεῖν.

V. Τὰ δὲ καλούμενα μαλάκια καὶ μαλακόστρακα
πολλὴν ἔχει πρὸς ταῦτα διαφοράν. εὐθὺς γὰρ τὴν
τῶν σπλάγχνων ἀπασαν οὕκ ἔχει φύσιν. ὁμοίως δ’
30 οὐδὲ τῶν ἄλλων ἀναίμων οὐδὲν. ἐστὶ δὲ δύο γένη
λοιπὰ τῶν ἀναίμων, τὰ τ’ ὀστρακόδερμα καὶ τὸ τῶν
ἐντόμων γένος. ἔξι οὖ γὰρ συνεστηκεν ἡ τῶν
σπλάγχνων φύσις, οὐδὲν τούτων ἔχει αἷμα, διὰ τὸ

1 αὐτῆς Peck: αὐτῆς vulg.
2 ἑσχάτης Peck: εἰσαύουτης vulg.
3 πάντα Ogle: ταῦτα vulg.: om. Z.
special name for it in the others.) Now there must be some passage or passages (as it might be roots) through which this nutriment shall pass from the stomach to the blood-vessels. The roots of plants are of course in the ground, because that is the source from which plants get their nutriment. For an animal, the stomach and the intestines correspond to the ground, the place from which the nutriment has to be derived. And the Mesentery exists to contain these vessels, corresponding to roots; they pass through the inside of it. This completes my account of its Final Cause. As for the means by which the nutriment is taken up, and the way in which that portion of the ultimate nutriment which is distributed into the blood-vessels reaches all the parts of the body through them, these points will be dealt with in the treatises on the Generation of Animals and on Nutrition.

I have now described the blooded animals as far as concerns the parts that have been dealt with, and also the causes that are responsible. It remains, and would follow after this, to speak of the organs of generation, by which male and female are distinguished. But as we shall have to deal with generation itself, it is more appropriate to speak of these organs in our consideration of that subject.

V. The animals called Cephalopods and Crustacea are very different from the blooded ones. First of all, they have no visceral structure at all. This is true of all the bloodless creatures, in which are included beside Cephalopods and Crustacea two other groups, the Testacea and the Insects. This is because none of them has blood, which is the material out of which
678 a

τῆς ουσίας αὐτῶν εἶναι τῷ τοιούτου πάθος [αὐτῆς].

ὅτι γάρ ἔστι τὰ μὲν ἐναίμα τὰ δ’ ἀναίμα, ἐν τῷ

λόγῳ ἐνυπάρξει τῷ ὁρίζοντι τῆς ουσίας αὐτῶν. ἦτι

δ’ ὅπ πένευ ἔχουσι τὰ σπλήγκνα τὰ ἐναίμα τῶν

ζώων, οὔτ’ ὑπάρξει τοῖς τοιούτοις οὕτε γὰρ

678 b

φλέβας ἔχουσιν οὕτε κύστιν οὔτ’ ἀναπνέουσιν, ἀλλὰ

μόνον ἀναγκαῖον ἔχειν αὐτοῖς τὸ ἀνάλογον τῇ καρδίᾳ, τὸ γὰρ αἰσθητικὸν ψυχῆς καὶ τὸ τῆς ζωῆς αἴτιον (ἐν)² ἀρχὴ τινὶ τῶν μορίων καὶ τοῦ σώματος ὑπάρχει πάση τοῖς ζώοις. τὰ δὲ πρὸς τὴν τροφὴν

μόρια ἔχει καὶ ταῦτα ἐξ ἀνάγκης πάντα: οἱ δὲ τρόποι διαφέρουσι διὰ τοὺς τόπους ἐν οἷς λαμβάνουσι τὴν τροφήν.

"Εχοῦσι δὲ τὰ μὲν μαλάκια περὶ τὸ καλούμενον

στόμα δύο ὄδοντας, καὶ ἐν τῷ στόματι ἀντὶ γλώττης σαρκῶδες τι, ὃ κρίνουσι τὴν ἐν τοῖς ἐδέστοις ἤδονήν. ὅμοιως δὲ καὶ τὰ μαλακόστρακα τούτοις

touς πρῶτοις ὄδοντας ἔχει καὶ τὸ ἀνάλογον τῇ

γλώττῃ σαρκῶδες. ἦτι δὲ καὶ τὰ ὀστρακόδερμα

πάντα τὸ τοιούτον ἔχει μόριον διὰ τὴν αὐτὴν αἰτίαν

toῖς ἐναίμοις, πρὸς τὴν τῆς τροφῆς αἰσθησιν.

ὁμοίως δὲ καὶ τὰ ἐντομα τὰ μὲν τὴν ἔξωσαν ἐπι-

βοσκίδα τοῦ στόματος, οἴον τὸ τε τῶν μελιττῶν

gένος καὶ τὸ τῶν μυλῶν, ὃσπερ εἰρηται καὶ πρό-

tερον: ὅσα δὲ μὴ ἔστιν ἐμπροσθόκεντρα, ἐν τῷ

στόματι ἔχει τὸ τοιοῦτον μόριον, οἴον τὸ τῶν

μυρμήκων γένος καὶ εἰ τι τοιοῦτον ἔτερον. ὄδοντας

de τὰ μὲν ἔχει τούτων, ἀλλοιωτέρους δὲ, καθάπερ

ἀὐτὴς seclusi.
² ἐν supplevit Th.

a See Introduction, pp. 26 ff.

b These teeth are the two halves of what might be compared to a beak.

316
viscera are made; and the reason for this is that a condition of this sort is part of their being: the fact that some animals are blooded and some bloodless will be found to be included in the logos \(^a\) which defines their being. Further, we shall see that none of those purposes for whose sake blooded animals have viscera operate in these other creatures: they have no blood-vessels and no bladder, they do not breathe: the only organ they must necessarily have is the counterpart of the heart, since the sensitive part of the Soul and the original cause of life is always situated in some place which rules the body and its parts. Also, they all have of necessity the parts adapted for dealing with food and nutrition; but the manner of these varies according to the places where they take their food.

The Cephalopods have two teeth around what is called their mouth \(^b\); and inside the mouth, instead of a tongue, they have a fleshy object, by means of which they discriminate the savour of things to eat. Likewise, the Crustacea have these front teeth and the fleshy counterpart of the tongue. The Testacea all have this latter part, too, for the same reason that blooded animals have a tongue, viz. to perceive the taste of the food they eat. Similarly, too, the Insects have, some of them, a proboscis which comes out from the mouth, as with the Bees and Flies (this has been mentioned earlier\(^c\)); and the ones which have no sharp protrusion in front have a part such as this inside the mouth, as Ants, and the like. Some of these creatures have teeth, though somewhat different from ordinary teeth (as the Flies,\(^d\) and Bees);

\(^a\) At 661 a 21; cf. Hist. An. 528 b 28.
\(^b\) Or "Ants" (translating Meyer's emendation).
678 b
tό τε τῶν μυιῶν¹ καὶ τό τῶν μελιττῶν γένος, τὰ δ’
οὐκ ἔχει, ὡσα ὑγρὰ χρήται τῇ τροφῇ· πολλὰ γὰρ
τῶν ἐντόμων οὐ τροφῆς ἔχει χάριν τοὺς ὀδόντας
ἀλλ’ ἀλκῆς.
Τῶν δ’ ὀστρακοδέρμων τὰ μέν, ὦσπερ ἐλέχθη καὶ
ἐν τοῖς κατ’ ἀρχὰς λόγοις, τήν καλομένην ἔχει
γλώτταν ἵσχυράν, οἱ δὲ κόχλοι καὶ ὀδόντας δύο,
καθάπερ τὰ μαλακόστρακα. μετὰ δὲ τὸ στόμα τοῖς
μαλακίοις ἐστὶ στόμαχος μακρός, τοῦτον δ’ ἔχο-
μενος πρόλοβος οἶς περ τοῖς ὀρνισιν, εἴτε συνεχῆς
κοιλία, καὶ ταύτης ἐχόμενον ἐντερον ἀπλοῦν μέχρι
τῆς ἐξόδου. ταῖς μὲν οὖν σηπίαις καὶ τοῖς πολύ-
ποσιν ὦμοια καὶ τοῖς σχῆμασι καὶ τῇ ἀφῇ τὰ περὶ
τὴν κοιλίαν· ταῖς δὲ καλομέναις τευθία δύο μὲν
ὄμοις αἱ κοιλώδεις εἰσὶν ὑποδοχαί, ἦττον δὲ
προλοβώδης ἢ ἐτέρα, καὶ τοῖς σχῆμασι ἐκείνων
dιαφέρουσι διὰ τὸ καὶ τὸ σῶμα πᾶν ἐκ μαλακω-
tέρας συνεστάναι σαρκός.
Ταῦτα δ’ ἔχει τὰ μόρια τοῦτον τὸν τρόπον διὰ
τὴν αὐτὴν αἰτίαν ὦσπερ καὶ οἱ ὀρνιθες· οὐδὲ γὰρ
τοῦτων οὐδὲν ἐνδέχεται λειαίνει τὴν τροφὴν, διόπερ
ὁ πρόλοβος ἐστὶ πρὸ τῆς κοιλίας.
Πρὸς βοηθείαν δὲ καὶ σωτηρίαν ἔχει ταῦτα τὸν
679 a καλοῦμενον βολῶν ἐν χιτῶνι ὑμενώδει προσπεφυ-
kότι,² τῆν ἐξοδον ἔχοντι καὶ τὸ πέρας ἦπερ ἀφιάσι
τὸ περίττωμα τῆς κοιλίας κατὰ τὸν καλοῦμενον
αὐλὸν· οὕτως δ’ ἐστὶν ἐν τοῖς ὑπτίοις. ἔχει μὲν οὖν
πάντα τὰ μαλάκια τούτο τὸ μόριον ἰδιον, μάλιστα
d’ ἡ σηπία καὶ πλείστον· ὅταν γὰρ φοβηθῶσι καὶ

¹ μυιῶν] μυίων ξῶν EY: μυρμήκων Meyer.
² προσπεφυκότι Ogle: προσπεφυκότα vugl.
others have no teeth at all: these are the creatures whose food is fluid. Indeed, in many of the insects the purpose of the teeth is not mastication of food at all, but for use as weapons.

Of the Testacea, as we stated in the opening treatise, some have a very strong tongue (so-called); and the Sea-snails actually have two teeth as well, like the Crustacea. In the Cephalopods there is a long gullet next after the mouth, and contiguous to that is a crop like a bird's. Continuous with this is the stomach, then immediately the intestine, which is simple and reaches to the vent. In the Sepias and Octopuses these parts round the stomach are similar both in shape and in consistency. The creatures called Calamaries, like the others, have the two gastric receptacles, but the first of them is less like a crop; and they differ in shape from the organs of the previous classes, and that is because their bodies are composed of softer flesh throughout.

These creatures have these parts arranged in this way for the same reason that birds have them: they, like birds, are unable to grind down their food; hence the crop is placed before the stomach.

The Cephalopods, for the sake of self-defence and self-preservation, have what is called their Ink. This is contained in a membranous bag which is attached to the body, and comes to an end in an outlet where the residue from the stomach is discharged by the so-called funnel. This is on the under side of the body. All the Cephalopods have this peculiar part, but it is most remarkable in the Sepia, as well as the largest in size. When the Sepia is frightened and in terror,

\[ a \text{ At Hist. An. 528 b 30 ff.} \]
\[ b \text{ Viz. the crop and the stomach.} \]
The mytis, which is the same as the mecon, is an excretory organ, and corresponds to the liver. See below, 679 b 11.

Cf. above, 676 a 32.
PARTS OF ANIMALS, IV. v.

it produces this blackness and muddiness in the water, as it were a shield held in front of the body. Now the Calamaries and Octopuses have this ink-bag in the upper region of the body, quite near the mytis\(^a\); whereas in the Sepia it is lower down, against the stomach, since it has a larger supply because it uses it more. This circumstance is due (1) to its living near the land and (2) to its having no other means of defence—nothing like the Octopus, for instance, which has its twining feet, which are useful for this purpose; it can also change its colour, and it does so (just as the Sepia emits its ink) when put in fear. Of all these, only the Calamary lives well out at sea and gets protection thereby. Hence, compared with it, the Sepia has a larger supply of ink; and because this is larger, it is lower in the body, as it is easy for it to be emitted even to a considerable distance when the supply is great. The ink is earthy in its nature, like the white deposit on the excrement of birds, and it is produced by these creatures for the same reason—they, like birds, have no urinary bladder\(^b\); so the earthiest matter is excreted into this ink, especially in the Sepia, for the Sepia contains an exceptionally large amount of earthy matter. An indication of this is its bone, which is earthy. The Octopuses do not have this bone, and in the Calamary it is cartilaginous and slight. (We have said why some of these animals have this part and why some have not, and what in each case its character is.)

These animals, as they have no blood, are cold and liable to take fright. While in some other animals fear causes a disturbance of the stomach, and in some the discharge of residue from the bladder, in these creatures its effect is to make them discharge their
679 a

ἀνάγκης ἀφιέναι διὰ δειλίαν, ὥσπερ ἐκ κύστεως
tois ἐπουροῦσιν, ἢ δὲ φύσις ἁμα τῷ τοιούτῳ περιτ-
tώματι καταχρῆται πρὸς βοήθειαν καὶ σωτηρίαν
αὐτῶν.

"Εξουσί δὲ καὶ τὰ μαλακόστρακα, τά τε καρα-
βοειδῆ καὶ οἱ καρκίνοι, δύο μὲν ὀδόντας τοὺς
πρώτους, καὶ μεταξὺ τήν σάρκα τήν γλωσσοειδῆ,
ὡσπερ έἱρηται καὶ πρότερον, εὐθὺς δ' ἐχόμενον τοῦ
στόματος στόμαχον μικρὸν κατὰ μέγεθος τῶν
σωμάτων [τὰ μείζων πρὸς τὰ ἐλάττων]1. τούτου δὲ
κοιλίαν ἐχομένην, ἐφ' ἢς οἱ τε κάραβοι καὶ ένοι
τῶν καρκίνων ὀδόντας έχουσιν ἐτέρους διὰ τὸ τοὺς
679 b ἀνώ μὴ διαιρέων ἱκανῶς, ἀπὸ δὲ τῆς κοιλίας έντερον
ἀπλοῦν κατ' εὐθὺ μέχρι πρὸς τήν έξοδον τοῦ
περιττώματος.

"Εχει δὲ καὶ τῶν ὀστρακοδέρμων ἐκαστὸν ταῦτα
tὰ μόρια, τὰ μὲν διηρήσμενα μάλλον τὰ δ' ἡττον·
ἐν δὲ τοῖς μείζοσι διαδηλότερά ἐστιν ἐκαστὰ τού-
tων. οἱ μὲν οὖν κόχλοι καὶ ὀδόντας έχουσι σκλη-
ροὺς καὶ ὄξεις, ὥσπερ έἱρηται πρότερον, καὶ τὸ
μεταξὺ σαρκώδεις όμοίως τοῖς μαλακίοι καὶ μαλα-
κοστράκοις, καὶ τήν προβοσκίδα, καθάπερ έἱρηται,
μεταξὺ κέντρου καὶ γλώττης, τοῦ δὲ στόματος
ἐχόμενον οὖν ὀρνιθώδη τυὰ πρόλοβον, τούτου δ' 10
ἐχόμενον στόμαχον τούτου δ' ἔχεται ἡ κοιλία, ἐν ἡ
ἡ καλομένη μῆκων, ἀφ' ἢς συνεχές ἐστιν ἐντερον
ἀπλῆς τήν ἀρχήν ἔχον ἀπὸ τῆς μῆκος· ἐστὶ γὰρ
ἐν πάσι τοῖς ὀστρακηροῖς περιττώμα τούτο τὸ
μάλιστα δοκοῦν εἶναι ἐδώδημον. ἔχει δ' όμοίως τῷ

1 seclusit Rackham.
ink; and though this is an effect due to necessity, like the discharge of urine in the others, yet Nature makes good use of this residue at the same time for the animal's defence and preservation.

The Crustacea as well, that is, both the Crabs and the Caraboids, have the two front teeth, and between the teeth they have the tongue-like flesh, as has already been stated; and immediately next to the mouth they have a gullet which is quite small compared with the animal's size; and immediately after that the stomach; and on this the Carabi and some of the Crabs have another set of teeth, since the upper ones do not masticate the food sufficiently. From the stomach a simply formed intestine runs straight to the vent where residues are discharged.

These parts are present in every one of the Testacea as well, more distinct in some, less in others. They are more clearly marked in the larger animals. Take the Sea-snails. These have (1) as stated already, the teeth, which are hard and sharp, (2) the fleshy object in between them, similarly to the Crustacea and Cephalopods; (3) the proboscis, as already mentioned, something between a sting and a tongue; (4) immediately after the mouth is a sort of bird's crop, and (5) after that the gullet; (6) continuous with that is the stomach, and (7) in the stomach is what is known as the mecon; and (8) attaching to this is an intestine: this intestine begins directly from the mecon. This residue (the mecon) appears to be the most tasty piece in all the Testacea. The other creatures that have spiral shells (e.g. the

a At 678 b 10.
b At 661 a 15 ff.
c The hepatopancreas or liver; see above, 679 a 9.
κόχλω καὶ τὰλλα τὰ στρομβώδη, οίον πορφύραι καὶ κήρυκες.

"Εστὶ δὲ γένη καὶ εἴδη πολλὰ τῶν ὀστρακο-

dέρμων· τὰ μὲν γὰρ στρομβώδη ἔστιν, ὡσπερ τὰ

νῦν εἰρημένα, τὰ δὲ δίθυρα, τὰ δὲ μονόθυρα. τρόπον

dὲ τινα καὶ τὰ στρομβώδη διθύροις ἐοικεν· ἔχει γὰρ

ἐπιπτύγματ' ἐπὶ τῷ φανερῷ τῆς σαρκὸς πάντα τὰ

tοιαῦτα ἐκ γενετῆς, οίον αἱ τε πορφύραι καὶ

cήρυκες καὶ οἱ νηρεῖται καὶ πάν το τοιοῦτον γένος,

πρὸς βοήθειαν ὑ γὰρ μὴ προβεβληται τὸ ὀστρακὸν,

ρίδιον ταύτη βλάπτεσθαι ὑπὸ τῶν θυραθεν προσ-
pιπτόντων. τὰ μὲν οὖν μονόθυρα διὰ τὸ προσ-

πεφυκέναι σώζεται τῷ πρανές ἔχειν τὸ ὀστρακὸν,

καὶ γίνεται ἀλλοτρίω φράγματι τρόπον τινὰ δί-

θυρον, οίον αἱ καλοῦμεναι λεπάδες· τὰ δὲ δίθυρα,

οίον κτένες καὶ μύες, τῶ συνάγειν, τὰ δὲ στρομβώδη

tοῦτῳ τῷ ἐπικαλύμματι, ὡσπερ δίθυρα γινόμενα ἐκ

μονοθύρων. ὁ δ' ἔχινος μάλιστα πάντων ἀλεωράν

ἔχει· κύκλῳ γὰρ τὸ ὀστρακὸν συνηρεφές καὶ κε-

χαρακωμένον ταῖς ἀκάνθαις. ὑδιον δ' ἔχει τῶν

ὀστρακοδέρμων τούτο, καθάπερ ἐιρηταὶ πρότερον.

Τῶν δὲ μαλακοστράκων καὶ τῶν ὀστρακοδέρμων

συνέστηκεν ἡ φύσις τοῖς μαλακίοις ἀντικειμένως·

τοῖς μὲν γὰρ ἔξω τὸ σαρκώδες, τοῖς δ' ἐντός, ἐκτὸς

dὲ τὸ γεώδες. ὁ δ' ἔχινος οὐδὲν ἔχει σαρκώδες.

πάντα μὲν οὖν ἔχει, καθάπερ ἐιρηταὶ, καὶ τάλλα

tὰ ὀστρακόδερμα στόμα τε καὶ τὸ γλωττοειδὲς καὶ

κοιλίαν καὶ τοῦ περιπτώματος τὴν ἔξοδον, διαφέρει

The operculum.
Purpuras and the Whelks) are similar to the Sea-snails in structure.

There are very many genera and species of Testacea. Some have spiral shells, like the ones just mentioned; some are bivalves, some univalves. In a way, the spiral shells resemble the bivalves, as they have, all of them, from birth, a covering over the exposed part of their flesh, e.g. the Purpuras, the Whelks, the Nerites, and the whole tribe of them. This covering serves as a protection; for in any place where the animal has no shell to protect it, it could quite easily be injured by the impact of external objects. The univalves’ means of preservation is this: they cling to some object, and have their shell on the upper side; so they become in a way bivalves in virtue of the borrowed protection afforded by the object to which they cling. Example, the Limpets. The bivalves proper (e.g. Scallops and Mussels) get their protection by closing themselves up; the spiral-shelled creatures by the covering I mentioned, which, as it were, turns them from univalves into bivalves. The Sea-urchin has a better defence system than any of them: he has a good thick shell all round him, fortified with a palisade of spines. As I stated previously, the Sea-urchin is the only one of the Testacea which possesses this peculiarity.

The natural structure of the Crustacea and of the Testacea is the reverse of that of the Cephalopods. The latter have their fleshy part outside, the former have the earthy part outside and the fleshy inside. The Sea-urchin, however, has no fleshy part at all.

All these parts, as described—mouth, tongue-like object, stomach, vent for the residue—are present in the rest of the Testacea too, but they differ in
This seems to imply that diagrams or illustrations accompanied the treatises.

These form what is compared to a lantern at Hist. An. 531 a 5, hence the name, "lantern of Aristotle."
their position and size. For the details of these, consult the *Researches upon Animals* and the *Dissections*. Some points are better explained by inspection than in words.

The Sea-urchin and the genus of Ascidians are peculiar among the Testacea. The Sea-urchin has five teeth, and between them it has the fleshy substance (the same as in all the above-mentioned creatures); after that, the gullet, after that, the stomach, which is divided into several compartments, so that the animal seems to have several stomachs. But although they are separated from each other and are full of residue, they all spring from the gullet and they all terminate in the residual vent. Apart from the stomach, these creatures contain no fleshy substance, as I have said. They have, however, what are called ova; there are several of them and each is in a separate membrane; and scattered at random round the body, beginning from the mouth, are certain black objects, which have no name. There are several kinds of Sea-urchin, and in all of them these parts are present. Not all, however, have edible ova, and, except in the common varieties, they are quite small. There is a similar distinction among the other Testacea: the flesh is not equally edible in all of them, and in some of them the residue (the so-called mecon) is edible, in others not. In the spiral shells, the mecon is in the spiral, in univalves

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\[d\] These are really ovaries (or testes): gonads.

\[e\] These may be the ambulacral vesicles, but the identification is not certain.

\[f\] See the story of the Spartan in Athenaeus iii. 41.

\[g\] The word translated "common" may mean "living near the surface."
This is true of the sea-urchins in the Red Sea, though not of the Mediterranean ones. The former have a cycle corresponding exactly to that of the moon. The five roes, ovaries, or testes are large and swollen during the week preceding each of the summer full moons, and the spawning of the eggs takes place during the few days before and after full moon. For a most interesting discussion of this and kindred matters
(like limpets) it is in the tip; in bivalves it is near the hinge. In the bivalves the so-called ovum is on the right-hand side, and the residual vent on the left. "Ovum" is a misnomer; actually it corresponds to fat in blooded creatures when they are in good condition; and that is why it appears only in spring and autumn, which are the seasons when they are in good condition. In great cold and great heat all the Testacea are hard put to it; they cannot endure inordinate temperatures. The behaviour of the Sea-urchins is a good illustration of this: they have ova in them as soon as they are born, and at the time of full moon these increase in size; and this is not, as some think, because the creatures eat more then, but because the nights are warmer owing to the moonlight. These creatures have need of the heat because they are bloodless and therefore adversely affected by cold. That is why they are in better condition during the summer, and this is true of them in all localities except the strait of Pyrrha, where they flourish equally well in winter, and the reason for this is that in winter they have a more plentiful supply of foodstuff, due to the fish leaving the district at that season.

The Sea-urchins all have the same number of ova—an odd number, five, identical with the number of teeth and stomachs which they have. This is accounted for by the "ovum" not being really an ovum (as I said before) but simply a result of good nourishment. The "ovum" is found in Oysters too, though see H. M. Fox, Selene, especially pp. 35 ff., and id. Proc. Roy. Soc. B., 1923, 95, 523.

In Lesbos, leading to the lagoon, one of Aristotle's favourite hunting-grounds: see Hist. An. 544 a 21 (sea-urchin), 548 a 9, 603 a 21, 621 b 12. Cf. Gen. An. 763 b 2.
μόνον ἐν τοῖς ὀστρέοις, τὸ καλοῦμενον φῶν. ταύτῳ δὲ τούτῳ ἐστὶ καὶ τὸ ἐν τοῖς ἐχίνοις. ἐπεὶ τοῖς ἐστὶ ἑφαρμοεῖδης ὁ ἐχίνος, καὶ οὐχ ὁσπερ ἐπὶ τῶν ἄλλων ὀστρέων τοῦ σώματος κύκλος εἰς, ὁ δὲ ἐχίνος οὐ τῇ μὲν τοιούτος τῇ δ' οὗ, ἀλλὰ πάντῃ ὁμοίως (σφαιροειδὴς γὰρ), ἀνάγκη καὶ τὸ φῶν ὁμοίως ἔχειν· οὐ γάρ ἐστιν, ὁσπερ τοῖς ἄλλοις, τὸ κύκλῳ ἄνω-ὁμοίων· ἐν μέσῳ γάρ ἡ κεφαλὴ πᾶσιν αὐτοῖς, τῷ δ' ἀνω τοιούτων μόριον. ἀλλὰ μὴν οὐδὲ συνεχεῖς οἷον τ' εἶναι τὸ φῶν—οὐδὲ γὰρ τοῖς ἄλλοις—ἀλλ' ἐπὶ θάτερα τοῦ κύκλου μόνον. ἀνάγκη τοῖς, ἐπεὶ τούτῳ μὲν ἀπαντῶν κοινόν, ἵδιον δ' ἐκείνου εἶναι τὸ σώμα σφαιροειδεῖς, μὴ εἶναι ἀρτια τὰ φά. κατὰ διάμετρον γὰρ ἂν ἦν, διὰ τὸ ὁμοίως δεῖν ἔχειν τὸ ἐνθεν καὶ ἐνθεν, εἰ ἦν ἀρτια [καὶ κατὰ διάμετρον]. οὕτως δ' ἐχόντων ἐπὶ ἀμφότερα ἂν τοῦ κύκλου εἶχον τὸ φῶν. τούτῳ δ' οὗ ἦν οὔδ' ἐπὶ τῶν ἄλλων ὀστρέων· ἐπὶ θάτερα γὰρ τῆς περιφερείας ἔχουσι τὰ ὀστρεά καὶ οἱ κτένες τὸ τοιοῦτον μόριον. ἀνάγκη τοῖς τρία ἤ πέντε εἶναι ἡ ἄλλον των ἀριθμοῦν περιττόν. εἰ μὲν οὖν τρία εἴχε, πόρρω λίαν <ἂν> ἦν, εἰ δὲ πλείω τῶν πέντε, συνεχεῖς ἂν· τούτων δὲ τὸ μὲν οὐ βέλτιον, τὸ δ' οὗ ἐνδεχόμενον. ἀνάγκη ἀρα πέντε αὐτοὺς ἔχειν τὰ φά. 

Διὰ τὴν αὐτὴν δ' αἰτίαν καὶ ἡ κοιλία τοιαύτη ἐσχισταί καὶ τὸ τῶν ὀδόντων τοσοῦτον ἐστὶ πλῆθος. ἔκαστον γὰρ τῶν φῶν, οἶν οὐσὶ τῷ τῷ ζῴου οὖν, πρὸς τὸν τρόπον τὸν τῆς κοιλίας ὁμοιον ἔχειν

1 secludenda.  
2 <ἂν> Ogle.  
3 κοιλίας Ogle: ζωῆς vulg.
on one side of the body only; it is the same as that of the Sea-urchin. Now the Sea-urchin is spherical, and is not just one flat disk like the Oysters; thus, being spherical, it is not different shapes in different directions, but equiform in all directions; hence of necessity its "ovum" is correspondingly arranged, since this creature's perimeter is not, as in the others, non-equiform: they all have their head in the centre, whereas the Sea-urchin's is at the top. Yet even so the "ovum" cannot be continuous, since no other of the Testacea has it thus; it is always on one side of the disk only. Hence, since this is a common property of all species of Testacea, and the Sea-urchin is peculiar in having a spherical shape, the result follows of necessity that the Sea-urchins cannot have an even number of ova. If they were even, they would have to be arranged in diametrically opposite positions, because both sides would have to be alike, and then there would be ova on both sides of the circumference; but this arrangement is not found in any of the other Ostreae; both Oysters and Scallops have ova on one side only of their circumference. Therefore there must be three, or five, or some other odd number of ova in the Sea-urchin. If there were three, they would be too far apart; if more than five, they would be quite continuous; the former would not subserve a good purpose, the latter is impossible. Therefore the Sea-urchin must of necessity have five ova.

For the same cause the creature's stomach is cloven into five and it has five teeth. Each of the ova, being, as it were, a body belonging to the creature, must conform to the general character of the stomach,

* That is, it is circular in all planes, not in one only.
This is true; but motion is effected mainly by the tubefeet, not noticed by Aristotle (vide Ogle).

a The "sea-squirts."
PARTS OF ANIMALS, IV. v.

because growth has its origin from the stomach. Now if there were only one stomach, either the ova would be too far away from it, or the stomach would entirely fill up the cavity, which would make it difficult for the Sea-urchin to move about and to find sufficient food to replenish itself. But, as it is, there are five ova separated by five intervals, and so there must be five departments of the stomach, one for each interval. For the same reason there are five teeth, since this enables Nature to assign one tooth alike to each ovum and each department of the stomach.

I have now stated why the Sea-urchin has an odd number of ova, and why it has five of them. Now some Sea-urchins have quite small ones, and some large: the reason for this is that the latter have a hotter constitution, and the heat enables them to concoct their food better. This explains why the uneatable ones tend to be full of residue. This natural heat also induces the creatures to move about, and so instead of remaining settled in one place they keep on the move as they feed. An indication of this is that Sea-urchins of this sort always have something sticking on to their spines (which they use as feet), a which suggests that they are continually moving about.

The Ascidians b differ very little in their nature from plants, but they are more akin to animals than the Sponges are, which are completely plants. Nature passes in a continuous gradation from lifeless things to animals, and on the way there are living things which are not actually animals, with the result that one class is so close to the next that the difference seems infinitesimal. Now a sponge, as I said just now, is in
ARISTOTLE

681 a

ώσπερ εἴρηται, καὶ τῷ ζήν προσπεφυκὼς μόνον, ἀπολυθεῖς δὲ μὴ ζῆν, ὀμοίως ἔχει τοῖς φυτοῖς παντελῶς· τὰ δὲ καλοῦμενα ὀλοθούρια καὶ οἱ πνεῦμονες, ἔτι δὲ καὶ ἑτέρα τοιαύτ’ ἐν τῇ θαλάσσῃ μικρόν διαφέρει τούτων τῷ ἀπολελύσθαι· αἰσθητοὶ μὲν γὰρ οὐδεμίαν ἔχει, ζῆν δ’ ὦσπερ οὖντα φυτὰ ἀπολελυμένα. ἔστι δὲ καὶ ἐν τοῖς ἐπιγείους φυτοῖς ἐνα τοιαύτα, ἀ καὶ ζῆν καὶ γίνεται τὰ μὲν ἐν ἑτέρους φυτοῖς, τὰ δὲ καὶ ἀπολελυμένα, οἶνον καὶ τὸ ἐκ τοῦ Παρνασσοῦ καλοῦμενον ὑπὸ τῶν ἐπίπετρον· τοῦτο γὰρ ζῆν πολὺν χρόνον κρεμάμενον ἄνω ἐπὶ τῶν παττάλων. ἔστι δ’ ὀτε καὶ τὰ τῆθανα, καὶ εἰ τι τουούτον ἑτερον γένος, τῷ μὲν προσπεφυκός ζῆν μόνον φυτῶν παραπλῆσιον, τῷ δ’ ἔχειν τι σαρκώδες δόξειν ἀν ἐχειν των’ αἰσθησιν’ ἄδηλον δὲ τούτον ποτέρως θετέον.

’Εχει δὲ τοῦτο τὸ ζῆων δύο πούρους καὶ μίαν διαίρεσιν, ἡ τε δέχεται τὴν ὑγρότητα τῆς εἰς τροφήν, καὶ ἡ πάλιν διαπέμπει τὴν ὑπολειπομένην ἵκμαδα· περίττωμα γὰρ οὐδέν ἔστι δῆλον ἔχον, ἥσπερ τὰλλα τὰ ὀστρακόδερμα. διὸ μάλιστα καὶ τοῦτο, κἂν εἰ τι ἅλλο τουούτον τῶν ζῶν, φυτικὸν δίκαιον καλεῖν· οὐδὲ γὰρ τῶν φυτῶν οὐδέν ἔχει περίττωμα. διὰ μέσου δὲ λεπτον διάζωμα, ἐν ὧ τὸ κύριον ὑπάρχει εὐλογον τῆς ζωῆς. ἂς δὲ καλοῦσιν οἱ μὲν κνίδας εἰ δ’ ἀκαλλῆφας, ἔστι μὲν οὐκ ὀστρακόδερμα, ἀλλ’ ἔξω πίπτει τῶν διηρημένων γενῶν, ἐπαμφοτερίζει δὲ τοῦτο καὶ φυτῷ καὶ ζώῳ

681 b

a Or “sea-cucumbers.”

b The precise reference of this term is not known.

c Sea-anemones, called by the Greeks “sea-nettles.”

334
all respects like a plant: it lives only while it is growing on to something, and when it is pulled off it dies. What are called Holothuria and the Sea-lungs and other similar sea-animals differ only slightly from the sponges in being unattached. They have no power of sensation, but they live just as if they were plants unattached to the soil. Even among land-plants such instances exist: living and growing either on other plants or quite unattached: for example, the plant found on Parnassus, sometimes called the Epipetron (Rockplant). If you hang this up on the pegs it will keep alive for a considerable time. Sometimes it is doubtful whether these Ascidians and any other such group of creatures ought to be classed as plants or as animals: In so far as they live only by growing on to some other object they approach the status of a plant; but yet they have some fleshy substance and therefore probably are capable of sensation of a kind.

This particular creature (the Ascidian) has two orifices and one septum; by one orifice it takes in fluid matter for food, by the other it discharges the surplus moisture; so far as can be seen it has no residue like the other Testacea. And as no plant ever has any residue this is a strong justification for classing it (and any other such animal) as a plant. Through its middle there runs a thin partition, and it is reasonable to suppose that the governing and vital part of the creature is situated here. As for what are called Knides or Acalephae, they are not Testacea, it is true, but fall outside the defined groups. In their nature they incline towards the plants on one side

Those common to the Mediterranean are more virulent in their stinging powers than those of the north.
τὴν φύσιν. τῷ μὲν γὰρ ἀπολύεσθαι καὶ προσπίπτειν πρὸς τὴν τροφὴν ἐνίας αὐτῶν ἔστιν ἠμικόν ἔστι,
5 καὶ τῷ αἰσθάνεσθαι τῶν προσπιπτόντων. ἔτι δὲ τῇ τοῦ σώματος τραχύτητι χρήσται πρὸς τὴν σωτηρίαν.
τῷ δ’ ἀτελεῖς εἶναι καὶ προσφύεσθαι ταχέως ταῖς πέτραις τῷ γένει τῶν φυτῶν παραπλήσιον, καὶ τῷ
περίττωμα μηδὲν ἐξειν φανερόν, στόμα δ’ ἐξειν. ὁμοίουν δὲ τούτῳ καὶ τὸ τῶν ἀστέρων ἔστι γένος—
10 καὶ γὰρ τοῦτο προσπίπτον ἐκχυμίζει πολλὰ τῶν ὀστρέων—τοῖς τ’ ἀπολελυμένοις τῶν εἰρημένων
ξώνων, οὶν τοῖς τε μαλακίοις καὶ τοῖς μαλακοστράκοις. ὁ δ’ αὐτὸς λόγος καὶ περὶ τῶν ὀστρακο-
δέρμων.
Τὰ μὲν οὖν μόρια τὰ περὶ τὴν τροφὴν, ἀπερ
ἀναγκαίον πᾶσιν ὑπάρχειν, ἔχει τὸν προειρημένον
15 τρόπον, δεῖ δὲ δηλονότι καὶ τῶν τοῖς ἐναϊμος
ὑπαρχόντων κατὰ τὸ κύριον τῶν αἰσθήσεων ἔχειν ἀνάλογον τι μόριον· τοῦτο γὰρ δεῖ πᾶσιν ὑπάρχειν
toῖς ξώοις. ἔστι δὲ τοῦτο τοῖς μὲν μαλακίοις ἐν
ὑμένι κείμενον ὑγρόν, δ’ οὔτε ὁ στόμαχος τέταται πρὸς τὴν κοιλίαν, προσπέφικε δὲ πρὸς τὰ πραγμ
μᾶλλον, καὶ καλεῖται μύτις ὑπὸ τῶν. τοιοῦτον δ’
20 ἔτερον καὶ τοῖς μαλακοστράκοις ἔστι, καὶ καλεῖται
kάκεινο μύτις. ἔστι δ’ ὑγρόν καὶ σωματώδες ἀμα
τοῦτο τὸ μόριον, τείνει δὲ δ’ αὐτοῦ, καθάπερ
εἰρηται, διὰ μέσου μὲν ὁ στόμαχος· εἰ γὰρ ἣν
μεταξὺ τούτου καὶ τοῦ πρανοῦ, οὐκ ἂν ἦδύνατο
25 λαμβάνειν ὁμοίως διάστασιν εἰσιούσης τῆς τροφῆς
dιὰ τὴν τοῦ νῶτον σκηνρότητα. ἔπι δὲ τῆς μύτιδος
tο ἔτερον ἔξωθεν, καὶ ὁ θολὸς πρὸς τῷ ἐντέρω,
a That is, dorsal.
and the animals on the other. Towards the animals, because some of them detach themselves and fasten upon their food, and are sensible of objects that come up against them; and also because they make use of the roughness of their body for self-preservation. Towards the plants, because they are incomplete, and quickly attach themselves to rocks; and further, because they have no residue that can be seen, though they have a mouth. The group of Starfish resembles these creatures; Starfish too fasten on to their food, and by doing this to oysters suck large numbers of them dry. But Starfish also resemble those unattached creatures of which we spoke, the Cephalopods and the Crustacea. The same may be said of the Testacea.

The parts connected with nutrition are such as I have now described. These must of necessity be present in all animals. But there is yet another part which every animal must have. These creatures must have some part which is analogous to the parts which in blooded animals are connected with the control of sensation. In the Cephalopods this consists of a fluid contained in a membrane, through which the gullet extends towards the stomach. It is attached to the body rather towards the upper side. Some call it the mytis. An organ just like this, also called the mytis, is present in the Crustacea. This part is fluid and corporeal at the same time. The gullet, as I said, extends through the middle of it. If the gullet had been placed between the mytis and the dorsal side, the gullet would not have been able to distend sufficiently when the food enters, owing to the hardness of the back. The intestine is placed up against the outer surface of the mytis, and the ink-bag
681 b

ὅπως ὅτι πλείστον ἀπέχῃ τῆς εἰσόδου καὶ τὸ
δυσχερὲς ἀποθεὶ ἢ τοῦ βελτίωνος καὶ τῆς ἀρχῆς.
ὅτι δ' ἐστὶ τὸ ἀνάλογον τῇ καρδίᾳ τούτῳ τὸ μόριον,
80 δηλοὶ ὁ τόπος (οὗτος γὰρ ἐστὶν ὁ αὐτὸς) καὶ ἡ
γλυκύτης τῆς υγρότητος ὡς οὕσα πεπεμμένη καὶ
αιματώδης.

'Εν δὲ τοῖς ὀστρακοδέρμοις ἔχει μὲν τῶν αὐτῶν
τόπον' τὸ κύριον τῆς αἰσθήσεως, ἢττον δ' ἐπίδηλον.
πλὴν δεὶ ζητεῖν ἄει περὶ μεσοτῆτα ταύτην τὴν
ἀρχήν, ὅσα μὲν μόνιμα, τοῦ δεχομένου μορίου τὴν
35 τροφήν, καὶ δι' οὗ ποιεῖται τὴν ἀπόκρισιν ἢ
τὴν σπερματικὴν ἢ τὴν περιττωματικὴν, ὅσα δὲ
καὶ πορευτικὰ τῶν ζώων, ἄει ἐν τῷ μέσῳ τῶν
dεξιῶν καὶ τῶν ἀριστερῶν.

Τοῖς δ' ἐντόμοις τὸ μὲν τῆς τουαύτης ἀρχῆς
μόριον, ὥσπερ ἐν τοῖς πρώτοις ἐλέχθη λόγους,
μεταξὺ κεφαλῆς καὶ τοῦ περὶ τὴν κοιλίαν ἐστὶ
kύτος. τούτῳ δὲ τοῖς μὲν πολλοῖς ἐστὶν ἐν, τοῖς
5 δὲ πλείως, καθάπερ τοὺς οὐσιώδεις καὶ μακροῖς·
dιόπερ διαστημὸμενα ζῇ. βούλεται μὲν γὰρ ἡ φύσις
ἐν πάσι μόνον ἐν ποιεῖν τὸ τοιοῦτον, καὶ δυναμένῃ
mὲν ποιεῖ μόνον ἐν, οὐ δυναμένη δὲ πλείως. δὴ
δὲ ἐν ἑτέρους ἑτέρων μᾶλλον.

Τὰ δὲ πρὸς τὴν τροφήν μόρια οὐ πᾶσιν ὁμοίως,
10 ἀλλὰ διαφοράν ἔχει πολλὴν. ἐντὸς γὰρ τοῦ στό-
ματος ἐνίοις μὲν ἐστὶ τὸ καλούμενον κέντρον,
ὡσπερανεὶ σύνθετον καὶ ἐχον γλώττης καὶ χειλῶν

1 τόπον Rackham: τρόπον vulg.
2 ἐν P: om. vulg.
3 sic SUY (δυνάμενα bis S): καὶ δυναμένη μὲν, ἐν ποιεῖ μόνον·
oc δυναμένη δὲ πλείως Z: οὐ δυναμένη δ' ἐνεργεία ποιεῖ μόνον ἐν,
dυνάμει δὲ πλείως vulg. (cf. 667 b 25).

338

ARISTOTLE
up against the intestine; this is to ensure that it and its unpleasantness are kept as far as possible from the body’s entrance and from the sovereign and most noble part. The *mytis* occupies a place which corresponds exactly with that of the heart in blooded creatures: which shows that it is the counterpart of it.\(^a\) Another proof of this is that the fluid in it is sweet—that is, it has undergone concoction and is of the nature of blood.

In the Testacea the part which rules sensation occupies the same place but is not so easy to pick out. But this source of control should always be looked for around some middle position in these creatures: in stationary ones, in the midst between the part which receives the food and the part where the seed or the residue is emitted; and in those which move about, always midway between the right side and the left.

In insects the part where this control is placed, as was said in the first treatise,\(^b\) is situated between the head and the cavity where the stomach is. In the majority there is one such part, but in creatures like the Centipede, that is, which are long in the body, there are more than one: so if the creatures are cut up they go on living. Now Nature’s desire is to make this part a unity in all creatures, and when she can, she makes it a unity, when she cannot, a plurality.\(^c\) This is clearer in some cases than in others.

The parts connected with nutrition are by no means alike in all insects; indeed they exhibit great differences. For instance: Some have what is known as a sting inside the mouth—a sort of combination of tongue and lips,—which possesses the

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\(^a\) The heart of invertebrates escaped the notice of Aristotle.
\(^b\) At Hist. An. 531 b 34.
\(^c\) Cf. 667 b 22 ff.
ἀμα δύναμιν· τοὶς δὲ μὴ ἔχουσιν ἐμπροσθεν τὸ κέντρον ἐστὶν ἐντὸς τῶν ὁδόντων τοιοῦτον αἰσθη-
τήριον. τούτου δ’ ἔχομενον πάσιν ἐντερον εὐθὺ καὶ 
15 ἀπολοῦν μέχρι τῆς έξόδου τοῦ περιττώματος· ἐνίοις 
δὲ τούτῳ ἔλικην ἔχει. τὰ δὲ κοιλίαν μετὰ τὸ στόμα, 
ἀπὸ δὲ τῆς κοιλίας τὸ ἐντερον εἰλιγμένον, ὅπως 
ὅσα βρωτικάτερα καὶ μείζω τὴν φύσιν ὑποδοξήν 
ἔχει πλείονος τροφῆς. τὸ δὲ τῶν τεττίγων γένος 
идιαν ἔχει μάλιστα τούτων φύσιν· τὸ γάρ αὐτὸ 
20 μόριον ἔχει στόμα καὶ γλώτταν συμπεφυκός, δι’ 
οὗ καθαπερεὶ διὰ ρίζης δέχεται τὴν τροφὴν ἀπὸ 
τῶν υγρῶν. πάντα μὲν οὖν ἐστὶν ὀλιγότροφα τὰ 
ἐντομα τῶν ζώων, οὐχ οὕτω διὰ μικρότητα ἀλ 
διὰ ψυχρότητα (τὸ γάρ θερμὸν καὶ δεῖται τροφῆς 
καὶ πέττει τὴν τροφὴν ταχέως, τὸ δὲ ψυχρὸν ἀ-
25 τροφον), μάλιστα δὲ τὸ τῶν τεττίγων γένος· ἵκανή 
γάρ τροφὴ τῷ σώματι ἡ ἐκ τοῦ πνεῦματος ὑπο-
μένουσα υγρότης, καθάπερ τοῖς ἐφημέροις ζώοις 
(γίνεται δὲ τάτα περὶ τῶν Πόντων), πλὴν ἐκεῖνα 
μὲν τυί μιᾶς ἡμέρας χρόνον, ταῦτα δὲ πλείονων 
μὲν ἡμερῶν, ὀλγών δὲ τούτων.

30 Ἐπεὶ δὲ περὶ τῶν ἑντὸς ὑπαρχόντων μορίων τοῖς 
ζώοις εὑρηταί, πάλιν περὶ τῶν λοιπῶν τῶν ἑκτὸς 
ἐπαντέον. ἀρκτέον δ’ ἀπὸ τῶν νῦν εἰρημένων, 
ἀλλ’ οὐκ ἄφ’ ὃν ἀπελπομεν, ὅπως ἀπὸ τούτων 
διατριβήν ἐλάττω ἐχόντων ἐπὶ τῶν τελείων καὶ 
ἐναίμων ζώων ὁ λόγος σχολάζῃ μάλλον.

35 VI. Τὰ μὲν οὖν ἐντομα τῶν ζώων οὐ πολυμερὴ 
μὲν τὸν ἀριθμόν ἐστιν, ὃμως δ’ ἔχει πρὸς ἀλληλα
character of both. Those that have no sting in front have a sense-organ of that sort behind the teeth. After the mouth, in all insects comes the intestine, which is straight and simple right up to the residual vent. (Sometimes, however, it has a spiral in it.) And some there are which have the stomach next after the mouth, while from the stomach runs a twisted intestine; this gives the bigger and more gluttonous insects room for a larger amount of food. Of all these creatures the grasshoppers are the most peculiar. In them the mouth and tongue are united so as to make one single part, and through this they draw up their nourishment from fluid substances as through a root. All insects take but little nourishment; and this is not so much because they are small as because they are cold. (Heat needs nourishment and quickly concocts it; cold needs none.) This is most marked in the grasshoppers. They find sufficient nourishment in the moisture which the air deposits; so do the one-day creatures which occur around the Black Sea. Still, they live only for the space of a day; whereas the grasshoppers live for several, though not many, days.

Now that we have spoken of the internal parts of animals, we must go back and deal with the remainder of the external parts. We had better begin with the creatures of which we have just been speaking, and not go back to the point where we left the external parts. This will mean that we take first those which need less discussion, and that will give more time for speaking of the "perfect" animals, i.e. the blooded ones.

VI. Insects first, then. Though their parts are not numerous, insects differ from one another. They all
Διαφοράς. πολύποδα μὲν γὰρ ἐστὶ πάντα διὰ τὸ
πρὸς τὴν βραδυτῆτα καὶ κατάψυξιν τῆς ὁσεως τὴν
πολυποδίαν ἀντικωτέραν αὐτοὶς ποιεῖν τὴν κύησιν,
καὶ μάλιστα πολύποδα τὰ μάλιστα κατέβηκεν διὰ
tὸ μῆκος οἷον τὸ τῶν οὐλῶν γένος. ἔτι δὲ διὰ τὸ
ἀρχαῖο ἐχεῖν πλείονας αἱ τ’ ἐντομαὶ εἰσὶ καὶ πολύ-
ποδα κατὰ ταύτα ἐστιν.

'Ὅσα δ’ ἐλάττονας ἔχει πόδας, πηνα ταύτ’ ἔστι
πρὸς τὴν έλλειψιν τὴν τῶν ποδῶν. αὐτῶν δὲ τῶν
πτηνῶν ὧν μὲν ἐστὶν ὁ βίος νομαδικός καὶ διὰ τὴν
τροφὴν ἀναγκαίον ἐκτοπίζειν, τετράπτερα τε ἔστι
καὶ τῶν τοῦ σώματος ἔχει κούφον ὄγκον, οἷον αἱ τε
11 μελίτται καὶ τὰ σύμφυλα ἔξα ταύταις. δύο γὰρ ἐό
ékάτερα πτερά ἐχουσιν. ὡσά δὲ μικρὰ τῶν τουό-
των, δίπτερα, καθάπερ τὸ τῶν μυιῶν γένος. τὰ δὲ
βαρέα3 καὶ τοῖς βίοις ἐδραῖα πολύπτερα μὲν ὀμοίως
ταῖς μελίτταις4 ἐστίν, ἔχει δ’ ἐλυστα τοῖς πτεροῖς,
13 οἷον αἱ τε μυλολόνθαι καὶ τὰ τουαίτα τῶν ἐντόμων,
ὅπως σώζῃ τὴν τῶν πτερῶν διόνυσιν ἐδραῖων γὰρ
ὄντων εὐθύπθορα μᾶλλον ἐστὶ τῶν εὐκυκτήτων,
διόπερ ἔχει ὁραγμὸν πρὸ αὐτῶν. καὶ ἄσχιστον δὲ
τούτων ἐστὶ τὸ πτερόν καὶ ἀκαυλον: οὐ γὰρ ἐστὶ
πτερόν ἀλλ’ ὑμήν δερματικός, ὅ δ’ ἐξήρωτητα ἐξ
20 ἀνάγκης ἀφύσταται τοῦ σώματος αὐτῶν ψυχομένου
τοῦ σαρκώδους.

Ἐντομα δ’ ἐστὶ διὰ τε τὰς εἰρημένας αἰτίας, καὶ
ὅπως σώζῃται δι’ ἀπάθειαν συγκαμπτόμενα: συν-
elίπτεται γὰρ τὰ μῆκος ἕχουσιν αὐτῶν, τούτο δ’ οὐκ
ἀν ἐγίνετ’ αὐτοῖς μὴ οὐδὲν ἐντόμοις. τὰ δὲ μὴ

3 πτερὰ τοῦ σώματος vulg.: τοῦ σ. delevi.
4 μελίτταις (οὐκ) Platt.

342
have numerous feet; this is in order to make their (a) Insects. motion quicker, and to counteract their natural slowness and coldness. Those which are most subject to coldness owing to their length (e.g. the Centipedes) have the greatest number of feet. Furthermore, these creatures have several sources of control; and on that account they have the "insections" in their bodies, and the numerous feet which are placed in precise correspondence.

Those that have fewer feet are winged by way of compensation. Some of these flying insects live a wandering life and have to go abroad in search of food; so they have a light body and four wings, two on either side; such are the bees and the kindred tribes. The small ones have only two wings all told—like the flies. Those that are heavy and sedentary in their habits have the larger number of wings like the bees, but they have shards round their wings (e.g. the Melolonthae and similar insects) to preserve them in their proper condition; for, as these creatures are sedentary, their wings are more liable to be destroyed than those of the nimbler insects; and that is why there is this protection round them. An insect’s wing is not divided, and it has no shaft. In fact, it is not a wing at all, but a membrane of skin, which being dry detaches itself of necessity from the creature’s body as the fleshy part cools off.

I have already stated some reasons why these creatures have "insected" bodies: there is another, viz. it is so that they may curl up and thus escape injury and remain safe. It is the long ones that roll themselves up, and this would be impossible for them if they were not insected. Those that do not roll up

\[a\] Perhaps cockchafers (Ogle).
682 b ἐλικτά αὐτῶν σκληρύνεται μᾶλλον συνιόντα εἰς τὰς
tομάς. δὴ λοις δὲ τούτο γίνεται βιγγανίντων, οἷον
ἐπὶ τῶν καλομένων κανθάρων· φοβηθέντα γὰρ
ἀκινητίζει, καὶ τὸ σῶμα γίνεται σκληρὸν αὐτῶν.
ἀναγκαίον δ’ ἐντόμοις αὐτοῖς εἶναι. τούτο γὰρ ἐν
τῇ οὐσίᾳ αὐτῶν ὑπάρχει τὸ πολλὰς ἐχεῖν ἀρχάς, καὶ
30 ταύτη προσέοικε τοῖς φυτοῖς. ὥσπερ γὰρ τὰ φυτά,
καὶ ταύτα διαιροῦμενα δύναται ζῆν, πλὴν ταύτα μὲν
μέχρι τινός, ἐκεῖνα δὲ καὶ τέλεια γίνεται τὴν φύσιν
καὶ δύο εἴς ἑνὸς καὶ πλείω τῶν ἀριθμῶν.

"Εχει δ’ ἐνα τῶν ἐντόμων καὶ κέντρα πρὸς
βοῆθειν τῶν βλαπτόντων. τὸ μὲν οὖν κέντρον
35 τοῖς μὲν ἐμπροσθέν ἐστι τοῖς δ’ ὀπισθεν, τοῖς μὲν
ἐμπροσθέν κατὰ τὴν γλώτταν, τοῖς δ’ ὀπισθεν κατὰ
tὸ οὐραῖον. ὥσπερ γὰρ τοῖς ἐλέφασι τὸ τῶν
ὀσμῶν αἰσθητήριον γεγένηται χρώσιμον πρὸς τε
683 a τὴν ἀλκήν καὶ τὴν τῆς τροφῆς χρῆσιν, οὕτως τῶν
ἐντόμων ἐνίοις τὸ κατὰ τὴν γλώτταν τεταγμένον·
αἰσθάνονται τε γὰρ τούτῳ τῆς τροφῆς καὶ ἀναλαμ-
βάνουσι καὶ προσάγονται αὐτήν. ὡσα δὲ μὴ ἐστιν
αὐτῶν ἐμπροσθόκεντρα, ὀδόντας ἔχει τὰ μὲν
5 ἐδώδης χάριν τὰ δὲ τοῦ λαμβάνειν καὶ προσαγεῖσθαι
τὴν τροφὴν, οἷον οὗ τε μύριμκα καὶ τὸ τῶν μελι-
τῶν πασῶν γένος. ὡσα δ’ ὀπισθόκεντρά ἐστι, διὰ
tὸ θυμὸν ἔχειν ὀπλον ἔχει τὸ κέντρον. ἔχουσι δὲ
tὰ μὲν ἐν ἑαυτοῖς τὰ κέντρα, καθάπερ αἱ μέλιται
καὶ οἱ σφῆκες, διὰ τὸ πτηναὶ εἶναι. λεπτὰ μὲν γὰρ
10 ὄντα καὶ ἔξω εὐφθαρτα <ἀν> ἦν· εἰ δὲ παχέα ἦν
ὡσπερ τοῖς σκορπίοις, βάρος ἀν παρείχεν. τοῖς δὲ

1 <ἀν> Ogle. 2 δὲ παχέα ἦν Platt: δ’ ἀπείχεν vulg.
increase their hardness by closing up the insections. This is obvious if you touch them—e.g. the insects called Canthari (dung-beetles) are frightened when touched and become motionless, and their bodies become hard. But also it is necessary for them to be insected, for it is of their essential being to have numerous sources of control; and herein they resemble plants. Plants can live when they are cut up; so can insects. There is a difference, however, for whereas the period of survival of a divided insect is limited, a plant can attain the perfection of its nature when divided, and so two plants or more come out of one.

Some of the insects have a sting as well, for defence against attackers. In some the sting is in front, by the tongue; in others it is behind at the tail-end. Consider the elephant's trunk: this is its organ of smell; but the elephant uses it as a means of exerting force as well as for the purposes of nutrition. Compare with this the sting of insects: when, as in some of them, it is ranged alongside the tongue, not only do they get their sensation of the food by means of it, but they also pick up the food with it and convey it to the mouth. Those which have no sting in front have teeth; which some of them use for eating, others for picking up the food and conveying it to the mouth, as do the ants and the whole tribe of bees. Those that have a sting at the back are fierce creatures and the sting serves them as a weapon. Sometimes the sting is well inside the body, as in bees and wasps. This is because they are winged, and a delicate sting on the outside of the body would be easily destroyed; on the other hand, a thick one such as scorpions have would weigh them down. Scorpions
The principle of "division of labour" in a living organism, not stated again until 1827 (by Milne Edwards). See Ogle's note.
PARTS OF ANIMALS, IV. vi.

themselves, being land-creatures and having a tail, are bound to have their sting on their tail; otherwise it would be no use for exerting force. No two-winged insect has a sting at the rear; these are small weak creatures, and can be supported by a smaller number of wings: that is why they have only two. The same reason explains why they have their sting in the front: owing to their weakness they cannot well deliver a blow with their hind parts. Many-winged creatures, on the other hand, owe their greater number of wings to their own greater size, and so too their hind parts are stronger and bear the sting. It is better, when it is possible, that one and the same organ should not be put to dissimilar uses; that is, there should be an organ of defence which is very sharp, and another organ to act as a tongue, which should be spongy and able to draw up nourishment. And thus, whenever it is possible to employ two organs for two pieces of work without their getting in each other's way, Nature provides and employs two. Her habits are not those of the coppersmith who for cheapness' sake makes you a spit-and-lampstand combination. Still, where two are impossible, Nature employs the same organ to perform several pieces of work.

Some insects, whose eyesight is not distinct owing to their eyes being made of some hard substance, have specially long forefeet, which enable them to clear away anything that comes down on to the eyes. Flies and bees and the like are obvious examples: they are always crossing their front legs. These creatures' hind legs are longer than their middle ones for two reasons: (1) to assist them in walking, and (2) to lift them more easily off the ground when they
ARISTOTLE

683 a όμενα. οὖν δὲ πηδητικὰ αὐτῶν ἐτὶ μᾶλλον τοῦτο φανερόν, οἷον αἱ τ᾽ ἀκρίδες καὶ τὸ τῶν ψυλλῶν

35 γένος· ὅταν γὰρ κάμψαντ᾽ ἐκτείνῃ πάλιν, ἀναγκαίοιον ἀπὸ τῆς γῆς ἡρθαι. οὐκ ἐμπροσθεν δ᾽ ἄλλ᾽ ὁπισθεν μόνον ἔχουσι τὰ πηδαλιώδη αἱ ἀκρίδες· τὴν γὰρ καματὴν ἀναγκαίον εἶσω κεκλάσθαι, τῶν δὲ προσθίων κόλων οὐδέν ἐστὶ τοιοῦτον. ἕξαποδά δὲ τὰ τοιαύτα πάντ᾽ ἐστὶ σὺν τοῖς ἀλτικοῖς μορίοις.

VII. Τῶν δ᾽ ὀστρακοδέρμων οὐκ ἔστι τὸ σῶμα

5 πολυμερές. τούτου δ᾽ αίτιον τὸ μόνιμον αὐτῶν εἶναι τὴν φύσιν· πολυμερέστερα γὰρ ἀναγκαίοιν εἶναι τῶν ξύων τὰ κινητικὰ διὰ τὸ <πλείους> εἶναι αὐτῶν πράξεισι· ὀργάνων γὰρ δεῖται πλειόνων τὰ πλειόνων μετέχοντα κινήσεων. τούτων δὲ τὰ μὲν ἀκίνητα πάμπαν ἐστὶ, τὰ δὲ μικρὰς μετέχει κι-

10 νήσεως· ἀλλ' ἡ φύσις πρὸς σωτηρίαν αὐτοῖς τὴν τῶν ὀστράκων σκληρότητα περιέθηκεν. ἐστὶ δὲ τὰ μὲν μονόθυρα τὰ δὲ δίθυρα αὐτῶν, τὰ δὲ στρομβίωδη, καθάπερ εἰρηται πρότερον· καὶ τούτων τὰ μὲν ἐλίκην ἔχοντα, οἶνον κήρυκες, τὰ δὲ σφαιροειδῆ μόνον, καθάπερ τὸ τῶν ἐχύων γένος. καὶ τῶν

15 διθύρων τὰ μὲν ἐστὶν ἀναπτυκτά, οἶνον κτένες καὶ μίες (ἐπὶ θάτερα γὰρ συγκέκλεισται, ὡστε ἀν- αίγεσθαι ἐπὶ θάτερα καὶ συγκλειέσθαι), τὰ δ᾽ ἐπ᾽ ἄμφω συμπέφυκεν, οἶνον τὸ τῶν σωλήνων γένος. ἀπαντα δὲ τὰ ὀστρακόδερμα, καθάπερ τὰ φυτὰ,

20 κάτω τὴν κεφαλὴν ἔχει. τούτου δ᾽ αἴτιον ὅτι κάτωθεν λαμβάνει τὴν τροφήν, ὡσπερ τὰ φυτὰ ταῖς ρίζαις. συμβαίνει οὖν αὐτοῖς τὰ μὲν κάτω ἀνω ἔχειν, τὰ δ᾽ ἀνω κάτω. ἐν ύμενι δ᾽ ἐστὶ, δι᾽

1 <πλείους> Peck: <πολλάς> Platt.
rise in flight. This peculiarity is even more noticeable in the leaping insects, such as locusts and the various sorts of fleas, which first bend their hind legs and then stretch them out again, and this forces them to rise up from the ground. The rudder-shaped legs which locusts have are at the rear only and not in front; this is because the joint must bend inwards, and no front limb satisfies this condition. All these creatures have six feet, inclusive of the parts used for leaping.

VII. In Testacea the body is not divided into several parts, owing to their being of stationary habits, as opposed to creatures which move about: the latter are bound to have more parts to their body because their activities are more numerous, and the more motions of which a species is capable, the more organs it requires. Now some of the Testacea are altogether stationary: others move about but little; and so, to keep them safe, Nature has compassed them about with hard shells. Some of them are (as I said earlier) one-valved, some two-valved; and some conical, either spiral like the Whelks, or spherical like the Sea-urchins. The two-valved shells are divided into (a) those which open—i.e. which have a joint on one side and can open and shut on the other; e.g. the scallops and mussels; (b) those which are joined together on both sides, e.g. the group of razor-fishes. In all Testacea, just as in plants, the head is down below. The reason for this is that they take up their food from below, as plants take it up by their roots; so they have their nether parts above and their upper parts below. These creatures are enveloped in a membrane, and through this they strain fresh-

\* See note on 693 b 3, p. 433.
\* At 679 b 16.
οὐ διηθεὶ τὸ πότιμον καὶ λαμβάνει τὴν τροφήν. ἔχει δὲ κεφαλὴν μὲν πάντα, τὰ δὲ τοῦ σώματος μόρια παρὰ τὸ τῆς τροφῆς δεκτικὸν ἀνώνυμα τᾶλλα.

25 VIII. Τὰ δὲ μαλακόστρακα πάντα καὶ πορευτικά, διὸ ποδῶν ἔχει πλῆθος. ἔστι δὲ γένη μὲν τέταρτα τὰ μέγιστον αὐτῶν οἱ τε καλούμενοι κάραβοι καὶ ἀστακοὶ καὶ καρίδες καὶ καρκίνοι: τούτων δ᾿ ἐκάστου πλείω εἰδὴ ἔστι διαφέροντα οὐ μόνον κατὰ τὴν μορφὴν ἄλλα καὶ κατὰ τὸ μέγεθος πολὺ τὰ μὲν γὰρ μεγάλα τὰ δὲ μικρὰ πάμπαν αὐτῶν ἔστιν. τὰ μὲν οὖν καρκινώδη καὶ καραβώδη παρόμοιοι ἐστὶ τῷ χλαὶς ἔχειν ἀμφότερα. ταῦτας δ᾿ οὐ πορείας ἔχουσι χαρῶν, ἄλλα πρὸς τὸ λαβεῖν καὶ κατασχεῖν ἀντὶ χειρῶν. διὸ καὶ κάμπτουσιν ἐναντίως ταῦτας τοὺς ποσῶν τοὺς μὲν γὰρ ἐπὶ τὸ κοῖλον τὰς δ᾿ ἐπὶ τὸ περιφερές κάμπτουσι καὶ ἐλισσοῦν: οὔτω γὰρ χρήσιμαι πρὸς τὸ λαβῶσαι προσφέρεσθαι τὴν τροφήν.

35 Διαφέρουσι δ᾿ ὧν οἱ μὲν κάραβοι ἔχουσιν οὐρὰν, οἱ δὲ καρκίνοι οὐκ ἔχουσιν οὐρὰν· τοῖς μὲν γὰρ διὰ τὸ νευστικῶς εἶναι χρήσιμοι ὡς οὐρὰ (νέους γὰρ ἀπερειδόμενοι οἴον πλάτας αὐτῶν), τοῖς δὲ καρκίνοις οὐδὲν χρήσιμον διὰ τὸ πρόσγειον εἶναι τὸν βίον1 αὐτῶν καὶ εἶναι τρωγλοῦτας. ὅσοι δ᾿ αὐτῶν πελάγιοι εἰσή, διὰ τοῦτο πολὺ ἀργοτέρους ἔχουσι τοὺς πόδας2 πρὸς τὴν πορείαν, οἴον αἰ τε μαίαι καὶ οἱ Ἦρακλειστοί καλούμενοι καρκίνοι, ὅτι ὄλγη κυνήσει χρώνται, ἀλλ᾿ ἡ σωτηρία αὐτῶς τῷ ὀστρειῶδεις εἶναι γίνεται· διὸ αἱ μὲν μαίαι

1 τὸ βίον Bekker per hypothetae errorem.
2 αὐτῶν post πόδας vulg.: om. Y.
PARTS OF ANIMALS, IV. vii.—viii.

Water to drink, which is their way of taking nourishment. All of them possess a head, but except for the part which takes in the food none of the other parts has a special name.

VIII. All the Crustacea can walk on land as well as swim; and hence they all have numerous feet. There are four main groups of Crustacea, called (1) Carabi; (2) Astaci; (3) Carides; and (4) Carcini. Each of these contains several species which differ not only in shape, but also in size, and that considerably, for some species are large, others extremely small. The Carcinoid and the Caraboid crustacea resemble each other, in both having claws. These claws are not for the sake of locomotion, but serve instead of hands, for catching and holding; and that is why they bend in an opposite direction to the feet, which bend and twist toward the concave side, while the claws bend toward the convex side. This makes the claws serviceable for catching hold of the food and conveying it to the mouth.

The two groups, Carabi and Carcini, differ in that the former have a tail and the latter have not. The Carabi find a tail useful because they are swimmers: they propel themselves with it as though with oars. A tail would be useless to the Carcini, which spend their lives near the land and creep into holes and crannies. Those that live out at sea and move about but little, and owe their safety to their shelly exterior, have for these reasons feet which are considerably less effective for locomotion: examples of this are the

*Roughly, these four divisions may be represented by our own groups, thus: (1) lobsters; (2) crayfish; (3) prawns and shrimps; (4) crabs.*
ΑΡΙΣΤΟΤΛΗ

684 α

λεπτοσκελείς, οί δ’ Ἦρακλεωτικοί μικροσκελεῖς εἶσιν.

Οἱ δὲ πάμπαν μικροὶ καρκίνοι, οἱ ἀλλόκοται εἰς τοὺς μικροὶς ἱχθύδιοις, ἔχουσι τοὺς τελευταίους πλατεῖς πόδας, ὅνα πρὸς τὸ νεῖν αὐτοῖς χρήσιμοι ὄσιν, ὥσπερ πτερύγια ἡ πλάτας ἔχοντες τοὺς πόδας.

Αἱ δὲ καρίδες τῶν μὲν καρκινοείδών διαφέρουσι τῷ ἔχειν κέρκον, τῶν δὲ καραβοείδών διὰ τὸ μὴ ἔχειν χηλάς· ὅσον ἔχουσι διὰ τὸ πλείους ἔχειν πόδας, ἐνταῦθα γὰρ ἡ ἐκείθεν ἀνήλωται αὐξήσιοι. πλείους δ’ ἔχουσι πόδας, ὅτι νευστικώτερά ἐστιν ἡ πορευτικώτερα.

Τὰ δ’ ἐν τοῖς ὑπίπτουσι μόρια καὶ περὶ τὴν κε- φαλὴν τὰ μὲν εἰς τὸ δέξασθαι τὸ ὕδωρ καὶ άφεῖναι ἐχουσι βραγχοειδῆ· πλακωδέστερα δὲ τὰ κάτω αἰ θήλειαι τῶν ἀρρένων καράβων ἔχουσι, καὶ τὰ ἐν τῷ ἐπιπτύγματι δασύτερα αἰ θήλειαι καρκίνοι τῶν ἀρρένων, διὰ τὸ ἐκτείνειν τὰ ἡμὰ πρὸς αὐτά, ἀλλὰ μὴ ἀποθεῖν, ὥσπερ οἱ ἱχθύες καὶ τὰλλα τὰ (ὡὰ)¹ τίκτονται· εὐρυχωρέστερα γὰρ ὄντα καὶ μείζων χώραν ἔχει τοῖς ὑσίς μᾶλλον. οἱ μὲν οὖν καραβοι καὶ οἱ καρκίνοι πάντες τὴν δεξιὰν ἔχουσι χηλήν μείζω καὶ ἵσχυροτέραν· τοῖς γὰρ δεξιοῖς πάντα πέφυκε τὰ ζώα ὅραν μᾶλλον, ἡ δὲ φύσις ἀποδίδω- σιν ἀεὶ τοῖς χρήσθαι δυναμένοις ἐκαστὸν ἡ μόνως ἡ μᾶλλον, οἶον χαυλιόδοντας καὶ ὄδοντας καὶ κέρατα καὶ πλήκτρα καὶ πάντα τὰ τοιαῦτα μόρια, ὅσα πρὸς βοηθεῖαν καὶ ἀλκήν ἐστιν.²

Οἱ δ’ ἀστακοὶ μόνοι, ὅποτέραν ἀν τῆς χειρῆς ἔχουσι μείζων τῶν χηλῶν, καὶ αἱ θηλειαι καὶ οἱ

¹ ωὰ Peck: τίκτοντα S: κυκάκοντα PY: φωτοκούντα Ogle.
² ἐστιν Peck: εἰσιν vulg.
Maiae (whose legs are thin) and the crabs called Heracleotic (whose legs are short).

The little tiny crabs, which are found among the catch with small fishes, have their hindmost feet flat, like fins or oars, to make them useful for swimming.

The Carides differ from the Carcinoids in having a tail, and from the Caraboids just mentioned in not having claws. Claws are absent because they have more feet: the material for their growth has gone into the feet. And they have more feet because they swim about more or move about more.

As for the parts on the under surface around the head, in some animals these are formed like gills so as to let in the water and to discharge it; the lower parts, however, of female crabs are flatter in formation than those of male ones, and also the appendages on the flap are hairier. This is because they deposit their eggs there instead of getting rid of them, as the fishes and the other oviparous animals do. These appendages are wider and larger and so can provide more space for the eggs. In all the Carabi and in all the Carcini the right claw is bigger and stronger than the left. This is because all animals in their activities naturally use the right side more; and Nature always assigns an instrument, either exclusively or in a better form, to those that can use it. This holds good for tusks, teeth, horns, spurs and all such parts which serve animals for assistance and offence.

In Lobsters only, whether male or female, it is a matter of chance which claw is the bigger. The

\* Probably the spiny spider-crab.
\* That is, ventral.
At 678 b 24 ff.

The theory that the cuttle-fish is comparable to a vertebrate bent double was put forward in a paper read before the Academy of Sciences in 1830, and was the origin of the famous 354
reason why they have claws is because they belong to a group which has claws; and they have them in this irregular way because they themselves are deformed and use the claws not for their natural purpose but for locomotion.

For an account of every one of the parts, of their position, and of the differences between them, including the differences between the male and the female, consult the Anatomical treatises and the *Inquiries upon Animals*.a

IX. With regard to the Cephalopods, their internal parts have already been described, as have those of the other animals.b The external parts include (1) the trunk of the body, which is undefined, and (2) in front of this, the head, with the feet round it: the feet are not beyond the eyes, but are outside the mouth and the teeth. Other footed animals either have some of their feet in front and some at the back; or else arranged along the sides—as with the bloodless animals that have numerous feet. The Cephalopods, however, have an arrangement of their own. All their feet are on what may be called the front. The reason for this is that their back half is drawn up on to the front half,c just as in the conical-shelled Testacea. And generally, though in some respects the Testacea resemble the Crustacea, in others they resemble the Cephalopods. In having their earthy material outside and their fleshy material inside, they resemble the Crustacea; but as regarding the formation and construction of their body they resemble the Cephalopods—all of controversy between G. St-Hilaire and Cuvier about unity of type. This controversy excited Goethe more than the revolution of the same year. (Ogle.)
ARISTOTLE

684 b
tina panta, maliota de twn stroymboðon ta exonta tin elikyn: amphoteron gar tou'ton exei tou' tròpon ou' phusis1: et propter hoc ambulant uniformiter (all' ou)2 katháper symbebetaive épi twn tetrapódwn zówv kai twn anðròpwn. homo vero 25 habet os in capite, scilicet in parte superiori corporis, épeita tou stómachon, épeita de tin koulivan, apó de taúths to ènterou méxri tis diezódous tout periptw mátos. touton mén ouv touton exei tois enaímosi zówis, kai metà tin kefalhn èstiv ò kalou'menos thwra, kai tà peri touton tà de loipà mória

touton te xarvn kai èneka tis kynhsews prosebthikev ou' phusis, ouin tâ te prósobia kôla kai tâ ópiothenv. boûletai de kai tois malakostrákois kai tois èntomous ou' g' euthuwría touton èntosîdijoun tout auton exeun tròpon, kata de tás ûpereisias tás eixwthen kynhtikas diaferei touten ènaímos. tâ de malakia te kai (tâ)3 stroymboðha touton òsttrakodermwn exei

1 sequitur locus corruptus. quae corrigi possunt sec. vers. arabicam corrixi, suppositicia eici, amissa e versione latina Mich. Scot supplevi. text. vulg. habet ou' phusis õspere ei' tis nohseion ep' euthéias, katháper symbebetaive épi touten tetrapódwn zówv kai twn anðròpwn, práton mén èpi ákro tout anw stómato tis euthéias kata touto A, épeita <kata addunt PY> touto B touten stómachon, [tou de om. PY] G touten koulivan apó de touto ènterou méxri tis diezódous tout periptw mátos, ou' touto mén ouv touten exei tois ènaímosi zówis, kai peri touto èstiv ou' kefalh kai ò thwra kalou'menos (kal. thwra SU): tâ de loipà, etc. vide et quae p. 432 scripsi.

2 <all' ou> Peck.

3 <tâ> Peck.
them do so to some extent, but most markedly those conical Testacea which have a spiral shell, since both these classes have this natural structure; and therefore they walk with an even gait, and not as is the case with quadrupeds and man. Now man has his mouth placed in his head, viz. in the upper part of the body, and after that the gullet, then the stomach, and after that the intestine which reaches as far as the vent where the residue is discharged. This is the arrangement in the blooded animals, i.e., after the head comes what is known as the trunk, and the parts adjoining. The remaining parts (e.g. the limbs at front and back) have been added by Nature for the sake of those which I have just mentioned and also to make movement possible. Now in the Crustacea too and in the Insects the internal parts tend to be in a straight alignment of this kind; though with regard to the external parts which subserve locomotion their arrangement differs from that of the blooded animals. The Cephalopods and the conical-shelled Testacea have the same

\[a\] The passage which follows has been badly corrupted by references to a diagram which have ousted the text. The words in italics have been translated from the Arabic version, of which Michael Scot's Latin translation is given opposite, in default of the original Greek. See supplementary note on p. 432.

\[b\] This refers to their uneven progression by moving first one side of the body and then the other. The Testacea, however, "have no right and left" (De incessu an. 714 b 9), and their movement was evidently an awkward problem for Aristotle. He reserves them until the very end of the De incessu, and he has to admit that they move, although they ought not to do so! They move παρὰ φῶν. The mechanism of their motion can be detected by the microscope, and is known as ciliary. See also De incessu, 706 a 13, 33, Hist. An. 528 b 9.
685 a αὐτοῖς μὲν παραπλησίως, τούτοις δ' ἀντεστραμμένως· κέκαμπται γὰρ ἡ τελευτὴ πρὸς τὴν ἀρχήν, ὡσπερ ἄν εἴ τις τὴν εὐθείαν [ἐφ' ἢς τὸ Ε]¹ κάμψας προσαγάγοι τὸ Δ πρὸς τὸ Α. οὔτως γὰρ κεμένων νῦν τῶν ἐντοσθίων περικείται τοῖς μὲν μαλακίοις τὸ κύτος, δ' καλεῖται μόνον ἐπὶ τῶν πολυπόδων κεφαλὴ· τοῖς δ' ὀστρακοδέρμοις τὸ τοιούτον ἔστων δ' στρόμβος. διαφέρει δ' οὗδεν ἄλλο πλὴν ὅτι τοῖς μὲν μαλακῶν τὸ πέριξ, τοῖς δὲ σκληρῶν περὶ τὸ σαρκῶδες περιέθηκεν ἡ φύσις, ὅπως σώζεται διὰ τὴν δυσκινησίαν· καὶ διὰ τούτο τὸ περίττωμα τοῖς τε μαλακίοις ἐξέρχεται περὶ τὸ στόμα καὶ τοῖς στρομβώδεσι, πλὴν τοῖς μὲν μαλακίοις κάτωθεν, τοῖς δὲ στρομβώδεσιν ἐκ τοῦ πλαγίου.

Διὰ ταύτην μὲν οὖν τὴν αὐτίαν τοῖς μαλακίοις οἱ πόδες τοῦτον ἔχουσι τὸν τρόπον, καὶ ὑπεναντίως ἡ τοῖς ἄλλοις. ἔχουσι δ' ἀνομοίωσιν αἱ σηπίαι καὶ αἱ τευθίδες τοῖς πολύποσι διὰ τὸ νευστικαί μόνον εἶναι, τοὺς δὲ καὶ πορευτικοὺς. αἱ μὲν γὰρ τοὺς ἀνωθέν τῶν ὀδόντων £€ξ μικροῦς£ ἔχουσιν, καὶ τούτων τοὺς ἐσχάτους δύο μείζους, τοὺς δὲ λουποὺς τῶν ὀκτὼ δύο κάτωθεν μεγίστους πάντων.³ ὡσπερ γὰρ τοῖς τετράποσι τὰ ὀπίσθια ἱσχυρότερα κῶλα, καὶ ταύταις μέγιστοι οἱ κάτωθεν (πόδες)⁴· τὸ γὰρ φορτίον οὕτοι ἔχουσι καὶ κινοῦσι μάλιστα. καὶ οἱ ἐσχάτοι δύο μείζους τῶν μέσων, ὅτι τούτους συν-

² Schneider ex Gazae vers. (senos exiguos); sex Σ; μικροῦς Z (sed podōw pro odōntow), idem E teste Buss.
³ πάντων Ogle: τούτων vulg. ⁴ £πόδες£ Rackham.
arrangement as one another, but it differs completely from that of the others, as the tail-end of these creatures is bent right over to meet the front, just as if I were to bend the straight line over until the point D met the point A. Such

A B C D

then, is the disposition of their internal parts. Round them, in Cephalopods, is situated the sac (in the Octopuses and in them only it is called the head): in the Testacea the corresponding thing is the conical shell. The only difference is that in the one case the surrounding substance is soft, and in the other Nature has surrounded the flesh with something hard, to give them the preservation they need owing to their bad locomotion. As a result of the above-mentioned arrangement, in both sets the residue leaves at a point near the mouth: in the Cephalopods under the mouth, in the conical Testacea at the side of it.

So what we have said explains why the feet of Cephalopods are where they are, quite differently placed from all other animals' feet. Sepias and Calamaries, however, being swimmers merely, differ from the Octopuses, which are walkers as well; they have six small feet above the teeth, and of these the ones at each end are larger; the remaining two out of the total eight are down below and largest of all. These creatures have their strongest feet down below, just as quadrupeds have their strongest limbs at the back; and the reason is that they carry the weight of the body and they chiefly are responsible for locomotion. The two outer feet are larger than the inner ones because they have to help the others
The use of these σαυραι or σεφαί is described by Hippocrates, Ἐπὶ ἄρθρων (Littre iv. 318-320; L.C.L. iii. 390: "The tubes woven out of palm-tissue are satisfactory means of..."
in performing their duty. In the Octopuses, however, the four middle feet are the biggest.

And although all these creatures have eight feet, the Sepia's and the Calamary's are short ones, since their bodies are large in the trunk, and the Octopus's feet are long, because his body is small. Thus in one case the substance which she took from the body Nature has given towards lengthening the feet, and in the other she has taken away from the feet and made the body itself bigger. Hence it results that the Octopuses have feet which will serve them for walking as well as for swimming, whereas the other creatures' feet will not do so, being small, while the body itself is big. And inasmuch as these creatures' feet are short, and useless for holding on tightly to the rock in a storm when there is a strong sea running, or for bringing to the mouth objects that are at a distance, by way of compensation they have two long probosces, with which during a storm they moor themselves up and ride at anchor like a ship; thereby also they hunt distant prey and bring it to their mouths. These things the Sépias and Calamaries do. The Octopuses have no probosces because their feet serve these purposes. Some creatures have suckers and twining tentacles as well as feet: these have the same character and function as well as the same structure as those plaited tubes which the early physicians used for reducing dislocated fingers. They are similarly made out of plaited fibres, and their reduction, if you make extension of the finger both ways, grasping the tube at one end and the wrist at the other." The σαύρα was thus a tube open at both ends. A similar passage in Diocles ap. Apollonius of Kitium, no doubt taken from Hippocrates, refers to "the σείραί which children plait" (L.C.L. iii. 453).
πεπλεγμέναι εἰσίν, καὶ ἐλκοῦσι τὰ σαρκία καὶ τὰ ἐνδιδόντα. περιλαμβάνει μὲν γὰρ χαλαρὰ ἄντα· ὅταν δὲ συντεῖν, πιέζει καὶ ἔχεται τοῦ ἐντῶς θυγγάνοντος παντὸς.

10 Ὡστ' ἐπεὶ ἄλλο οὐκ ἐστὶν ὁ προσάξονται, ἄλλ' ἡ τὰ μὲν τοῖς ποσὶ τὰ δὲ ταῖς προβοσκίσαι, ταῦτας ἔχουσι πρὸς ἄλκην καὶ τὴν ἄλλην βοήθειαν ἀντὶ χειρῶν.

Τὰ μὲν οὖν ἄλλα δικότυλά ἐστι, γένος δὲ τὶ πολυπόδων μονοκότυλον. αὐτίον δὲ τὸ μῆκος καὶ ἡ λεπτότης τῆς φύσεως αὐτῶν· μονοκότυλον γὰρ ἀναγκαῖον εἶναι τὸ στενόν. οὐκ οὖν ὡς βέλτιστον ἔχουσιν, ἄλλ' ὡς ἄναγκαιον διὰ τοῦ ἱδίου λόγου τῆς οὐσίας.

Πτερύγιον δ' ἔχουσι ταύτα πάντα κύκλων περὶ τὸ κύτος. τούτῳ δ' ἐπὶ μὲν τῶν ἄλλων συναπτόμενον καὶ συνεχές ἐστι, καὶ ἐπὶ τῶν μεγάλων τευθών· αἱ δ' ἐλάττως καὶ καλούμεναι τευθίδες πλατύτερον τε τοῦτο ἔχουσι καὶ οὐ στενόν, ὡσπερ αἱ σητίαι καὶ οἱ πολύποδες, καὶ τοῦτ' ἀπὸ μέσου ἤργωσαν, καὶ οὐ κύκλως διὰ παντός. τούτῳ δ' ἔχουσιν ὡς νέωσι καὶ πρὸς τὸ διορθοῖν, ὡσπερ τοῖς μὲν πτηνοῖς τὸ όρροπύγιον, τοῖς δ' ἱχθύσι τὸ οὐραῖον. ἐλάχιστον δὲ τοῦτο καὶ ἥκιστα ἐπίδηλον τοῖς 25 πολυποτεῖν ἔστι διὰ τὸ μικρὸν ἔχεω τὸ κύτος καὶ διορθοῦσθαι τοῖς ποσὶν ıkανῶς.

Περὶ μὲν οὖν τῶν ἐντόμων καὶ μαλακοστράκων καὶ ὀστρακοδέρμων καὶ μαλακών εἰρηται, καὶ περὶ τῶν ἐντός μορίων καὶ τῶν ἐκτόσ.

80 Χ. Πάλιν δ' ἐξ ὑπαρχῆς περὶ τῶν ἐναίμων καὶ 1 καὶ Ogle: als vulg.
2 ἄλλην χρείαν καὶ βοήθειαν Υ, Ogle.
action is to draw flesh and yielding substances, as follows. First they encircle the object while they are still relaxed; then they contract, and by so doing compress and hold fast the whole of whatever is in contact with their inner surface.

So, as these creatures have nothing else with which to convey objects to the mouth except the feet (in some species) and the probosces (in others), they possess these organs in lieu of hands to serve them as weapons and generally to assist them otherwise.

All these creatures have two rows of suckers, except a certain kind of Octopus, and these have only one, because owing to their length and slimness they are so narrow that they cannot possibly have another. Thus they have the one row only, not because this arrangement is the best, but because it is necessitated by the particular and specific character of their being.

All these animals have a fin which forms a circle round the sac. In most of them it is a closed and continuous circle, as it is in the large Calamaries (*teuthi*), while in the smaller ones called *teuthides* it is quite wide (not narrow as in the Sepias and Octopuses), and furthermore it begins at the middle and does not go round the whole way. They have this fin to enable them to swim and to steer their course, and it answers to a bird’s tail-feathers and a fish’s tail-fin. In the Octopuses this fin is extremely small and insignificant because their body is small and can be steered well enough by means of the feet.

This brings to an end our description of the internal and external parts of the Insects, the Crustacea, the Testacea, and the Cephalopods.

X. Now we must go back and begin again with
685 b

ξωτόκων ἐπισκεπτέον, ἀρξαμένοις ἀπὸ τῶν ύπο-
λοίπων καὶ πρότερον εἰρημένων μορίων· τούτων δὲ
dιορισθέντων περὶ τῶν ἐναίμων καὶ ψωτόκων τῶν
αὐτῶν τρόπων ἐροῦμεν.

686 a
tα μὲν ὡς ἔχειν περὶ τὴν κεφαλὴν τῶν ζῴων

35 εἰρήθαι πρότερον, καὶ τὰ περὶ τὸν καλοῦμένον
αὐχένα καὶ τράχηλον. ἔχει δὲ κεφαλὴν πάντα τὰ

686 b

έναμα ᾽ζωα· τῶν δὲ ἀναίμων ἐνίοις ἀδιόριστον

τοῦτο τὸ μόριον, ὀδοῖς καρκίνοις. αὐχένα οὖν

τὰ μὲν ζωοτόκα πάντ' ἔχει, τῶν δὲ ζωοτόκων τὰ

μὲν ἔχει τὰ δ' οὐκ ἔχει· ὅσα μὲν γὰρ πνεύμονα


5 ἔχει, καὶ αὐχένα ἔχει, τὰ δὲ μη ἀναπνέοντα θύραθεν

οὐκ ἔχει τοῦτο τὸ μόριον.

'Εστι δ' ἡ μὲν κεφαλὴ μάλιστα τοῦ ἐγκεφάλου
χάριν· ἀνάγκη γὰρ τοῦτο τὸ μόριον ἔχειν τοῖς ἐν-

αίμοις, καὶ ἐν ἀντικειμένῳ τόπῳ τῆς καρδίας,

διὰ τὰς εἰρημένας πρότερον αἰτίας. ἔξεθετο δ' ἡ

10 φύσις ἐν αὐτῇ καὶ τῶν αἰσθήσεων ἑνίας διὰ τὸ

σύμμετρον εἶναι τὴν τοῦ αἵματος κράσων καὶ ἐπι-

τηθείαν πρὸς τῇ τοῦ ἐγκεφάλου ἄλεαν καὶ πρὸς τῇ

τῶν αἰσθήσεων ἑσυχίαν καὶ ἀκρίβειαν. ἔτι δὲ τρίτον μόριον υπέθηκε τὸ τῆς τροφῆς

εἴσοδον δημιουργοῦν· ἐνταῦθα γὰρ ὑπέκειτο συμ-

μέτρως μάλιστα· οὔτε γὰρ ἀνωθεν κεῖσθαι τῆς

15 καρδίας καὶ τῆς ἄρχης ἐνεδέχετο τὴν κοιλίαν, οὔτε

κατωθεν ὤσπερ ὅτι τρόπον ἔχει νῦν ἐνεδέχετο τὴν
eἴσοδον ἔτι κάτω εἶναι τῆς καρδίας· πολὺ γὰρ ἄν

τὸ μήκος ἢν τοῦ σώματος, καὶ πόρρω λίαν τῆς

κινουσῆς ἄρχης καὶ πεπτούσης. ἡ μὲν οὖν κεφαλὴ
tούτων χάριν ἔστιν, δ' αὐχένα τῆς ἀρτηρίας χάριν.

1 ἀν P, om. vulg.
the blooded viviparous animals. Some of the parts which we have already enumerated still remain to be described, and we will take these first. This done, we will describe similarly the blooded Ovipara.

We have already a spoken of the parts around the head, and what is called the neck, and the throat. All blooded animals have a head, but in some of the bloodless ones the head is indistinct (e.g. in crabs). All Vivipara have a neck, but not all Ovipara: to be precise, only those which breathe in air from without and have a lung.

The presence of the head is mainly for the sake of the brain. Blooded creatures must have a brain, which (for reasons aforeshown) b must be set in some place opposite to the heart. But in addition, Nature has put some of the senses up in the head, apart from the rest, because the blend of its blood is well proportioned and suitable for securing not only warmth for the brain but also quiet and accuracy for the senses. There is yet a third part which Nature has disposed of in the head, viz. the part which manages the intake of food; it was put here because this gave the best-ordered arrangement. It would have been impossible to put the stomach above the source and sovereign part, the heart; and it would have been impossible to make the entrance for the food below the heart, even with the stomach below the heart as it actually is, because then the length of the body would be very great, and the stomach would be too far away from the source which provides motion and concoction. These then are the three parts for whose sake the head exists. The neck exists for the sake of the

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a At 655 b 27—665 a 25.  
b At 652 b 17 ff.
20 πρόβλημα γάρ ἐστί, καὶ σῶζει ταύτην καὶ τὸν οἶσο-φάγον κύκλω περιέχων. τοῖς μὲν οὖν ἄλλοις ἐστὶ καμπτὸς καὶ σφονδύλους ἔχων, οἱ δὲ λύκοι καὶ λέοντες μονόστοι τὸν αὐξένα ἔχουσιν. ἐβλέψε γάρ ἣ φύσις ὅπως πρὸς τὴν ἑσχύν χρήσιμον αὐτὸν ἐξωσε μᾶλλον ἢ πρὸς τὰς ἄλλας βοηθείας.

Ἐχόμενα δὲ τοῦ αὐξένος καὶ τῆς κεφαλῆς τὰ τε
25 πρόσθια κώλα τοῖς ζῷοις ἐστὶ καὶ θώραξ. οἱ μὲν
σύν ἄνθρωπος ἀντὶ σκέλον καὶ ποδῶν τῶν προσθέων
βραχίων καὶ τὰς καλουμένας ἔχει χειράς. ὄρθον
μὲν γάρ ἐστὶ μόνον τῶν ζῴων διὰ τὴν φύσιν
αὐτῶ καὶ τὴν οὐσίαν εἶναι θείαν. ἔργον δὲ τοῦ
θειότάτου τὸ νοεῖν καὶ φρονεῖν τοῦτο δ' ὁ ὑδάτων
50 πολλοῦ τοῦ ἀνωθέν ἐπικεκμένου σώματος· τὸ γάρ
βάρος δυσκίνητον ποιεῖ τὴν διάνοιαν καὶ τὴν
κοινὴν αἴσθησιν. διὸ πλεῖονος γινομένου τοῦ
βάρους καὶ τοῦ σωματώδους ἀνάγκη ῥέπειν τὰ
σώματα πρὸς τὴν γῆν, ὡστε πρὸς τὴν ἀσφάλειαν
ἀντὶ βραχίων καὶ χειρῶν τοὺς προσθέουσι πόδας
35 ὑπέθηκεν ἢ φύσις τοῖς τετράποσιν. τοὺς μὲν
686 a γάρ ὀπισθίους δύο πάσιν ἀναγκαῖον τοῖς πορευ-
tικοῖς ἔχειν, τὰ δὲ τοιαύτα τετράποδα ἐγένετο οὐ
dυναμένης φέρειν τὸ βάρος τῆς ψυχῆς. πάντα γάρ
ἐστὶ τὰ ζῷα νανώδη τάλλα παρὰ τὸν ἀνθρωποῦ
νανώδες γάρ ἐστιν οὐ τὸ μὲν ἄνω μέγα, τὸ δὲ
5 φέρον τὸ βάρος καὶ πεζεύον μικρὸν· ἄνω δ' ἐστὶν
ἀπὸ τῆς κεφαλῆς μέχρι τῆς

686 b γάρ ὀπισθίους δύο πάσιν ἀναγκαῖον τοῖς πορευ-
tικοῖς ἔχειν, τὰ δὲ τοιαύτα τετράποδα ἐγένετο οὐ
dυναμένης φέρειν τὸ βάρος τῆς ψυχῆς. πάντα γάρ
ἐστὶ τὰ ζῷα νανώδη τάλλα παρὰ τὸν ἀνθρωποῦ
νανώδες γάρ ἐστιν οὐ τὸ μὲν ἄνω μέγα, τὸ δὲ
φέρον τὸ βάρος καὶ πεζεύον μικρὸν· ἄνω δ' ἐστὶν
ἀπὸ τῆς κεφαλῆς μέχρι τῆς

—for the “general” or “common” sense see De mem. 450 a 10, etc.; and cf. De part. an. 656 a 28, 665 a 12. the “general” sense is not another sense over and above the ordinary five, but rather the common nature inherent in
windpipe: it acts as a shield and keeps the windpipe and the oesophagus safe by completely encircling them. The neck is flexible and has a number of vertebrae in all animals except the wolf and the lion whose neck consists of one bone only, for Nature's object was to provide these with a neck that should be useful for its strength rather than for other purposes.

The anterior limbs and the trunk are continuous with the head and neck. Man, instead of forelegs and forefeet, has arms and hands. Man is the only animal that stands upright, and this is because his nature and essence is divine. Now the business of that which is most divine is to think and to be intelligent; and this would not be easy if there were a great deal of the body at the top weighing it down, for weight hampers the motion of the intellect and of the general sense. Thus, when the bodily part and the weight of it become excessive, the body itself must lurch forward towards the ground; and then, for safety's sake, Nature provided forefeet instead of arms and hands—as has happened in quadrupeds. All animals which walk must have two hind feet, and those I have just mentioned became quadrupeds because their soul could not sustain the weight bearing it down. Compared with man, all the other animals are dwarf-like. By "dwarf-like" I mean to denote that which is big at the top (i.e. big in the "trunk," or the portion from the head to the residual vent), and small where the weight is supported and where them all; thus Aristotle (De somno) argues that their simultaneous inactivity during sleep is not a mere coincidence but is due to the inactivity of the central perceptive faculty of which they are differentiations. Among the functions of the "general" sense are: discrimination between the objects of two senses, and the perceiving that we perceive.
ἐξόδου τοῦ περιπτώματος. τοῖς μὲν οὖν ἀνθρώποις τούτο πρὸς τὸ κάτω σύμμετρον, καὶ πολλῷ ἐλαττῶν ἐστὶν τελειομένους· νέοις δ’ οὖσι του- ναντίον τὰ μὲν ἄνω μεγάλα, τὸ δὲ κάτω μικρὸν
10 (διὸ καὶ ἔρπον, βαδίζειν δ’ οὖ δύνανται, τὸ δὲ πρῶτον οὖδ’ ἔρπον, ἀλλ’ ἀκωντίζοντι). νάνοι γάρ εἰσι τὰ παιδία πάντα. προσοψὶ δὲ τοῖς μὲν ἀνθρώποις αὐξεῖται τὰ κάτωθεν· τοῖς δὲ τετράποσι τουλάντιον τὰ κάτω μέγιστα τὸ πρῶτον, προϊόντα δ’ αὐξέται ἐπὶ τὸ ἄνω, τοῦτο δ’ ἐστὶ τὸ ἄπο τῆς ἔδρας ἐπὶ τὴν κεφαλὴν κύτως. διὸ καὶ τῷ ὑψεὶ οἱ
15 πάλαι τῶν ἰπτων οὐδὲν ἢ μικρὸν ἐλάττουσι εἰσι, καὶ νέοι μὲν οὖν ὄντες θυγγάνουσι τῷ ὅπισθεν σκέλει τῆς κεφαλῆς, πρεσβύτεροι δ’ οὖντες οὖ δύνανται. τὰ μὲν οὖν μόνον καὶ δίχθηλα τούτον ἔχει τὸν τρόπον, τὰ δὲ πολυδάκτυλα καὶ ἀκέρατα νανώδη μὲν ἔστων, ἂττων δὲ τούτων· διὸ καὶ τὴν αὐξήσων
20 πρὸς τὰ ἄνω τὰ κάτω κατὰ λόγον ποιεῖται τῆς ἐλλεύψεως.

"Εστι δὲ καὶ τὸ τῶν ὄρνιθων καὶ τὸ τῶν ἔθυμων γένος καὶ πᾶν τὸ ἔναιμον, ὦσπερ εἰρηται, νανώδες. διὸ καὶ ἀφρονέστερα πάντα τὰ ζῷα τῶν ἀνθρώπων ἔστων. καὶ γάρ τῶν ἀνθρώπων, οὗν τὰ τε παιδία πρὸς τοὺς ἀνδρᾶς καὶ αὐτῶν τῶν ἐν ἡλικίᾳ οἱ
25 νανώδειοι τὴν φύσιν, ἐὰν καὶ τῶν ἀλλήν δύναμιν ἕχωσιν περιττῆν, ἀλλὰ τῶ τῶν νοῦν ἔχειν ἐλ- λείπουσιν. αὐτῶν δ’, ωσπερ εἰρηται πρότερον, ὅτι ἡ τῆς ψυχῆς ἀρχὴ πολλοῖς δὴ διυσκίνητος ἐστὶ καὶ σωματώδης. ἔτι δ’ ἐλάττονος γινομένης τῆς

1 πολλοῖς δὴ Peck: πολλῷ δὴ vulg.: add. καὶ Y, Platt, qui et insuper addit ἡ σώματι καταφερομένη."
locomotion is effected. In man, the size of the trunk is proportionate to the lower portions, and as a man grows up it becomes much smaller in proportion. In infancy the reverse is found: the upper portion is large and the lower is small (and that is why infants cannot walk but crawl about, and at the very beginning cannot even crawl, but remain where they are). In other words, all children are dwarfs. Now, in man, as time proceeds, the lower portion grows: Not so with the quadruped animals: their lower portion is biggest at the beginning, and as time proceeds the top portion grows (i.e. the trunk, the portion between the head and the seat). Thus foals are quite or almost as high as horses, and at that age a foal can touch its head with its hind leg, but not when it is older.a What has been said holds good of the animals that have solid hoofs or cloven. The polydactylous, hornless animals are indeed dwarf-like too, but not so markedly, and so the growth of their lower portions compared with the upper is proportionate to the smaller deficiency.

The whole groups of birds and fishes are dwarf-like; indeed, so is every animal with blood in it, as I have said. This is why all animals are less intelligent than man. Even among human beings, children, when compared with adults, and dwarf adults when compared with others, may have some characteristics in which they are superior, but in intelligence, at any rate, they are inferior. And the reason, as afore-said, is that in very many of them the principle of the soul is sluggish and corporeal. And if the heat which

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a These observations are entirely correct. Cf. Ogle’s quotation ad loc. from T. H. Huxley. See also Hist. an. 500 b 26 ff.
αἱροῦσθαι θερμότητος καὶ τοῦ γεώδους πλείονος, τά
tε σώματα ἐλάττονα τῶν ζῴων ἐστὶ καὶ πολύποδα,
tέλος δ’ ἀποδα γίνεται καὶ τεταμένα πρὸς τὴν γην.
μικρὸν δ’ οὕτω προβαίνοντα καὶ τὴν ἄρχην ἔχουσι
κάτω, καὶ τὸ κατὰ τὴν κεφαλὴν μόριον τέλος
ἀκίνητον ἐστὶ καὶ ἀναίσθητον, καὶ γίνεται φυτὸν,
ἐχον τὰ μὲν ἀνω κάτω, τὰ δὲ κάτω ἄνω· αἱ γὰρ
ρίζαι τοῖς φυτοῖς στόματος καὶ κεφαλῆς ἔχουσι
δύναμιν, τὸ δὲ σπέρμα τοῦντιν· ἄνω γὰρ καὶ
ἐπ’ ἀκρος γίνεται τοῖς πτόρθαις.

Δι’ ἢν μὲν οὖν αἰτιὰν τὰ μὲν δύσποδα τὰ δὲ πολύ-
ποδα τὰ δ’ ἀποδα τῶν ζῴων ἐστὶ, καὶ διὰ τὴν
αἰτιὰν τὰ μὲν φυτὰ τὰ δὲ ζώα γέγονεν, εὑρῆται,
καὶ διότι μόνον ὀρθῶν ἐστὶ τῶν ζῴων ὁ ἄνθρωπος;
ὁρθῶ δ’ ὁντι τὴν φύσιν οὐδεμία χρεία σκελῶν τῶν
ἐμπροσθίων, ἄλλ’ ἀντὶ τοῦτων βραχίονας καὶ χείρας
ἀποδεδωκεν ἡ φύσις. Ἀναξιγόρας μὲν οὖν φησι
diὰ τὸ χείρας ἐχειν φρονιμώτατον εἶναι τῶν ζῴων
ἀνθρωπον εὐλογον δε διὰ τὸ φρονιμώτατον εἶναι
χείρας λαμβάνειν. αἱ μὲν γὰρ χεῖρες ὀργανόν
εἰσι, ἡ δὲ φύσις ἀεὶ διανέμει, καθάπερ ἄνθρωπος
φρόνιμος, ἐκαστὸν τῷ δυναμένῳ χρήσθαι (προσ-
ήκει γὰρ τῷ ὀντι αὐλητῆ δοῦναι μᾶλλον αὐλοὺς
ἡ τῷ αὐλοῦς ἔχοντι προσθεῖναι αὐλητικὴν). τῷ γὰρ
μεῖζον καὶ κυριωτέρῳ προσέθηκε τοῦλαττον, ἀλλ’
oὐ τῷ ἐλάττον τῷ τιμῶτερον καὶ μεῖζον. εἰ οὖν
οὕτως βέλτιον, ἡ δὲ φύσις ἐκ τῶν ἐνδεχομένων

a With the terminology used in ll. 28-29 cf. Hippocrates, Περὶ διαίτης, i. 35.
b That is, it answers to residue in animals; cf. 655 b 35.

370
PARTS OF ANIMALS, IV. x.

raises the organism up wanes still further while the earthy matter waxes, then the animals' bodies wane, and they will be many-footed; and finally they lose their feet altogether and lie full length on the ground. Proceeding a little further in this way, they actually have their principal part down below, and finally the part which answers to a head comes to have neither motion nor sensation; at this stage the creature becomes a plant, and has its upper parts below and its nether parts aloft; for in plants the roots have the character and value of mouth and head, whereas the seed counts as the opposite, being produced in the upper part of the plant on the ends of the twigs.

We have now stated why it is that some animals have two feet, some many, some none at all; why some creatures are plants and some animals; and why man is the only one of the animals that stands upright. And since man stands upright, he has no need of legs in front; instead of them Nature has given him arms and hands. Anaxagoras indeed asserts that it is his possession of hands that makes man the most intelligent of the animals; but surely the reasonable point of view is that it is because he is the most intelligent animal that he has got hands. Hands are an instrument; and Nature, like a sensible human being, always assigns an organ to the animal that can use it (as it is more in keeping to give flutes to a man who is already a flute-player than to provide a man who possesses flutes with the skill to play them); thus Nature has provided that which is less as an addition to that which is greater and superior; not vice versa. We may conclude, then, that, if this is the better way, and if Nature always does the best she can in the circumstances, it is not true
687 ά
ποιεί τὸ βέλτιστον, οὐ διὰ τὰς χειρὰς ἐστὶν ὁ ἀνθρώπος φρονιμώτατος, ἀλλὰ διὰ τὸ φρονιμώ-
τατον εἶναι τῶν ζῷων ἔχει χεῖρας. ὁ γὰρ φρονι-
μώτατος πλεῖστοι ἂν ὀργάνοις ἐχρήσατο καλῶς,
ἢ δὲ χείρ ἐουκεν εἶναι οὐχ ἐν ὀργανον ἀλλὰ πολλὰ;
ἔστι γὰρ ὡσπερ ὀργανον πρὸ ὀργάνων. τῷ οὖν
πλείστας δυναμένω δέξασθαι τέχνας τὸ ἐπὶ
πλεῖστον τῶν ὀργάνων χρήσιμον τὴν χεῖρα ἀπο-
δέδωκεν ἡ φύσις.
'Αλλ' οἱ λέγοντες ὡς συνεστηκεν οὐ καλῶς ὁ ἀνθρώπος ἀλλὰ χείριστα τῶν ζῴων (ἀνυπόδητον
τε γὰρ αὐτὸν εἶναι φασι καὶ γυμνῶν καὶ οὐκ
ἐχοντα ὁπλον πρὸς τὴν ἄλκην) οὐκ ὀρθῶς λέγουσιν.
τὰ μὲν γὰρ ἀλλὰ μίαν ἔχει βοηθειαν, καὶ μετα-
βάλλεσθαι ἀντὶ ταύτης ἐτέραν οὐκ ἐστὶν, ἀλλ' ἀναγκαῖον ὠσπερ ὑποδεδεμένον ἂεὶ καθεύδειν καὶ
πάντα πράττειν, καὶ τὴν περὶ τὸ σῶμα ἄλεωραν
μυδέποτε καταθέσαται, μηδὲ μεταβάλλεσθαι ὁ δὴ
ἔτυγχανεν ὁ πλον ἔχον τῷ δὲ ἀνθρώπῳ τάς τε
βοηθειας πολλάς ἔχειν καὶ ταύτας ἂεὶ ἔξεστι
μεταβάλλειν, ἐτὶ δ' ὁ πλον οἶον ἂν βούληται καὶ
ὁπον ἄν3 βούληται ἔχειν. ἡ γὰρ χεῖρ καὶ ὄνυξ καὶ
χηλή καὶ κέρας γίνεται καὶ δόρυ καὶ ξίφος
καὶ ἀλλο ὁποιονοῦ ὁπλον καὶ ὀργανον πάντα γὰρ
ἔσται ταύτα διὰ τὸ πάντα δύνασθαι λαμβάνειν καὶ
ἔχειν αὐτήν. ἐς4 δὲ συμμεμιχάνεται5 καὶ τὸ εἴδος6
τῇ φύσει τῆς χειρὸς, διαιρετὴ γὰρ καὶ πολυσχιδῆς.
1 ἔτυγχανεν ὁ πλον Ε1: τυγχάνει ἐν Θ.; hie alia omnino Σ.
3 ὁπον ἄν] ὁποταν Ogle.
4 ἔχειν αὐτήν: ἔσ P: ἔχειν ταύτην vulg.
5 συμμεμιχάνεται Ogle: συμμεμιχάνεσθαι vulg.
6 εἴδος καὶ vulg.: εἴδος PSUYZ.
to say that man is the most intelligent animal because he possesses hands, but he has hands because he is the most intelligent animal. We should expect the most intelligent to be able to employ the greatest number of organs or instruments to good purpose; now the hand would appear to be not one single instrument but many, as it were an instrument that represents many instruments. Thus it is to that animal (viz. man) which has the capability for acquiring the greatest number of crafts that Nature has given that instrument (viz. the hand) whose range of uses is the most extensive.

Now it must be wrong to say, as some do, that the structure of man is not good, in fact, that it is worse than that of any other animal. Their grounds are: that man is barefoot, unclothed, and void of any weapon of force. Against this we may say that all the other animals have just one method of defence and cannot change it for another: they are forced to sleep and perform all their actions with their shoes on the whole time, as one might say; they can never take off this defensive equipment of theirs, nor can they change their weapon, whatever it may be. For man, on the other hand, many means of defence are available, and he can change them at any time, and above all he can choose what weapon he will have and where. Take the hand: this is as good as a talon, or a claw, or a horn, or again, a spear or a sword, or any other weapon or tool: it can be all of these, because it can seize and hold them all. And Nature has admirably contrived the actual shape of the hand so as to fit in with this arrangement. It is not all of one piece, but it branches into several pieces; which gives the possi-
ARISTOTLE

687 b

ἐνι γὰρ ἐν τῷ διαπερτήν εἶναι καὶ συνθετὴν εἶναι, ἐν τοῦτῳ δ’ ἐκεῖνο οὐκ ἔστιν. καὶ χρῆσθαι ἐνὶ
10 καὶ δυοῖν καὶ πολλαχῶς ἔστιν. καὶ αἱ καμπαὶ τῶν
daktύλων καλῶς ἔχουσι πρὸς τὰς λήψεις καὶ
πιέσεις. καὶ ἐκ πλαγίου εἰς, καὶ οὕτος βραχὺς
καὶ παχὺς ἀλλ’ οὐ μακρός· ωσπερ γὰρ εἰ μὴ ἦν
χείρ ὅλως, οὐκ ἦν ἡ λήψις, οὕτω κἂν εἰ μὴ ἐκ
πλαγίου οὕτος ἦν. οὕτος γὰρ κάτωθεν ἀνω πιέζει,
15 ὅπερ οἱ ἐτεροὶ ἀνωθεν κάτω· δεὶ δὲ τοῦτο συμβαί
eυν, εἰ μέλλει ἴσχυρῶς ωσπερ σύναμμα ἴσχυρὸν
συνδειν, ἵνα ἰσάζῃ εἰς ὅν πολλοῖς. καὶ βραχὺς
dιὰ τὴν ἴσχυν καὶ διότι οὐδὲν ὄφελος εἰ μακρός.
(καὶ ὁ ἐσχατος δὲ μικρός ὅρθως, καὶ ὁ μέσος
μακρός, ωσπερ κόπτῃ μεσόνες). μᾶλιστα γὰρ τὸ
20 λαμβανόμενον ἀνάγκη περιλαμβάνεσθαι κύκλῳ
catὰ τὸ μέσον πρὸς τὰς ἐργασίας.) καὶ διὰ τοῦτο
καλεῖται μέγας μικρὸς ὅν, ὅτι ἄρηστοι ὅσ
eιπεῖν οἱ ἀλλοὶ ἀνευ τοῦτον. εὗ δὲ καὶ τὸ τῶν
ὄνυχων μεμηχάνηται· τὰ μὲν γὰρ ἄλλα ζώα ἔχει
καὶ πρὸς χρῆσιν αὐτοὺς, τοῖς δ’ ἀνθρώποις ἐπι-
25 καλυπτήρια· σκέπασμα γὰρ τῶν ἀκρωτηρίων εἰσὶν.

Αἱ δὲ καμπαὶ τῶν βραχιών ἔχουσι πρὸς τε
τὴν τῆς τροφῆς προσαγωγῆν καὶ πρὸς τὰς ἄλλας
χρῆσεις ἐναντίως τοῖς τετράποσιν. ἐκείνοις μὲν
γὰρ ἄναγκαιον εἶσος κάμπτειν τὰ ἐμπρόσθια κῶλα
(χρῶνται γὰρ ὡς 3 posín) ἵν’ ἥ χρῆσιμα πρὸς τὴν

1 ἐνὶ] μᾶ Ogle.
2 μεσόνες Schneider: μέσον νέως vulg.
3 ὡς P, om. vulg.

* That is, the pieces. Ogle’s suggested emendation would be translated “use the hands singly.” The two transpositions suggested for this passage by Ogle seem unnecessary.

374
bility of its coming together into one solid piece, whereas the reverse order of events would be impossible. Also, it is possible to use them singly, or two at a time, or in various ways. Again, the joints of the fingers are well constructed for taking hold of things and for exerting pressure. One finger is placed sideways: this is short and thick, not long like the others. It would be as impossible to get a hold if this were not placed sideways as if no hand were there at all. It exerts its pressure upwards from below, whereas the others act downwards from above; and this is essential for a strong tight grip (like that of a strong clamp), so that it may exert a pressure equivalent to that of the other four. It is short, then, first, for strength, but also because it would be no good if it were long. (The end finger also is small—this is as it should be—and the middle one is long like an oar amidships, because any object which is being grasped for active use has to be grasped right around the middle.) And on this account it is called “big” although it is small, because the other fingers are practically useless without it. The nails, too, are a good piece of planning. In man they serve as coverings: a guard, in fact, for the tip of the fingers. In animals they serve for practical use as well.

The joints of the arms in man bend in the opposite direction to those of quadrupeds: this is to facilitate the bringing of food to the mouth, and other uses to which they are put. Quadrupeds must be able to bend their fore limbs inwards so that they may be serviceable in locomotion, since they use them as

\[b\] That is, as tools.

\[c\] See note on 693 b 3, p. 433.
30 πορείαν, ἐπεὶ θέλει γε κάκείνων τοῖς πολυδακτύλοις
οὐ μόνον πρὸς τὴν πορείαν χρήσιμ' εἶναι τὰ ἐμ-
προσθέν σκέλη, ἀλλὰ καὶ ἀντὶ χειρῶν, ὦσπερ καὶ
φαίνεται χρώμενα· καὶ γὰρ λαμβάνουσι καὶ ἀμύ-

30 ἐπὶ τοῖς προσθέοις. τὰ δὲ μένυχα τοῖς ὑπισθίοις·
οὐ γὰρ ἔχει αὐτοῖς τὰ πρόσθια σκέλη ἀνάλογον τοῖς
ἀγκώσι καὶ ταῖς χερσίν. τῶν δὲ πολυδακτύλων
ἐνα καὶ διὰ τοῦτο καὶ πενταδακτύλους ἔχει τοὺς

5 προσθίους πόδας, τοὺς δ᾽ ὑπισθεῖς πετραδακτύλους,
οἷον λέοντες καὶ λύκοι, ἔτι δὲ κύνες καὶ παρδάλεις·
ὁ γὰρ πέμπτος ὦσπερ τῇς χειρῶσ γίνεται μέγας
[πέμπτος]. 1 τὰ δὲ μικρὰ τῶν πολυδακτύλων καὶ
τοὺς ὑπισθίους ἔχει πενταδακτύλους διὰ τὸ
ἐρπυστικά εἶναι, ὅπως τοῖς οὐνύξι πλείσσιν οὖν

10 ἀντιλαμβανόμενα ῥᾶν ἀνέρτη πρὸς τὸ μετεωρό-
τερον καὶ ὑπὲρ κεφαλῆς.

Μεταξὺ δὲ τῶν ἀγκώνων τοῖς ἄνθρώπωις, τοῖς
δ᾽ ἄλλοις τῶν ἐμπροσθίων σκελῶν, τὸ καλοῦμενον
στήθος ἔστι, τοῖς μὲν ἄνθρώποις ἔχον πλάτος εὐ-
λόγως (οὐ γὰρ κωλύουσιν οἱ ἀγκῶνες ἐκ πλαγίου
προσκείμενοι τοῦτον εἶναι τὸν τόπον πλατύν), τοῖς

15 δὲ τετράποσι διὰ τὴν ἐπὶ τὸ πρόσθιον τῶν κώλων
ἐκτασιν ἐν τῷ πορεύεσθαι καὶ μεταβάλλειν τὸν
tόπον στενῶν τοῦτ᾽ ἐστὶ τὸ μόριον. καὶ διὰ τοῦτο
tὰ μὲν τετράποσι τῶν ζώων οὐκ ἔχει μαστοὺς ἐν
tῷ τόπῳ τοῦ τούτῳ. τοῖς δὲ ἄνθρώποις διὰ τὴν εὐρυ-
χωρίαν καὶ τὸ σκεπάζεσθαι δεῖν τὰ περὶ τὴν

20 καρδίαν, διὰ τοῦτο ὑπάρχοντος τοῦ τόπου σαρ-
κώδους οἱ μαστοὶ διήρθουσι, σαρκώδεις ὡντες
tοῖς μὲν ἄρρεσι διὰ τὴν εἰρημένην αἰτίαν, ἐπὶ δὲ

1 πέμπτος seclusi.
PARTS OF ANIMALS, IV. x.

feet; though even among quadrupeds the polydactyloous ones tend to use the fore limbs not only for locomotion but also instead of hands; and this can actually be seen happening: they take hold of things and defend themselves with their fore limbs. (Solid-hoofed animals, on the other hand, do this with their hind limbs, as their forelegs have nothing that corresponds to elbows and hands.) This explains why some polydactyloous quadrupeds actually have five toes on their forefeet (lions, wolves, dogs and leopards, for instance), although there are only four on their hind feet: the fifth one, like the fifth \(^a\) digit on the hand, is a "big" one.\(^b\) However, the small polydactyloous quadrupeds have five toes on their hind feet too, because they are creepers; and this gives them more nails, and so enables them to get a better hold and creep up more easily to greater heights and above your head.

Between the arms in man (in other animals between the forelegs) is what is known as the breast. In man the breast is broad, and reasonably so, for the arms are placed at the side and so do not in any way prevent this part from being wide. In the quadrupeds, however, it is narrow, because as they walk about and change their position the limbs have to be extended forwards. And on this account, in quadrupeds, the mammae are not on the breast. In man, on the other hand, as the space here is wide, and the parts around the heart need some covering, the breast is fleshy in substance and the mammae are placed on it and are distinct. In the male they are themselves fleshy for the reason just given. In

\(^a\) Now generally called the "first."

\(^b\) And needed when the foot is used as a hand.
τῶν θηλείων παρακέχρηται καὶ πρὸς ἐτερον ἔργον ἡ φύσις, ὅπερ φαμέν αὐτὴν πολλάκις ποιεῖν. ἀπὸ-25 τίθεται γὰρ ἐνταῦθα τοῖς γεννωμένοις τροφήν. δύο δὲ εἶσιν οἱ μαστοὶ διὰ τὸ δύο τὰ μόρια εἶναι, τὸ τ´ ἀριστερὸν καὶ τὸ δεξιόν. καὶ σκληρότεροι μέν, διωρισμένοι δὲ διὰ τὸ καὶ τὰς πλευρὰς συνάπτεσθαι μὲν ἀλλήλαις¹ κατὰ τὸν τόπον τοῦτον, μὴ ἐπίπονον δ´ εἶναι τὴν φύσιν αὐτῶν. τοῖς δ´ ἀλλοις ζῷοις ἐν30 μὲν τῷ στήθει μεταξὺ τῶν σκελῶν ἀδύνατον ἐστὶν ἔχειν ἡ χαλέπον² τοὺς μαστοὺς (ἐμποδίζουσιν μὲν γὰρ ἀν πρὸς τὴν πορείαν), ἔχουσι δ´ ἦδη πολλοὺς τρόπους.³ τὰ μὲν γὰρ ὀλυγοτόκα καὶ μένων καὶ κερατοφόρα ἐν τοῖς μηροῖς ἔχουσι τοὺς μαστοὺς, καὶ τούτους δύο, τὰ δὲ πολυτόκα ἦ πολυσχιδὴ τὰ35 μὲν περὶ τὴν γαστέρα πλαγίους καὶ πολλοὺς, οἰνον ὅς καὶ κύων, τὰ δὲ δύο μόνους, περὶ μέσην μέντοι γαστέρα, οἰνον λέων. τούτου δ´ αἰτιον οὔχ ὅτι ὀλυγοτόκον, ἔπει τίκτει ποτὲ πλείω δυοίν, ἄλλα ὅτι οὐ πολυγάλακτον: ἀναλίσκει γὰρ εἰς τὸ σῶμα τὴν λαμβανομένην τροφήν, λαμβάνει δὲ στάνων διὰ τὸ40 σαρκοφάγον εἶναι.

Ο δ´ ἐλέφασ δύο μόνον ἔχει, τούτους δ´ ὑπὸ ταῖς μασχάλαις τῶν ἐμπροσθίων σκελῶν. αἰτιον δὲ τοῦ μὲν δύο ἔχειν ὅτι μονοτόκον ἐστὶν, τοῦ δὲ μὴ ἐν τοῖς μηροῖς ὅτι πολυσχιδὲς (οὐδὲν γὰρ ἔχει πολυσχιδὲς ἐν τοῖς μηροῖς), ἀνω δὲ πρὸς ταῖς μασχάλαις,

¹ ἀλλήλας Bekker per hypothetae errorem.
² ἡ χαλέπον P: vulg. non habet.
³ fort. τόπον Rackham (sic etiam E teste Buss. et Z).

378
the female, Nature employs them for an additional function (a regular practice of hers, as I maintain), by storing away in them nourishment for the offspring. There are two mammae because the body has two parts, the right and the left. The fact that they are somewhat hard and at the same time two in number is accounted for by the ribs being joined together at this place and by the nature of the mammae not being at all burdensome. In other animals it is either impossible or difficult for the mammae to be situated upon the breast, i.e. in between the legs, since they would be a hindrance to walking; but, excluding that particular position, there are numerous ways in which they are placed. Animals which have small litters, both those that have solid hoofs and those that carry horns, have their mammae by the thighs; and there are two of them. Animals that have large litters or are polydactylous, either have numerous mammae placed at the sides upon the abdomen—e.g. swine and dogs; or have only two, set in the middle of the abdomen—e.g. the lion.\footnote{This, like many of Aristotle’s statements about the lion, is incorrect.} The reason for this is not that the lion has few cubs at a birth, because sometimes the number exceeds two, but that it is deficient in milk. It uses up all the food it gets upon the upkeep of the body, and as it is a flesh-eater it gets food but rarely.

The elephant has only two mammae (this is because it has its young one at a time), and they are under the axillae of the forelegs and not by the thighs because the elephant is polydactylous and no polydactylous animal has them there. They are high up, near the axillae, because that is the place of the foremost
10 ὅτι πρῶτοι οὕτωι τῶν μαστῶν τοῖς πολλοῖς ἔχουσι μαστοὺς, καὶ ἴμωνται γάλα πλεῖστον. σημειον 
δὲ τὸ ἐπὶ τῶν ύόνων συμβαίνον· τοῖς γὰρ πρῶτοι 
γενομένοις τῶν χοίρων τοὺς πρῶτος παρέχουσι 
μαστοὺς. οὐ δὲ τὸ πρῶτον γυνόμενον ἐν μόνον 
ἐστὶ, τούτω τοὺς μαστοὺς ἀναγκαῖον ἔχειν τοὺς 
πρῶτος· πρῶτοι δ’ εἰσίν οἱ ὑπὸ ταῖς μασχάλαις.

15 ο μὲν οὖν ἐλέφας διὰ ταύτην τὴν αἰτίαν δύο ἔχει 
καὶ ἐν τούτῳ τῷ τόπῳ, τὰ δὲ πολυτόκα περὶ τὴν 
γαστέρα. τούτου δ’ αἰτιον ὅτι πλειόνων δεῖ μα-
στῶν τοῖς πλείω μέλλουσι ἑκτρέφειν· ἐπεὶ οὖν ἐπὶ 
πλάτος οὗρ οὖν τε ἅλλ’ ἢ δύο μόνους ἔχειν διὰ τὸ 
δύο εἶναι τὸ τ’ ἀριστερὸν καὶ τὸ δεξιόν, ἐπὶ μήκος

20 ἀναγκαίον ἔχειν· ο τὸ μεταξὺ τόπος τῶν ἐμπροσθεῖ
σκελῶν καὶ τῶν ὠτίσθην ἔχει μήκος μόνον. τὰ 
δὲ μὴ πολυσχίδι ἄλλ’ ὀλυγοτόκα ἢ κερατοφόρα ἐν1 
τοῖς μηροῖς ἔχει τοὺς μαστοὺς, οἷον ἵππος, ὄνος, 
κάμηλος (ταύτα γὰρ μονοτόκα, καὶ τὰ μὲν μώνυχα, 

25 τὸ δὲ δίχηλον), ἑτὶ δ’ ἐλαφος καὶ βοῦς καὶ αἴξ καὶ 
τάλλα πάντα τὰ τουαῖτα. αἰτιον δ’ ὅτι τοῦτος 
ἡ αὐξήσις ἐπὶ τὸ ἀνω τοῦ σώματος ἐστὶν. ἀρθ’ 
ὅπου συλλογὴ καὶ περιουσία γίνεται τοῦ περιτ-
τώματος καὶ αἵματος (οὕτως δ’ ὁ τόπος ἔστιν ὁ 
κάτω καὶ περὶ τὰς ἐκροάς), ἐνταῦθα ἐποίησέν 
ἡ φύσις τοὺς μαστοὺς· ὅπου γὰρ κύνησις γίνεται τῆς 

30 τροφῆς, ἐνεπέθεν καὶ λαβεῖν ἐστὶν αὐτοῖς δυνατόν. 
ἀνήρπως μὲν οὖν καὶ ὁ θῆλυς καὶ ὁ ἀρρήν ἔχει 
μαστοὺς, ἐν δὲ τοῖς ἀλλοις ἕνα τῶν ἄρρενων οὐκ 
ἔχει, οἶν ἵπποι οἱ μὲν οὐκ ἔχουσιν οἱ δ’ ἔχουσιν, 
ὅσοι ἐοίκασι τῇ μητρί.

1 καὶ ἐν vulg.: καὶ del. Ogle.
mammae in those that have many, and these are the ones that yield the most milk. An illustration of this is the case of the sow: a sow will offer the first of its mammae to the first ones of the litter. Thus, where the first of an animal’s litter amounts to one and no more, such an animal must possess these first mammae, and “the first mammae” means those under the axillae. This explains, then, the number and position of the elephant’s mammae. The animals that have large litters have their mammae upon the abdomen. Why is this? They have numerous young to feed, and so they need numerous mammae. Now as the body has two sides, right and left, the mammae cannot be more than two deep across the body, and so they have to be disposed lengthwise, and the only place where there is sufficient length for this is between the front and hind legs. Non-polydactylous animals which yet produce few at a birth, or carry horns, have their mammae by the thighs, as the horse and the ass (both solid-hoofed) and the camel (cloven-hoofed), all of which bear their young singly; also the deer, the ox, the goat, and all such animals. The reason for which is, that in them the growth of the body proceeds in an upward direction; so the place where the superfluous residue and blood collects is down below, near the places of efflux, and there Nature has made the mammae; for where the food is set in motion, there is the very place where they can get it. In man, both male and female have mammae, but some males of other animals have none, as e.g. stallions, some of which have none, while others, which resemble their dams, have them.
Καὶ περὶ μὲν μαστῶν εἴρηται, μετὰ δὲ τὸ στῆθος

οὐκ ἐπὶ τὴν κοιλίαν ἐστὶ τόπος, ἀσύγκλειστος ταῖς

πλευραῖς διὰ τὴν εἰρημένην ἐμπροσθεν αἰτίαν,

ὅπως μὴ ἐμποδίζωσι μήτε τὴν ἀνοίδησιν τῆς
tροφῆς, ἢν ἀναγκαίον συμβαίνειν θερμαινομένης

αὐτῆς, μήτε τὰς ύστερας τὰς περὶ τὴν κύησιν.

Τέλος δὲ τοῦ καλουμένου θώρακὸς ἐστὶ τὰ μόρια

ἐπὶ τὰ περὶ τὴν τῆς περιττώσεως ἔξοδον, τῆς τε ἔναρξιν

καὶ τῆς ὑγρᾶς. καταχρῆται δ’ ἡ φύσις τῷ αὐτῷ

μορίῳ ἐπὶ τε τὴν τῆς ὑγρᾶς ἔξοδον περιττώσεως

καὶ περὶ τὴν ὁχείαν, ὁμοίως ἐν τε τοῖς θήλεσι καὶ

τοῖς ἀρρεσιν; ἐξω τινῶν ὀλίγων πάσι τοῖς ἐναίμοις,

ἐν δὲ τοῖς ζωτόκοις πάσιν. αὐτίων δὲ ὑπ᾿ ἡ γονῆ

ὕγρον ἐστὶ τι καὶ περίττωμα. (τούτῳ δὲ νῦν μὲν

ὑποκείσθω, ὑστερον δὲ δειχθῆσεται περὶ αὐτοῦ.)

τὸν αὐτὸν δὲ τρόπον καὶ ἐν τοῖς θήλεσι τὰ τε

καταμήνια, καὶ ἡ προϊστα τὴν γονὴν. διορισθῆ-

σεται δὲ καὶ περὶ τούτων ὑστερον, νῦν δὲ ὑποκει-

σθω μόνον ὑπὶ περίττωμα καὶ τὰ καταμήνια τοῖς

θήλεσιν. ὕγρα δὲ τὴν φύσιν τὰ καταμήνια καὶ ἡ

γονῆ, ὅπερ τῶν ὁμοίων εἰς τὰ αὐτὰ μόρια τὴν

ἐκκρίσιν εἶναι κατὰ λόγον ἐστὶν. ἐντὸς δὲ πῶς

ἐχει, καὶ πὴ διαφέρουσι τὰ τε περὶ τὸ σπέρμα καὶ

τὰ περὶ τὴν κύησιν, ἐκ τε τῆς ἑστορίας τῆς περὶ
tὰ ζῶα φανερῶν καὶ τῶν ἀνατομῶν, καὶ ὑστερον

λειχθῆσεται ἐν τοῖς περὶ γενέσεως. ὅτι δ’ ἔχει καὶ

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1 τοῖς ἀρρεσίν Ogle: τῶν ἀρρένων vulg.
2 καὶ εἰ προϊστα τινα γονὴν Platt.
3 post ὡστε vulg. habet τῶν αὐτῶν καὶ: Ogle del.
4 τὰ αὐτὰ Peck: ταύτα τὰ vulg.
This concludes our remarks on the mammæ.

After the breast comes the region around the stomach, which is not enclosed by the ribs for the reason stated earlier, viz. to avoid interference (a) with the food when it swells, as it must do when it is heated, and (b) with the womb during pregnancy.

At the end of what is called the trunk are the parts that have to do with the discharge of the residue, both solid and fluid. Nature employs one and the same part for the discharge of the fluid residue and for copulation in all blooded animals (with a few exceptions), male and female alike, and in all Vivipara without exception. The reason is that the semen is a fluid, and a residue. (This statement may stand for the present: the proof of it will be given later on.) The same applies to the catamenia in females, and the part where they emit the semen. This also will be dealt with particularly later on. For the present, let the statement stand simply that the catamenia in females (like the semen in males) are a residue. Now both semen and catamenia are fluids, so it is reasonable that things which are alike should be discharged through the same parts. A clear account of the internal structure of these parts, showing the differences between the parts connected with semen and those connected with conception, is given in the Researches upon Animals and the Dissections, and there will be a discussion of them in the book on

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\[a\] At 655 a 2.
\[b\] In De gen. an. 724 b 21 ff.
\[c\] This seems to agree with what Aristotle says on the subject in the Hist. An., but contradicts what he says in De gen. an. Platt’s suggested emendation would make the translation read: “and to the semen, if so be they emit any.”
\[d\] At 493 a 24–b 6, 497 a 24 ff., book iii, ch. 1.
τὰ σχῆματα τῶν μορίων τούτων πρὸς τὴν ἐργασίαν ἀναγκαίως, οὐκ ἀδηλον. ἔχει δὲ διαφοράς τὸ τῶν ἀρρένων ὄργανον κατὰ τὰς τοῦ σώματος διαφοράς. οὐ γὰρ ὁμοίως ἀπαντᾶ νευρώδη τὴν φύσιν ἑστίν. ἐτὶ δὲ μόνον τούτῳ τῶν μορίων ἀνεύ νοσερᾶς μετα-

βολῆς αὐξήσιν ἔχει καὶ ταπείνωσιν· τούτων γὰρ τὸ μὲν χρήσιμον πρὸς τὸν συνδυασμὸν, τὸ δὲ πρὸς τὴν τοῦ ἀλλού σώματος χρείαν· ἀεὶ γὰρ ὁμοίως ἔχουν τὰλλα¹ ἐνεπόδιζεν ἀν. συνέστηκε δὲ τὴν φύσιν ἐκ τοιούτων τὸ μόριον τούτο ὡστε δύνασθαι ταῦτ' ἀμφότερα συμβαίνειν· τὸ μὲν γὰρ ἔχει νευρώδης τὸ δὲ ξονδρώδες, διόπερ συνιέναι τε δύναται καὶ ἐκτασιν ἔχειν καὶ πνεύματος ἐστι δεκτικόν. τὰ μὲν οὖν θήλεα τῶν τετραπόδων πάντ' ἐστίν ὀπι-

σθουρητικά διὰ τὸ πρὸς τὴν ὁχείαν οὕτως εἶναι αὐτοῖς χρησίμην τὴν θέσιν, τῶν δ' ἀρρένων ὅλγα ἐστὶν ὀπισθουρητικά, οἶον λύξιον, λέων, κάμηλος, 689 Β δασύτους· μένυχον δ' οὐδέν ἐστιν ὀπισθουρητικόν.

Τὰ δ' ὀπισθεν καὶ τὰ περὶ τὰ σκέλη τοῖς ἀνθρώ-

ποις ἑξε ἔχει πρὸς τὰ τετράποδα. κέρκων δ' ἔχει πάντα σχεδόν, οὐ μόνον τὰ ζωοτόκα ἄλλα καὶ τὰ φωστόκα· καὶ γὰρ ἄν μη μέγεθος αὐτοῖς ἔχουν τύχη²
tοῦτο τὸ μόριον, ἄλλα σημείου³ γ' ἐνεκεν ἔχουσι τίνα στόλον. δ' δ' ἀνθρωπος ἄκερκων μὲν ἐστίν, ἱσχία δ' ἔχει, τῶν δὲ τετραπόδων οὐδέν. ἐτὶ δὲ καὶ τὰ σκέλη δ' μὲν ἀνθρωπος σαρκώδη καὶ μηροῦς καὶ κυνήμας, τὰ δ' ἄλλα πάντ' ἀσαρκὰ ἔχει, οὐ μόνον τὰ ζωοτόκα ἄλλον ὀσα σκέλη ἔχει τῶν ζώων.

10 νευρώδη γὰρ ἔχει καὶ ὀστώδη καὶ ἀκανθώδη. τούτων δ' αἰτία μία τίς ἐστιν ὡς εἴπειν ἀπάντων,

¹ ἔχουν τἀλλα Peck: ἔχοντα vulg.
² τύχη Rackham: ἔχουσα vulg.
Still, it is clear that the actual forms of these parts is determined of necessity by the function they have to perform. The male organ, however, exhibits differences corresponding to those of the body as a whole, for some animals are more sinewy, some less. Further, this organ is the only one which increases and subsides apart from any change due to disease. Its increasing in size is useful for copulation, its contraction for the employment of the rest of the body, since it would be a nuisance to the other parts if it were always extended. And so it is composed of substances which make both conditions possible: it contains both sinew and cartilage; and so it can contract and expand and admits air into itself. All female quadrupeds discharge the urine backwards, as this arrangement is useful to them for copulation. A few males do this (among them are the lynx, the lion, the camel, and the hare), but no solid-hoofed animal does so.

The rear parts and the parts around the legs are peculiar in man compared with the quadrupeds, nearly all of which (Ovipara as well as Vivipara) have a tail, which even if it is not of any great size, still is present for a token as a sort of stump. Man has no tail, but he has buttocks, which no quadruped possesses. In man, the legs, both in thighs and calves, are fleshy: in all other animals that have them (not only Vivipara) the legs are fleshless, being sinewy, bony and spinous. One might say that there is a single explanation which covers them all, which is, that man is

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*a* At 716 a 2—721 a 29.

*b* There seems to be something wrong with this statement, but perhaps when taken in conjunction with the whole of the argument which follows, it may appear less unjustifiable.

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3 σημείου Buss.: σμικροῦ vulg. 4 κνήμας] πόδας Y.
διότι μόνον ἐστὶν ὁρθὸν τῶν ζώων ἄνθρωπος. ἦν οὖν φέρη ῥαδίως τάνω κούφα ὄντα, ἀφελούσα τὸ σωματῶδες ἀπὸ τῶν ἄνω πρὸς τὰ κάτω τὸ βάρος ἡ φύσις προσέθηκεν. διόπερ τὰ ἰσχία σαρκώδη 15 ἐποίησε καὶ μηροὺς καὶ γαστροκυνήμας. ἄμα δὲ τὴν τε τῶν ἰσχίων φύσιν καὶ πρὸς τὰς ἀναπαύσεις ἀπέδωκε χρήσιμον· τοῖς μὲν γὰρ τετράποσιν ἄκοπον τὸ ἐστάναι, καὶ οὐ κάμνουσι τοῦτο ποιοῦντα συνεχῶς (ὡσπερ γὰρ κατακείμενα διατελεῖ ὑποκειμένων τεττάρων ἐρεισμάτων), τοῖς δὲ ἄνθρωποις

οὐ βρίσκοι ὀρθῶς ἐστῶσι διαμένειν, ἀλλὰ δεῖται τὸ σῶμα ἀναπαύσεως καὶ καθέδρας. ἦ μὲν οὖν ἄνθρωπος ἰσχία τ' ἔχει καὶ τὰ σκέλη σαρκώδη διά τὴν εἰρημένην αἰτίαν, καὶ διὰ ταῦτα ἀκέρκον (ἡ τε γὰρ ἐκεῖσε τροφὴ πορευμένη εἰς ταῦτα ἀναλίσκεται, καὶ διὰ τὸ ἐχεῖν ἰσχία ἀφύρηται ἡ τῆς

25 οὐράς ἀναγκαία χρήσις), τὰ δὲ τετράποδα καὶ τάλλα ζώα ἐξ ἐναντίας· νανώδεσι γὰρ οὕσι πρὸς τὸ ἄνω τὸ βάρος καὶ τὸ σωματῶδες ἐπίκειται πᾶν, ἀφηρμένου ἀπὸ τῶν κάτωθεν· διόπερ ἀνίσχια καὶ σκληρὰ τὰ σκέλη ἔχουσιν. ὅπως δὲ ἐν φυλακῇ καὶ σκέψῃ ἡ τὸ λειτουργοῦν μόριον τὴν ἔξοδον τοῦ

περιττάματος, τὴν καλουμένην οὐρὰν καὶ κέρκων αὐτοῖς ἀπέδωκεν ἡ φύσις, ἀφελομένη τῆς εἰς τὰ σκέλη γυνομένης τροφῆς.

(Ὁ δὲ πίθηκος διὰ τὸ τὴν μορφὴν ἐπαμφοτερίζειν καὶ μυδετέρων τ' εἶναι καὶ ἀμφοτέρων, διὰ τούτοις οὔτ' οὐρὰν ἔχει οὔτ' ἰσχία, ὡς μὲν δίπους οὖν οὐράν, ὡς δὲ τετράπους ἰσχία.)

Τῶν δὲ καλουμένων κέρκων διαφορὰ τ' εἰσὶ

1 ἐκείσε Peck: ἐκεῖ vulg.
the only animal that stands upright. Hence, Nature, so as to make the upper parts light and easy to carry, took off the corporeal matter from the top and transferred the weight down below; and that is how she came to make the buttocks and the thighs and the calves of the legs fleshy. At the same time, in making the buttocks fleshy, Nature made them useful for resting the body. Quadrupeds find it no trouble to remain standing, and do not get tired if they remain continually on their feet—the time is as good as spent lying down, because they have four supports underneath them. But human beings cannot remain standing upright continually with ease; the body needs rest; it must be seated. That, then, is why man has buttocks and fleshy legs, and for the same reason he has no tail: the nourishment gets used up for the benefit of the buttocks and legs before it can get as far as the place for the tail. Besides, the possession of buttocks takes away the need and necessity of a tail. But in quadrupeds and other animals it is the opposite: they are dwarf-like, which means that their heavy corporeal substance is in the upper part of them and does not come into the lower parts; and as a result they have no buttocks and their legs are hard. Yet to ensure that the part which serves them for the discharge of the residue shall be guarded and covered over, Nature has assigned to them tails or scuts by taking off somewhat of the nourishment which would otherwise go into the legs.

(The Ape is, in form, intermediate between the two, man and quadruped, and belongs to neither, or to both, and consequently he has no tail, qua biped, and no buttocks, qua quadruped.)

There are numerous differences in the various tails,
πλείους καὶ ἡ φύσις παρακαταχρηται καὶ ἐπὶ τοῦ
των, οὐ μόνον πρὸς φυλακὴν καὶ σκέπην τῆς ἔδρας,
ἀλλὰ καὶ πρὸς ὠφέλειαν καὶ χρήσιν τοῖς ἐχοσων.

5 Οἱ δὲ πόδες τοὺς μὲν τετράποσι διαφέρουσιν· τὰ
μὲν γὰρ μόνονα αὐτῶν ἔστι τὰ δὲ δίχηλα τὰ δὲ
πολυσχίδη, μόνονα μὲν ὀσοὶ διὰ μέγεθος καὶ τὸ
πολὺ γεωδὲς ἔχειν ἀντὶ κεράτων καὶ ὀδόντων εἰς
τὴν τοῦ ὄνυχος φύσιν τὸ τοιοῦτον μόριον ἔλαβεν
ἀπόκρισιν, καὶ διὰ πλῆθος ἀντὶ πλειώνων ὀνύχων

10 εἰς ὄνυξ ἡ ὀπλή ἐστιν. καὶ ἀστράγαλον δὲ διὰ
tοῦτο οὐκ ἔχουσιν ὡς ἐπὶ τὸ πολὺ εἴπεω, καὶ διὰ
tὸ δυσκινητοτέραν εἶναι τὴν καμπήν τοῦ ὀπισθεν
σκέλους ἀστράγαλον ἐνόντος· θάττων γὰρ ἀνοίγεται
καὶ κλείεται τὰ μίαν ἔχοντα γωνίαν ἡ πλείους, ὃ
δὲ ἀστράγαλος γόμφος ὡν ὡσπερ ἀλλότριον κώλον

15 ἐμβέβλησεν τοῖς δυσί, βάρος μὲν παρέχον, ποιοῦν
dὲ ἀσφαλεστέραν τὴν βάσιν. διὰ γὰρ τούτο καὶ ἐν
τοῖς ἐμπροσθίοις οὐκ ἔχουσιν ἀστράγαλον τὰ ἔχοντα
ἀστράγαλον, ἀλλ' ἐν τοῖς ὀπισθεν, ὅτι δεὶ ἐλαφρὰ
εἶναι τὰ ἡγούμενα καὶ εὐκαμπτα, τὸ δὲ ἀσφαλὲς καὶ
τὴν τάσιν ἐν τοῖς ὀπισθεν. ἔτι δὲ πρὸς τὸ ἀμύνε-

20 σθαν ἐμβριθεστέραν ποιεῖ τὴν πληγήν· τὰ δὲ τουαῦτα
τοῖς ὀπισθεν χρήται κώλοις, λακτίζοντα τὸ λυποῦν.

Τὰ δὲ δίχηλα ἔχει ἀστράγαλον (κοιφότερα γὰρ
τὰ ὀπισθεν), καὶ διὰ τὸ ἔχειν ἀστράγαλον καί οὐ
μόνονα ἐστιν, ὡς τὸ ἐκλείπον ὀστώδες ἐκ τοῦ

1 καὶ διὰ SUZ Ogle: διὰ vulg.

a The word used in the Greek is “part.” See Introd. p. 28.
which provide another example of Nature's habit of using an organ for secondary purposes, for she employs the tail not only as a guard and covering for the fundament but also in other serviceable ways.

There are differences too in the feet of quadrupeds. Some have a solid hoof, some a cloven hoof; others have a foot that is divided into several parts. Solid hoofs are present in those animals which are large and contain much earthy substance, which instead of making horns and teeth forms an abscession so as to produce nail, and owing to the abundance of it, it produces not several separate nails but a single one, in other words, a hoof. Because of this, these animals in general have no hucklebone; and also because the presence of a hucklebone makes it rather difficult to bend the hind leg freely, since a limb that has one angle can be bent to and fro more quickly than one that has several. It is a sort of connecting-rod, and therefore practically interpolates another bit of a limb between the two, thereby increasing the weight; but it makes the animal's footing more reliable. This explains why, when hucklebones are present, they are present in the hind limbs only, never in the front: the front limbs have to be light and flexible because they go first, while the hind limbs must be reliable and able to stretch. Further, a hucklebone puts more force into a blow—a useful point in self-defence—and animals which have one use their hind limbs in this way: if anything hurts them they kick out at it.

Cloven-hoofed animals have a hucklebone, as their hind limbs are on the light side; and that is the very reason why they are cloven-hoofed: the bony substance stays in the joint and therefore is deficient in
ποδος ἐν τῇ κάμψει μένον. τὰ δὲ πολυδάκτυλα
25 οὔκ ἔχει ἀστράγαλον· οὐ γὰρ ἂν ἦν πολυδάκτυλα,
ἀλλὰ τοσοῦτον ἐσχύζετο τὸ πλάτος ὅσον ἐπέχει
ὁ ἀστράγαλος. διὸ καὶ τῶν ἐχόντων αὐτὸν τὰ
πλείω δίχηλα.
‘Ο δ’ ἀνθρωπος πόδας μεγίστους ἔχει τῶν ζώων
ὡς κατὰ μέγεθος, εὐλόγως· μόνον γὰρ ἐστηκεν
ὁρθόν, ὥστε τοὺς μέλλοντας δὺ’ ὄντας ἔξειν πᾶν τὸ
30 τοῦ σώματος βάρος δεὶ μήκος ἔχειν καὶ πλάτος.
καὶ τὸ τῶν δακτύλων δὴ μέγεθος ἐναντίως ἔχει ἔπι
tε τῶν ποδῶν καὶ τῶν χειρῶν κατὰ λόγον· τῶν
μὲν γὰρ τὸ λαμβάνειν ἔργον καὶ πνεύμων, ὥστε δεὶ
μακροὺς ἔχειν (τῶ γὰρ καμπτομένῳ μέρει περι-
λαμβάνει ἡ χείρ), τῶν δὲ τὸ βεβηκέναι ἀσφαλῶς,
πρὸς δὲ τοῦτο δεὶ τὸ μόριον εἶναι μεῖζον2 τὸ
ἀσχίστον τοῦ ποδὸς τῶν δακτύλων. ἐσχύσθαι δὲ
βέλτιον ἢ ἀσχίστον εἶναι τὸ ἐσχύτων· ἅπαν γὰρ ἂν
5 συμπάθες ἢν ἐνός μορίου πονησσάντος, ἐσχυσμένως3
d’ εἰς δακτύλους τοῦτ’ οὐ συμβαίνει ὁμοίως. ἕτι
dὲ καὶ βραχείς ὄντες ἦττον ᾧν βλάπτοιντο.4 διὸ
πολυσχίδεις οἱ πόδες τῶν ἀνθρώπων, οὐ μακρο-
δάκτυλοι δ’ εἰσίν. τὸ δὲ τῶν ὀνύχων γένος διὰ
tὴν αὐτὴν αἰτίαν καὶ ἐπὶ τῶν χειρῶν ἔχουσιν· δεὶ
10 γὰρ σκέπεσθαι τὰ ἀκρωτηρία μάλιστα διὰ τὴν
ἀσθένειαν.

Περὶ μὲν οὖν τῶν ἐναίμων ζώων καὶ ψωτόκων
καὶ πεζῶν εἰρήται σχεδὸν περὶ πάντων. XI. τῶν
δ’ ἐναίμων ζώων ψωτόκων δὲ τὰ μὲν ἔστι τετρά-

1 πρὸς δὲ Ogle: ὥστε vulg.
2 μεῖζον Platt, Th.: νομίζει vulg.
4 ᾧν Platt, Th.: βλάπτοιντο Y: συμβλάπτοιντο vulg.
the foot. The polydactylous animals have no hucklebone, otherwise they would not be polydactylous, and the divisions of the foot would cover only so much width as the hucklebone itself. So most of the animals which have a hucklebone are cloven-hoofed.

Man of all the animals has the largest feet for his size, and reasonably so, since he is the only one of them that stands upright, and as the feet have to bear the whole weight of the body and there are only two of them, they must be both long and broad. Also the toes are short compared with the fingers, and this too is reasonable. The business of the hands is to take hold and to keep hold of things, and this is done by means of that part of the hands which bends; therefore the fingers must be long. The business of the feet is to get a firm and reliable footing; and to secure this the undivided part of the foot must be greater than the toes. And it is better to have the tip of the foot divided than not, for otherwise, if one part were affected the whole foot would suffer as well, whereas this is to some degree avoided by the division of the tip of the foot into toes. Again, short toes are less liable to injury than long ones would be. All this indicates why the human foot has toes and why they are short. There are nails on the toes for the same reason that there are nails on the fingers: the extremities have but little strength and therefore specially need to be protected.

We have now dealt with practically all the blooded animals that are viviparous and live on the land.

XI. We now pass on to another class of blooded (b) Ovipara: animals, the oviparous, some of which have four feet, (i.) Serpents and quadrupeds.
ποδα τὰ δ' ἀποδα. τοιοῦτον δ' ἐν μόνον γένος 
ἔστιν ἄπουν, τὸ τῶν ὀφειν· ἢ δ' αἰτὶα τῆς ἀποδίας
αὐτῶν εἰρηται ἐν τοῖς περὶ τῆς πορείας τῶν ζῶνων
διωρισμένως. τὰ δ' ἄλλα παραπλησίαν ἔχει τὴν
μορφὴν τὸις τετράποσι καὶ φωτόκοις. 1

'.Expecti de τὸ ζώα ταῦτα κεφαλὴν μὲν καὶ τὰ ἐν
αὐτῇ μόρια διὰ τὰς αὐτὰς αἰτίας τοῖς ἄλλοις τοῖς
20 εναίμοις ζώοις, καὶ γλώτταν ἐν τῷ στόματι πλη
τοῦ ποταμίου κροκοδείλου· οὕτως δ' οὐκ ἂν δόξειν
ἔχειν, ἀλλὰ τὴν χώραν μόνον. αἰτίον δ' ὅτι τρόπον
μὲν τινα ἁμα χερσαίος καὶ ἐνυδρός ἐστιν· διὰ μὲν
οὖν τὸ χερσαίος εἶναι ἔχει χώραν γλώττης, διὰ δὲ
τὸ ἐνυδρός ἀγλωττός. οἱ γὰρ ἰχθύες, καθάπερ εἰρή-
25 ταὶ πρότερον, οἱ μὲν οὐ δοκοῦσιν ἔχειν, ἂν μὴ σφο-
δρα ἀνακλίνη τις, οἱ δ' ἀδιάρθρωτον ἔχουσιν. αἰτίον
dre ὅτι ὀλίγη τοῦτοις χρείαι 2 τῆς γλώττης διὰ τὸ μὴ
ἐνδεχεσθαι μασάζθαι μηδὲ προγενεσθαι, ἀλλ' ἐν τῇ
καταπόσει γίνεσθαι τὴν αἴσθησιν καὶ τὴν ἤδονήν
πάσι τοῦτοις τῆς τροφῆς. ἢ μὲν γὰρ γλώττα τῶν
30 χυμῶν ποιεῖ τὴν αἴσθησιν, τῶν δὲ ἐδεστῶν ἐν τῇ
καθόδῳ ἡ ἤδονή· καταπινομένων γὰρ αἰσθάνονται
tῶν λιπαρῶν καὶ θερμῶς καὶ τῶν ἄλλων τῶν
τοιοῦτων. ἔχει μὲν οὖν καὶ τὰ ζωοτόκα ταῦτη
τὴν αἴσθησιν (καὶ σχεδοῦ τῶν πλείστων ὀψιν καὶ
691 a ἐδεστῶν ἐν τῇ καταπόσει τῇ τάσει τοῦ ὀσοφάγου
γίνεται ἡ χάρις· διὸ οὖν ὦτοι περὶ τὰ πόματα
καὶ τοὺς χυμοὺς ἀκρατεῖς εἶσι καὶ τὰ ὀφα καὶ τὴν

1 φωτόκοις PUYZ: ζωοτόκοις vulg.
2 ἢν τοῦτοις χρείαι S: ἢν χρείαι τοῦτοις vulg.: ἢν delevi.
and some no feet at all. Actually there is only one group that has no feet, the Serpents; and the reason why they have none has been stated in my treatise on the *Locomotion of Animals*. In other respects their conformation is similar to that of the oviparous quadrupeds.

These animals have a head, and the parts that compose it, for the same reasons that other blooded creatures have one, and they have a tongue inside the mouth—all except the river crocodile, which apparently has none, but only a space for it; and the reason is that in a way he is both a land-animal and a water-animal. In virtue of being a land-animal, he has a space for a tongue; as a water-animal, he is tongueless. This agrees with our previous statement, that some fishes appear to have no tongue unless you pull the mouth very well open, others have one which is not distinctly articulated. The reason for this is that these creatures have not much need for a tongue because they cannot chew their food or even taste it before they eat it: they can perceive the pleasantness of it only while they are swallowing it. This is because the perception of juices is effected by the tongue; whereas the pleasantness of solid food is perceived while it is passing down the gullet, and thus oily food and hot food and the like are perceived while they are being swallowed. Of course the Vivipara as well as these creatures have this power of perception (indeed, the enjoyment derived from practically all edible dainties takes place while they are being swallowed and is due to the distension of the oesophagus—which is why intemperate appetite for edible dainties is not found in the same animals as intemperate appetite for drink and juices);
ἐδωδήν), ἀλλὰ τοῖς μὲν ἄλλοις ζῷοις καὶ ἢ κατὰ τὴν γεῦσιν ὑπάρχει αἰσθησίς, ἐκείνης δὲ ἄνευ ταύτης μόνη ἢ ἐτέρα. τῶν δὲ πετραπόδων καὶ ὕποτόκων οἱ σάφροι, ὦσπερ καὶ οἳ ὁφεῖς, δικρόον ἔχουσι τὴν γλώτταν καὶ ἐπὶ άκρου τριχώδη πάμπαν, καθάπερ εὑρίσκει πρότερον. ἔχουσι δὲ καὶ αἱ φώκαι δικρόον τὴν γλώτταν· διόι καὶ λίχνα πάντα τὰ ζῷα ἐστι ταύτα.

10 Ἐστὶ δὲ καὶ καρχαρόδοντα τὰ πετράποδα τῶν ὕποτόκων, ὦσπερ οἱ ἱχθύες. τὰ δὲ αἰσθητήρια πάντα ὁμοίως ἔχουσι τοῖς ἄλλοις ζῷοις, οἷον τῆς ὁσφρήσεως μυκτήρας καὶ ὁφεώς ὁφθαλμοὺς καὶ ἀκοῆς ὁτα, πλὴν οὐκ ἐπανεστηκότα, καθάπερ οὐδ᾿ οἱ ὀρνιθές, ἀλλὰ τὸν πόρον μόνον ἀτίμων δ᾿ ἀμφο-

15 τέροις ἢ τοῖς δέρματος σκληρότης. τὰ μὲν γὰρ πτερωτὰ αὐτῶν ἐστὶ, ταῦτα δὲ πάντα φολιδωτά, ἐστὶ δ᾿ ἡ φολίς ὁμοίων χώρα λεπίδος, φύσει δὲ σκληρότερον. δηλοὶ δ᾿ ἐπὶ τῶν χελώνων τοῦτο καὶ ἐπὶ τῶν μεγάλων ὁφεών καὶ τῶν ποταμῶν κροκοδείλων· ἵσχυρότεραι γὰρ γίνονται τῶν ὁστῶν ὡς οὖν τοιάδε τινὶ φύσιν.

20 Οὐκ ἔχουσι δὲ τὰ ζῷα ταῦτα τὴν ἄνω βλεφαρίδα, ὦσπερ οὐδ᾿ οἱ ὀρνιθές, ἀλλὰ τῇ κάτω μύουσι διὰ τὴν αἰτίαν τὴν εἰρήμενην ἐπὶ ἐκείνων. τῶν μὲν οὖν ὀρνίθων ἔνοι καὶ σκαρδαμύττουσιν οὐ μέν εἰ τῶν κανθῶν, ταῦτα δὲ τὰ ζῷα οὐ σκαρδαμύττει· σκληρ-

25 ὁφθαλμότερα γάρ ἐστὶ τῶν ὀρνίθων. αὕτιον δ᾿ ὅτι ἐκείνοις χρησιμωτέρα ἡ ὀξυωπία πτηνοῖς οὖσι πρὸς

1 δ᾿ ἄνευ ταύτης μόνη Peck: δ᾿ ἂν ἢ ὦσπερ μόνη Y: δ᾿ ὦσπερ pavel vulg.: plurima hic transposuit Ogle.

2 καὶ οἳ Y: οἳ vulg.
PARTS OF ANIMALS, IV. xi.

but whereas the rest of the animals have the power of perception by taste as well, these are without it and possess the other one only. Among oviparous quadrupeds, lizards (and serpents too) have a two-forked tongue, the tips of which are as fine as hairs. (This has been stated earlier.) Seals also have a forked tongue. This forked tongue explains why all these animals are so dainty in their food.

The four-footed Ovipara also have sharp interfitting teeth, as Fishes have. Their sense-organs are all similar to those of other animals: nostrils for smell, eyes for sight, and ears for hearing—though their ears do not stand out: they are merely a duct, as in birds; and in both groups the cause is the same, viz. the hardness of their integument. Birds are covered with feathers, and these creatures are all covered with horny scales which correspond in position to the scales of fishes, but are harder in substance. This is clearly illustrated by the tortoises, the great snakes, and the river crocodiles, where the scales are made of the same material as the bones and actually grow stronger than the bones.

These animals, like birds, have no upper eyelid; they close their eyes with the lower lid. The reason which was given for birds applies to them too. Some birds can also blink by means of a membrane which comes out of the corner of the eye; but these animals do not do this, since their eyes are harder than birds' eyes. The reason for this is that keen sight is of considerable use to birds in their daily

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a At 660 b 9.
b At 657 b 6 ff.

3 λίχνα Karsch: ιαχνα vulg.
4 ὀξυωπία καὶ τὸ πόρρω προϊδεῖν UY.
τὸν βίον, τούτοις δ’ ἢττον· τρωγλόδυτα γὰρ πάντα τὰ τοιαύτα ἐστίν.

Εἰς δύο δὲ διηρημένης τῆς κεφαλῆς, τοῦ τε ἀνω μορίου καὶ τῆς σιαγόνος τῆς κάτω, ἀνθρωπὸς μὲν καὶ τὰ ἑφοτόκα τῶν τετραπόδων καὶ ἀνω καὶ κάτω κινοῦσι τὰς σιαγόνας καὶ εἰς τὸ πλάγιον, οἳ δ’ ἑχθὲς καὶ ὅρνιθες καὶ τὰ ἑφοτόκα τῶν τετραπόδων εἰς τὸ ἀνω καὶ κάτω μόνον. αὐτίον δ’ ὅτι ἡ μὲν τοιαύτῃ κίνησις χρῆσιμος εἰς τὸ δακεῖν καὶ διελεῖν, ἢ δ’ εἰς τὸ πλάγιον ἐπὶ τὸ λεαίνειν. τοῖς μὲν οὖν ἐχουσι γομφίους χρῆσιμος ἡ εἰς τὸ πλάγιον κίνησις, τοῖς δὲ μὴ ἐχουσι οὐδὲν χρῆσιμος, διότερον ἀφηρηται πάντων τῶν τοιοῦτων οὐδὲν γὰρ ποιεῖ περιέργον ἡ ψυχή. τὰ μὲν οὖν ἄλλα πάντα κινεῖ τὴν σιαγόνα τὴν κάτω, δ’ ἐπὶ ποτάμιος κροκόδειλος μόνος τὴν ἀνω. τούτου δ’ αὐτίον ὅτι πρὸς τὸ λαβεῖν καὶ κατασχεῖν ἀρχήστους ἔχει τοὺς πόδας· μικρός γὰρ εἰς πάμπαν. πρὸς οὖν ταῦτας τὰς χρείας ἀντὶ ποδῶν τὸ στόμα ἡ φύσις χρῆσιμον αὐτῷ ἐποίησεν. πρὸς δὲ τὸ κατασχεῖν ἡ λαβεῖν, ὅποτέρωθεν ἂν ἢ ἡ πληγὴ ἵεχυροτέρα, ταῦτα χρησιμωτέρα κινομένη ἐστὶν. ἡ δὲ πληγὴ ἵεχυροτέρα ἄει ἄνωθεν ἡ κάτωθεν· ἔπει οὖν ἄμφοτέρων μὲν διὰ τοῦ στόματος ἡ χρῆσις, καὶ τοῦ λαβεῖν καὶ τοῦ δακεῖν, ἀνακαίνετορα δ’ ἡ τοῦ κατασχεῖν μὴτε χεῖρας ἔχοντι μὴτε πόδας εὐφυεῖς, χρησιμωτέρον τὴν ἄνωθεν κινεῖν σιαγόνα ἡ τῆς κάτωθεν αὐτοῖς. διὰ τὸ αὐτὸ δὲ καὶ οἱ καρκίνοι τὸ ἄνωθεν τῆς χελής κινοῦσι μόριον, ἀλλ’ οὐ τὸ κάτωθεν· ἀντὶ χειρὸς γὰρ ἔχουσι τὰς χελάς, ὥστε πρὸς τὸ λαβεῖν ἀλλ’ οὐ πρὸς τὸ διελεῖν χρῆσιμον 1 μὲν οὖν vulg.: μὲν YZ.
life, because they fly about; but it would be very little good to these creatures, because they all spend their time in holes and corners.

Their head has two divisions: the upper part, and the lower jaw. In man and in the viviparous quadrupeds the lower jaw moves from side to side as well as up and down; in fishes, however, and birds and these oviparous quadrupeds it moves up and down only. The reason is that this vertical motion is useful for biting and cutting up food, while the sideways motion is useful for grinding the food down. Of course this sideways motion is useful to animals which possess grinder-teeth; but it is of no use to those which lack grinders, and so not one of them has it. Nature never makes or does anything that is superfluous. All these animals, then, move the lower jaw—with one exception, the river crocodile, which moves the upper jaw, and the reason for this is that his feet are no use for seizing and holding things: they are too small altogether. So Nature has given him a mouth which he can use for these purposes instead of his feet. And when it comes to seizing things and holding them, the most useful direction for a blow to take is that which gives it the greatest strength. Now a blow from above is always stronger than one from below. And to an animal who has no hands and no proper feet, who has to use his mouth for seizing his food as well as for biting it, the power to seize it is the more necessary; and therefore it is more useful to him to be able to move his upper jaw than his lower one. For the same reason crabs move the upper part of their claws and not the lower: claws are their substitute for hands, so the claws have to be useful for seizing things (not for cutting them
ARISTOTLE

691 b

20 Δει εἶναι τὴν χηλήν· τὸ δὲ διελεῖν καὶ δακεῖν ὀδόντων ἐργὸν ἐστὶν. τοῖς μὲν οὖν καρκίνοις καὶ τοῖς ἄλλοις ὤσις ἐνδέχεται σχολαίως ποιεῖσθαι τὴν λῆμνι διὰ τὸ μὴ ἐν ύγρῷ εἶναι τὴν χρῆσιν τοῦ στόματος, διηρηταί, καὶ λαμβάνομεν μὲν χερσὶν ἡ ποσὶ, διαμορφοῦμεν δὲ τῷ στόματι καὶ δάκνουσιν· τοῖς 25 δὲ κροκοδείλοις ἐπ᾿ ἀμφότερα χρῆσιμον τὸ στόμα πεποίηκεν ἡ φύσις, κινούμενων οὔτω τῶν σιαγόνων. Ἐχουσι δὲ καὶ αὐχένα πάντα τὰ τοιαῦτα διὰ τὸ πλεύμονα ἔχεν· δέχονται γὰρ τὸ πνεῦμα διὰ τῆς ἀρτηρίας μὴκος ἐχούσης.

1' Ἐπεὶ δὲ τὸ μεταξὺ κεφαλῆς καὶ ὠμῶν κέκληται αὐχήν, ἥκιστα τῶν τοιούτων ὁ ὀφὺς δόξειεν ἂν ἔχειν αὐχένα, ἀλλὰ τὸ ἀνάλογον τῷ αὐχένι, εἰ γε δεὶ τοῖς εἰρημένοις ἐσχάτους διορίζειν τὸ μόριον τοῦτο. ἰδιον δὲ πρὸς τὰ συγγενή τῶν ζῷων 692 a ὑπάρχει τοῖς ὀφεσι τὸ στρέφειν τὴν κεφαλὴν εἰς τοῦπισθεν ἠρεμοῦντος τοῦ λουποῦ σώματος. αὐτίνιον δὲ ὅτι καθάπερ τὰ ἐντομά ἑλκτὸν ἐστιν, ὡστε εὐκάμπτοις ἔχειν καὶ χονδρώδεις τοὺς σπονδύλους. ἐξ ἀνάγκης μὲν οὖν διὰ ταύτην τὴν αὐτίαν τοῦτο 5 συμβέβηκεν αὐτοῖς, τοῦ δὲ βελτίων ἐνεκεν πρὸς φυλακῆν τῶν ὀπισθεν βλαπτόντων· μακρὸν γὰρ ὅν καὶ ἄπον ἀφνός ἐστι πρὸς τὴν στροφὴν καὶ πρὸς τὴν τῶν ὀπισθεν τήρησιν· οὐδὲν γὰρ ὀφελος αὑρειν μὲν, στρέφειν δὲ μὴ δύνασθαι τὴν κεφαλὴν. ἔχουσι δὲ τὰ τοιαῦτα καὶ τῷ στήθει ἀνάλογον μόριον.

10 μαστοὺς δ’ οὖκ ἔχουσιν οὐτ’ ἐνταῦθα οὐτ’ ἐν τῷ ἄλλῳ σώματι, ὁμοίως δ’ οὖδ’ ὀρνίς, οὐδ’ ἱχθύς οὐδείς. αὐτίον δὲ τὸ μηδὲ γάλα ἔχειν τοῦτων

1 hinc usque ad 695 a 22 varia codd.; text. vulg. exhibui.

398
up: this, and biting, is the business of the teeth). In crabs, then, and in other creatures which, because their mouth does not come into action while under water, can take their time about seizing their food, the labour is divided: they seize their food with their hands or feet, and cut it up and bite it with the mouth. For the crocodile, however, by making the jaws move as I have described, Nature has constructed a mouth which can be used for both these purposes.

All these animals have also a neck; this is because they have a lung and there is a long windpipe through which they admit the breath to it.

Since the neck is the name given to the part of the body between the head and the shoulders, the serpent would appear to be the very last of these creatures to possess one: at any rate, if the neck is to be defined by the limits mentioned above, he has merely something analogous to a neck. Compared with kindred animals, serpents have this peculiarity: they can turn their heads backwards while the rest of the body remains still. The reason is that their body (like an insect’s) can roll up; the vertebrae are cartilaginous and flexible. This, then, is the necessary cause why they have this ability; but it serves a good purpose too, for it enables them to guard against attacks from the rear, and with their long bodies devoid of feet they are ill adapted for turning themselves round to keep watch over the rear. To be able to raise the head and yet unable to turn it round would be useless. These animals have also a part which is a counterpart to the breast. But they have no mammae either here or elsewhere; nor have any of the birds or fishes. This is because the mammae are receptacles, vessels,
692a μηθεν· ο δε μαστος υποδοχη και ωσπερ αγγειον εστι γαλακτος. γαλα δ' ουκ εχει ουτε ταυτα ουτε αλλο ουδεν των μη ζωοτοκουτων εν αυτοις, διοτι ζωοτοκουσιν, εν δε τω ψω η τροφη εγχυνεται εν τοις ζωοτοκοις γαλακτωδης υπαρχουσα. σαφε
15 στερον δε περι αυτων λεχθησεται ειν τοις περι γενεσεως. περι δε της των σκελων1 καμψεως εν τοις περι πορειας προτερον επεσκεπται κοινη περι παντων.2

'Εχουσι δε και κερκον τα τοιαυτα, τα μεν μειζω τα δ' ελαττω, υπερ ου την αιτιαν καθολου προτερον ειρηκαμεν.

692b Περι μεν ουν των εναιμων ζωων των τε αποδων και τετραποδων, ουσα μορια τα εκτος εχει και δια τινας αιτιας, ειρηται σχεδον.

XII. 'Εν δε τως ορνισι της προς αλληλα διαφορα εν τη των μυριων εστιν υπεροχη και ελλειψει και 5 κατα το μαλλον και ηττον. ειτε γαρ αυτων οι μεν μακροσκελεις οι δε βραχυσκελεις, και την γλωτταν οι μεν πλατειαν εχουσιν οι δε στενην· ομοιως δε και επι των αλλων μυριων. ιδια δε μορια ολιγα

as it were, for the milk, and none of these creatures has any milk. Neither has any of the other animals that are not internally viviparous; the reason is that as they produce eggs the milky nutriment which they contain goes into these eggs. A more detailed account of these matters will be given in the treatise on Generation. With regard to the way in which they bend their legs, a general account, including all animals, has already been given in the treatise on the Locomotion of Animals.

These creatures have a tail, some a large one, some a small one. We have already given the reason for this as generally applicable.

Among the oviparous land-animals, the chameleon has the least flesh on him; this is because he has least blood, and the same reason is at the root of the animal’s habit of soul—he is subject to fear (to which his many changes in appearance are due), and fear is a process of cooling produced through scantiness of blood and insufficiency of heat.

This fairly concludes our account of the external parts of the blooded animals both footless and four-footed, and of the reasons thereof.

XII. We now pass on to Birds. As among themselves, they differ in their parts in respect of the more and less, and excess and defect—e.g., some of them have long legs, some short ones; some have a broad tongue, some a narrow one; and similarly with the other parts. Thus, as among themselves

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*a* At 752 b 16 ff.

*b* At 712 a 1 ff. See also below, 693 b 3, and additional note on that passage, p. 433.

*c* At 689 b 1 ff.

*d* Compare the passages at 650 b 27 and 667 a 11 ff.

*e* See 644 a 19, and introductory note on p. 19.
692 b
diaphéronta ἔχουσιν ἄλληλων· πρὸς δὲ τὰ ἄλλα ζῷα καὶ τῇ μορφῇ τῶν μορίων διαφέρουσιν. πτερωτοὶ
10 μὲν οὖν ἀπαντέσ εἴσιν, καὶ τούτ’ ἵδιον ἔχουσι τῶν ἄλλων. τὰ γὰρ μόρια τῶν ζώων τὰ μὲν τριχωτά ἐστὶ τὰ δὲ φολιδωτὰ τὰ δὲ λεπιδωτὰ, οἱ δ’ ὀρνιθεῖς πτερωτοί. καὶ τὸ πτερόν σχιστὸν καὶ οὐχ ὄμοιον τῷ εἴδει τοῖς ὀλοπέρους. τῶν μὲν γὰρ ἄσχιστον τῶν δὲ σχιστὸν ἐστὶ, καὶ τὸ μὲν ἄκαυλον, τὸ δ’
15 ἔχει καυλόν. ἔχουσι δὲ καὶ ἐν τῇ κεφαλῇ περιττήν καὶ ἵδιον τὴν τοῦ ῥύγχους φύσιν πρὸς τὰλλα· τοῖς μὲν γὰρ ἐλέφασιν ὁ μυκτήρ ἀντὶ χειρῶν, τῶν δ’ ἐντόμων εἴσιοι ἡ γλώττα ἀντὶ στόματος, τούτων δ’ ἀντὶ ὀδόντων καὶ χελών τῷ ῥύγχος ὀστινών ὑν.1 περὶ δὲ τῶν αἰσθητηρίων εἶρητα πρότερον.

20 Αὐχένα δ’ ἔχει τεταμένον τῇ φύσει, καὶ διὰ τὴν αὐτήν αἰτίαν ἤνπερ καὶ τὰλλα· καὶ τούτον τὰ μὲν βραχὺν τὰ δὲ μακρόν, καὶ σχεδὸν ἀκόλουθον τοῖς σκέλεσι τὰ πλείστα. τὰ μὲν γὰρ μακροσκελῆ μακρόν τὰ δὲ βραχυσκελῆ βραχύν ἔχει τὸν αὐχένα, χωρὶς τῶν στεγανοπόδων· τὰ μὲν γὰρ εἰ ἔχει βρα-

693 a χὺν ἐπὶ σκέλεσι μακροῖς, οὐκ ἀν ὑπηρέτει αὐτοῖς ὁ αὐχήν πρὸς τὴν ἀπὸ τῆς γῆς νομῆν, τοῖς δ’ εἰ μακρός ἢν ἐπὶ βραχέσιν. ἔτι δὲ2 τοῖς κρεωφάγοις αὐτῶν ὑπεναντίον ἂν ἦν3 τὸ μῆκος πρὸς τὸν βίον. 5 ὁ γὰρ μακρὸς αὐχήν ἀσθενής, τοῖς δ’ ὁ βίος ἐκ τοῦ κρατεῖν ἐστιν. διὸπερ οὐδὲν τῶν γαμψωνύχων μακρόν ἔχει τὸν αὐχένα. τὰ δὲ στεγανόποδα καὶ (τὰ)4 διηρημένους μὲν ἔχοντα τοὺς πόδας σεσιμω-

1 ὑν Y, Ogle: om. vulg.
they have few parts which differ from one to another. But as compared with other animals, they differ in respect of the form of their parts. One peculiarity of the birds is that they all have feathers, whereas in other animals the parts are covered with hair, or scales, or horny plates. A bird’s feather is split, and therefore different in form from the wing of certain insects, which is undivided; as well as having a shaft, whereas the insects have none. Another peculiarity of birds is the beak, an extraordinary appendage to the head. It is made of bone, and serves them instead of teeth and lips, just as the elephant’s trunk takes the place of hands, and the tongue of certain insects replaces a mouth. We have spoken already of the sense-organs.\(^a\)

Birds have a neck which sticks up, and for the same reason that other creatures have one. Some have a long neck, some a short one: in most of them it corresponds in length fairly closely to the legs, so that the long-legged birds have a long neck and the short-legged birds a short neck (web-footed birds excepted.) What assistance in getting food out of the ground would a short neck be to a bird on long legs, or a long neck to a bird on short legs? Furthermore, the carnivorous birds would find a long neck a real disadvantage in their daily life. These birds depend for their livelihood on superior strength, and length of neck means lack of strength; so no crook-taloned bird has a long neck. Web-footed birds, however, together with others in the same class whose

\(^a\) In Book II. chh. 12 ff.

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2 δε Langkavel: γε Yb: om. vulg.
3 ἀν Ἰν PYb, Ogle: om. vulg.
4 <τὰ> Ogle.
μένους δὲ καὶ ἐν τῷ αὐτῷ γένει ὁντα τοῖς στεγανό-
ποσι, τὸν μὲν αὐχένα μακρὸν ἔχουσιν (χρήσιμος
gάρ τοιοῦτος ὡν πρὸς τὴν τροφῆν τὴν ἐκ τοῦ
υγροῦ), τὰ δὲ σκέλη πρὸς τὴν νεύσιν βραχέα.

Διαφορὰν δ’ ἔχει καὶ τὰ ῥύγχη κατὰ τοὺς βίους.
τὰ μὲν γάρ εὐθὺ ἔχει τὰ δὲ γαμψόν, εὐθὺ μὲν ὅσα
tροφῆς ἐνιεκεν, γαμψόν δὲ τὰ ωμοφάγα. χρήσιμον
gάρ πρὸς τὸ κρατεῖν το τοιοῦτον, τὴν δὲ τροφῆν
ἀναγκαίον ἀπὸ ζώων πορίζεσθαι, καὶ τὰ πολλὰ
biazoméνoι. ὅσων δ’ ἔλειος δ’ βίος καὶ ποοφάγος,
πλατύ τὸ ῥύγχος ἔχουσιν. πρὸς τε γὰρ τὴν ὀρυγίν
χρήσιμον τὸ τοιοῦτον καὶ πρὸς τὴν τῆς τροφῆς
σπάσιν καὶ κουράν. ἐνὶ δὲ καὶ μακρὸν ἔχει τὸ
ῥύγχος τῶν τοιοῦτων, ἀσπερ καὶ τὸν αὐχένα, διὰ
τὸ λαμβάνειν τὴν τροφῆν ἐκ τοῦ βάθους. καὶ τὰ
πολλὰ τῶν τοιοῦτων καὶ τῶν στεγανοπόδων ἡ

ἀπλῶς ἢ κατὰ μόριον θηρεύοντα ζῆ τῶν ἐν τῷ
υγρῷ ἕνα ζωοδαρίων καὶ γίνεται τοῖς τοιοῦτοις δ’
mὲν αὐχένῃ καθάπερ ἀλευταίς δ’ κάλαμος, τὸ δὲ
ῥύγχος οἶνον ἢ ὀρμιὰ καὶ τὸ ἄγκιστρον.

Τὰ δὲ πρανῆ τοῦ σώματος καὶ τὰ ὑπτια, καὶ τὰ
τοῦ καλομένου θώρακος ἐπὶ τῶν τετραπόδων,

ολοφυῆς δ’ τόπος ἐπὶ τῶν ὀρνίθων ἐστίν καὶ ἔχουσιν
ἀπηρτημένας ἀντὶ τῶν βραχιών καὶ τῶν σκελῶν

tῶν προσθίων τὰς πτέρυγας, ὦδον τι μόριον,

διόπερ ἀντὶ ωμοπλάτης τὰ τελευταία ἐπὶ τοῦ νώτου

tῶν πτερύγων ἔχουσιν.

Σκέλη δὲ καθάπερ ἄνθρωπος δύο, κεκαμμένα

1 καὶ Υβ, Ogle: ὡς vulg.
2 κατὰ Υ, Ogle: κατὰ τὸ vulg.
404
feet though divided into toes yet are fashioned like a snub-nose — these have long necks, because a long neck is useful to them for getting food out of the water. Their feet, on the contrary, are short so that they can swim.

Birds' beaks also differ according to their different habits of life. Some beaks are straight, some curved; straight if they are used simply for feeding, curved if the bird eats raw meat, because a curved beak is useful for overpowering their prey, and such birds have to get their food from animals, most often by force. Those whose life is spent in swamps and are herbivorous have broad beaks, which are useful for digging and pulling up their food and for cropping plants. Some of them, however, have a long beak and a long neck as well, because they get their food from some depth. Practically all these birds and the completely or partially web-footed ones live by preying upon certain of the tiny water-animals, and their neck is to these birds what his fishing-rod is to an angler, while their beak is like a line and hook.

The under and the upper sides of the body (i.e. of what is called the trunk in quadrupeds) are in birds one uninterrupted whole. Instead of arms and forelegs they have wings attached to this part (wings are another peculiarity), and hence, instead of having the shoulder-blade on their back they have the ends of the wings there.

Birds, like men, have two legs, which are bent in-

a According to Ogle, this means that the main stem of the toe corresponds to the ridge of the nose, and the lobes on either side of it to the flattened nostrils.
καθάπερ τὰ τετράποδα εἶσον, καὶ οὖχ ὦσπερ ἀνθρωπος 
immers ἐξω· τὰς δὲ πτέρυγας, ὡς τὰ πρόσθια σκέλη 
tῶν τετραπόδων, ἐπὶ τὸ περιφερές. διόπουν δ' ἐξ ἀνάγκης ἐστὶν· τῶν γὰρ ἐναίμων ἢ τοῦ ὀρνιθὸς 
ουσία, ἀμα δὲ καὶ πτερυγωτός, τὰ δ' ἐναίμα ὦι 
kineitai pleiosin ἢ τέτταρις σημεῖως. τὰ μὲν οὖν ἀπηρτημένα μόρια τέτταρα, ὦσπερ τοῖς ἀλλοις 
τοῖς πεζοῖς καὶ τοῖς πορευτικοῖς, ἐστὶ καὶ τοῖς 
ὀρνισιν· ἀλλὰ τοῖς μὲν βραχίονες καὶ σκέλη, τοῖς δὲ 
tετράποσιν σκέλη τέτταρα ὑπάρχει, τοῖς δ' ὀρνισιν 
ἀντὶ τῶν προσθών σκελῶν ἢ βραχίονων πτερυγες 
tὸ ἵδιόν ἐστιν· κατὰ ταύτας γὰρ τοὺκόι εἰσι, τῷ 
δ' ὀρνιθι ἐν τῇ οὐσίᾳ τὸ πτητικὸν ἐστιν. ὥστε 
λείπεται αὐτοῖς ἐκ ἀνάγκης διόπουν εἰναι οὕτω γὰρ 
tέτταρι σημεῖως κινήσονται μετὰ τῶν πτερύγων. 
Στήθος δ' ἔχουσιν ἀπαντεῖ δέν καὶ σαρκῶδες, 
δέν μὲν πρὸς τὴν πτησιν (τὰ γὰρ πλατέα πολὺν 
άερα ωθοῦντα δυσκίνηται ἐστι), σαρκῶδες δὲ, διότι 
tὸ δέν ἁσθενεῖ μὴ πολλήν ἐχον σκέπην.
Ὑπὸ δὲ τὸ στήθος κοιλία μὲχρι πρὸς τὴν ἐξοδον 
tοῦ περιττώματος καὶ τὴν τῶν σκελῶν καμπῆν, 
kαθάπερ τοῖς τετράποσι καὶ τοῖς ἀνθρώποις. με-
ταξύ μὲν οὖν τῶν πτερύγων καὶ τῶν σκελῶν ταῦτα 
tὰ μόρια ἐστιν.
"Ομφαλὸν δ' ἐν μὲν τῇ γενέσει ἀπαντα ἔχει

1 sic PYb, Ogle: σκέλη, τοῖς δὲ τετρ. om. vulg.
2 πτητικοῖ conieci; idem Th. (volatilees Gaza).

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*a* For an explanation of Aristotle’s terminology on this subject see additional note on p. 433.

*b* The chief difficulty in translating this passage is due to the word τοὺκοι, a jargon-adjective in -ικὸς, which seems to have been suggested to Aristotle’s mind by the similar adjec-

406
PARTS OF ANIMALS, IV. xii.

wards as in the quadrupeds, not outwards as in man.¹ The wings are bent with the convex side outwards, like the forelegs of quadrupeds. It is inevitable that a bird should have two feet, for (a) it belongs essentially to the blooded creatures and (b) it is winged, and (c) four is the greatest number of motion-points which a blooded creature can have. So there are four parts (or limbs) attached to a bird’s body, and this corresponds exactly with the other blooded creatures, viz. those that live and move upon the ground. The only difference is that whereas the latter have two arms and two legs (or, if they are quadrupeds, four legs), the peculiarity of birds is that they have wings instead of arms (or forelegs). As its very essence includes the power to fly, a bird must have something which it can stretch out, and wings provide this.² So it remains that of necessity a bird shall have two feet: these with the two wings bring up the number of its motion-points to four.

All birds have a sharp-edged, fleshy breast: sharp-edged, for flying (a wide surface displaces so much air that it impedes its own motion); fleshy, because a sharp-edged thing is weak unless it has a good covering.

Below the breast is the stomach, which extends (as in the quadrupeds and in man) as far as the residual vent and the point where the legs join the body.

Those are the parts, then, which have their situation between the wings and the legs.

Birds, in common with all animals which are pro-

tive πτητικῶν in the next line. Literally, the passage reads: "for it is at these [viz. the wings] that birds are stretchable; and flight-ability is included in the essence of a bird."
ARISTOTLE

693 b

"Εστι τῶν ὀρνίθων οἱ μὲν πτητικοὶ καὶ τὰς πτέρνγας μεγάλας ἔχουσι καὶ ἱσχυρὰς, οἶον οἱ γαμμιφώνυχες καὶ ὁμοφάγοι· ἀνάγκη γὰρ πτητικοὺς εἶναι διὰ τὸν βίον, ὥστε ἕνεκα τούτου καὶ πλῆθος ἔχουσι πτερῶν καὶ τὰς πτέρνγας μεγάλας. ἔστι δ' οὐ μόνον τὰ γαμμιφώνυχα ἀλλὰ καὶ ἀλλὰ γένη ὀρνίθων πτητικὰ, ὅσος ἡ σωτηρία ἐν τῇ ταχυτητὶ τῆς πτήσεως ἢ ἐκτοπιστικός ὁ βίος. ἔνια δ' οὐ πτητικὰ τῶν ὀρνίθων ἔστιν ἀλλὰ βαρέα, οἶς ὁ βίος ἐπίγειος καὶ ἐστὶ καρποφάγα ἡ πλωτὰ καὶ περὶ ὅπως ἐισπεφώνους. ἔστι δὲ τὰ μὲν τῶν γαμμιφώνυχων σώματα μικρὰ ἄνευ τῶν πτερύγων διὰ τὸ εἰς ταῦτα ἀναλίσκεσθαι τῇ τροφῇ (καὶ) εἰς τὰ ὀπλα καὶ τὴν βοήθειαν. τοῖς δὲ μὴ πτητικοῖς τοῦνατιύν τὰ σώματα ὑγκώδη, διὸ βαρέα ἐστίν. ἔχουσι δ' ἐνοί τῶν βαρέων βοήθειαν ἀντὶ τῶν πτερύγων τὰ καλούμενα πληκτρα ἐπὶ τοῖς σκέλεσιν. ἄμα δ' οἱ αὐτοὶ οὐ γίνονται πληκτρα ἔχοντες καὶ γαμμιφώνυχες. αὐτίου δ' ὅτι οὐδὲν ἡ φύσις ποιεῖ περίεργον. ἔστι δὲ τοὺς μὲν γαμμιφώνυχοι καὶ πτητικοὶ ἀχρηστα τὰ

2 post ἀνευ habent τῶν πτερῶν καὶ Yb.  
3 εἰς ταῦτα QSUZ: ἐνταῦθα vulg.  
4 <καὶ> Ogle.  
5 desuit Z.

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This passage must be supplemented by reference to others (such as De gen. an. 753 b 20 ff., and Hist. An. 561 b), in which Aristotle speaks of τοὺς umbilici or umbilical cords—i.e. he recognized the allantois as well as the umbilical vesicle. He 408
duced alive or out of eggs, have an umbilicus while they are developing, but when they are more fully grown it ceases to be visible. The reason for this is clear from what happens during their development: the umbilical cord grows on to the intestine and unites with it, and does not form a part of the system of blood-vessels, as it does in the Vivipara.

The good fliers have big strong wings, e.g. the birds which have crooked talons and feed on raw meat: these must be good fliers owing to their habits of life, and so they have an abundance of feathers and big wings. But there are other sorts of birds which are good fliers beside these: birds whose safety lies in their speed of flight; and migrants. Some birds are poor fliers: heavy birds, which spend their time on the ground and feed on fruits; or birds that live on and around the water. The crook-talonned birds, leaving out of account their wings, have small bodies, because the nutriment is used up to produce the wings and weapons of offence and defensive armour. The poor fliers, on the contrary, have bulky, and therefore heavy, bodies. Some of these instead of wings have as a means of defence "spurs" on their legs. The same bird never possesses both spurs and talons, and the reason is that Nature never makes anything that is superfluous or needless. Spurs are of no use to a states that in the bird's egg, as the embryo grows, the allantois (the "second umbilicus") collapses first and then the "first umbilicus" (De gen. an. 754 a 9). Actually the reverse order is the correct one, but the interval is comparatively short. The umbilical vesicle in mammals, which shrivels very early in the process of development, escaped the notice of Aristotle, who supposed their allantois to be comparable to the umbilical vesicle of reptiles and birds. The umbilical vesicle of mammals was discovered by Needham in 1667. (See Ogle's note ad loc.)
πλήκτρα· χρήσιμα γάρ ἐστίν ἐν ταῖς πεζαίς μάχαις, διὸ ὑπάρχει ἐνίοις τῶν βαρέων· τούτους δὲ οὖν μονὸν ἄχρηστοι ἀλλὰ καὶ βλαβεροὶ οἱ γαμμαντικὲς τῷ ἐμπύγμυνσθαι ὑπεναντίοι πρὸς τὴν πορείαν ὄντες. 20 διὸ καὶ τὰ γαμμαντικὰ πάντα φαύλως πορεύεται καὶ ἐπὶ πέτρας οὐ καθιζόνουσιν· ὑπεναντία γάρ αὐτοῖς πρὸς ἁμφότερα ἢ τῶν ὄνιχων φύσις.

'Εξ ἀνάγκης δὲ τούτο περὶ τὴν γένεσιν συμβεβήκεν. τὸ γὰρ γεώδες ἐν τῷ σύμματι ἐξορμώμενον ἡ χρήσιμα μόρια γίνεται πρὸς τὴν ἀλκήν· ἀνω μὲν ρύθμους ἐποίησε σκληρότητα ἢ μέγεθος,

694 b κὸσ. ἐνίοις δὲ ἀντὶ τούτων συμπληροῖ τὸ μεταξὺ τῶν ποδῶν· καὶ διὰ τοῦτο ἀναγκαῖος οἱ πλωτοὶ τῶν ὀρνίθων οἱ μὲν ἀπλῶς εἰσὶ στεγανόποδες, οἱ δὲ διηγημένην μὲν ἔχουσι τὴν καὶ ἐκαστὰ τῶν δακτύλων φύσιν, πρὸς ἐκάστῳ δὲ αὐτῶν προσπέφυκεν οἷον πλάτη καὶ' ὅλον συνεχής.

'Εξ ἀνάγκης μὲν οὖν ταύτα συμβαίνει διὰ ταύτας τὰς αὐτίς· ὡς δὲ διὰ τὸ βέλτιον ἔχουσι τοιούτους τοὺς πόδας τοῦ βίου χάριν, ἵνα ζῶντες ἐν ύγρῷ καὶ τῶν πτερύγων τῆς ἀχρείων ὄντων τοὺς πόδας χρησίμους ἔχουσι πρὸς τὴν νεόσιν. γίνονται γὰρ ὁσπερ

1 ἐξορμώμενον Peck: καὶ ἐξορμούν ἐκ τούτου τὰ Yb: ἕξω ῥύειν Langkavel; fortasse ἐξορμάται καὶ ἐκ τούτου τὰ.
2 πτερύγων Yb, Ogle: πτερῶν vulg.
PARTS OF ANIMALS, IV. xii.

bird that has talons and can fly well: spurs are useful for fights on the ground, and that is why certain of the heavy birds possess them, while talons would not be merely useless to them but a real disadvantage: they would stick in the ground and impede the birds when walking. And in fact all crook-taloned birds do walk badly, and they never perch upon rocks; in both instances the nature of their claws is the impediment.

This state of affairs is the necessary result of the process of their development. There is earthy substance in the bird's body which courses along and issues out and turns into parts that are useful for weapons of offence. When it courses upwards it produces a good hard beak, or a large one; if it courses downwards it produces spurs on the legs or makes the claws on the feet large and strong. But it does not produce spurs and large claws simultaneously, for this residual substance would be weakened if it were scattered about. Again, sometimes this substance makes the legs long; and in some birds, instead of that, it fills in the spaces between the toes. Thus it is of necessity that water-birds either are web-footed, simply, or (if they have separate toes) they have a continuous fan or blade, as it were, running the whole length of each toe and of a piece with it.

From the reasons just stated it is clear that feet of this sort are the result of necessity, it is true; but they conduce to a good end and are meant to assist the birds in their daily life, for these birds live in the water, and while their wings are useless to them, these feet are useful and help them to swim. They

\[a\] See above, note on 648 a 16.
10 αἷ κωτα τοῖς πλέουσι καὶ τὰ πτερύγια τοῖς ἰχθύσιν. διὸ καὶ εἶν τῶν μὲν τὰ πτερύγια σφαλῆ, τῶν δὲ τὸ μεταξὺ τῶν ποδῶν, οὐκέτι νέουσιν.

'Ενιοὶ δὲ μακροσκελεῖς τῶν ὀρνίθων εἰσίν. αὕτων δ' ὅτι ὁ βίος τῶν τοιούτων ἔλεος· τὰ δ' ὀργανα πρὸς τὸ ἔργον ἡ φύσις ποιεῖ, ἀλλ' οὐ τὸ ἔργον πρὸς τὰ ὀργανα. διὰ μὲν οὖν τὸ μὴ πλωτὰ εἶναι οὐ στεγανόποδα ἔστιν, διὰ δὲ τὸ ἐν υπείκοντι εἶναι τῶν βίων μακροσκελῆ καὶ μακροδάκτυλα, καὶ τὰς καμπάς ἔχουσι πλείους ἐν τοῖς δακτύλοις οἱ πολλοὶ αὐτῶν. ἐπεὶ δ' οὐ πτητικὰ μὲν, ἐκ τῆς δ' αὐτῆς οὐλῆς ἐστὶ πάντα, ἢ εἰς τὸ οὐροπτύγιον αὐτοῖς τροφῇ.

20 εἰς τὰ σκέλη καταναλισκομένη ταύτα ἦξησαν. διὸ καὶ ἐν τῇ πτησίν ἀντ' οὐροπτύγιον χρωται αὐτοῖς· πέτονται γὰρ ἀποτείνοντες εἰς τὸ ὀπισθὲν· οὕτω γὰρ αὐτοῖς χρήσιμα τὰ σκέλη, ἀλλως δ' ἐμποδίζοιεν ἄν.

Τὰ δὲ βραχυσκελῆ ἡ δὲ σκέλη2 πρὸς τῇ γαστρὶ ἔχοντα πέτονται· τοῖς μὲν γὰρ αὐτῶν οὐκ ἐμποδίζοιεν οἱ πόδες οὕτω, τοῖς δὲ γαμφώνυξε καὶ πρὸ ἔργων εἰσὶ πρὸς τὴν ἀρπαγήν.

Τῶν δ' ἔχοντων ὀρνίθων τὸν αὐχένα μακρὸν οἱ μὲν παχύτερον ἔχοντες πέτονται ἐκτεταμένως τῷ αὐχένι, οἱ δὲ λεπτότερον3 συγκεκαμμένως· ἐπιπετομένοις γὰρ διὰ τὴν σκέπην ἢππου εὐθυρρεπτῶν ἑστιν.

695 a ἵσχυον δ' ἔχουσι μὲν οἱ ὀρνίθες πάντες ἢ οὐκ ἄν δοξαίειν ἐχειν, ἀλλὰ δύο μηροὺς διὰ τὸ τοῦ ἱσχίου μῆκος· ὑποτέταται γὰρ μέχρι μέσης τῆς γαστρός. αὕτων δ' ὅτι δίπους ἐστὶ τοῦτο τὸ ἄγων οὐκ ὀρθὸν

1 καὶ Yb, Ogle: om. vulg.
2 τὰ δὲ βραχυσκελῆ PYb; correx: ἐνα δὲ βραχέα <τὰ Langkavel> σκέλη vulg.

412
are like oars to a sailor or fins to a fish. A fish that has lost its fins can no longer swim; nor can a bird whose webs have been destroyed.

Some birds have long legs, owing to their living in marshes; for Nature makes the organs to suit the work they have to do, not the work to suit the organ. And these birds have no webs in their feet because they are not water birds, but because they live on ground that gives under them they have long legs and long toes, and most of them have additional joints in their toes. Furthermore, though these birds are not great fliers, they are composed of the same materials as the rest, and thus the nutriment which in the others goes to produce the tail feathers, in these is used up on the legs and makes them grow longer, and when in flight these birds stretch them out behind and use them in place of the missing tail feathers: placed thus, the legs are useful to them; otherwise they would get in the way.

Short-legged birds keep their legs up against the belly while they are flying, because if the feet are there they are out of the way; the crook-taloned birds do it for an additional reason: the feet are convenient for seizing prey.

When a bird has a long neck, this is either thick and is held stretched out during flight; or it is slender and is bent up during flight, because being protected in this way it is less easily broken if the bird flies into anything. All birds have an ischium, but in such a way that they would not appear to have one; it is so long that it reaches to the middle of the belly and looks more like a second thigh-bone. The reason for this is that a bird, although a biped, does not stand
<ον>, ώς εἰ γε εἰχε, καθάπερ ἐν τοῖς ἀνθρώποις ἡ τοῖς τετράποσιν, ἀπὸ τῆς ἔδρας βραχὺ τὸ ἱσχίον καὶ τὸ σκέλος εὐθὺς ἐχόμενον, ἰδυνάτει ἄν ὀλὸς ἐστάναι. ὁ μὲν γὰρ ἀνθρωπὸς ὀρθὸν, τοῖς δὲ τετράποσι πρὸς τὸ βάρος σκέλη ἐμπρόσθια ὑπερήψει-σταί. οἱ δὲ ὀρνιθές οὐκ ὀρθοὶ μὲν διὰ τὸ νανώδεις εἶναι τῷ φύσιν, σκέλη δὲ ἐμπρόσθια οὐκ ἔχουν.

10 σιν διὰ τὸ πτέρυγας ἔχειν ἀντ’ αὐτῶν. ἀντὶ δὲ τοῦτον μακρὸν ἡ φύσις τὸ ἱσχίον πουήσασα εἰς μέσον προσήρεισεν ἐντεύθεν δ’ ὑπέθηκε τὰ σκέλη, ὅπως ἰσορρόπου ὄντος τοῦ βάρους ἐνθεν καὶ ἐνθεν πορεύεσθαι δύνηται καὶ μένειν. δι’ ἣν μὲν οὖν αὐτίαν δύσον ἐστίν οὐκ ὀρθὸν ὄν, εἰρήται τοῦ δ’ ἀσαρκα τὰ σκέλη εἶναι ἡ αὐτὴ αὐτία καὶ ἐπὶ τῶν τετραπώδων, ὑπὲρ ἂς καὶ πρόσθεν εἰρήται.

15 Τετραδάκτυλοι δ’ εἰσὶ πάντες οἱ ὀρνιθὲς ὀμοίως οἱ στεγανόποδες τοῖς σχιζόποσιν (περὶ γὰρ τοῦ στρούθου τοῦ Λιβυκοῦ ὑστερον διοριούμεν, ὅτι δυχηλός, ἀμα τοῖς λοιποῖς ἐναπτιώμασιν οἴς ἔχει πρὸς τὸ τῶν ὀρνίθων γένος). τοὐτῶν δ’ οἱ μὲν τρεῖς ἐμπρο-σθεν, ὁ δ’ εἰς ὀπίσθεν πρὸς ἀσφάλειαν ἀντὶ πτέρυγης.

20 καὶ τῶν μακροσκελῶν λείπει τοῦτο κατὰ μέγεθος, οἶον συμβέβηκεν ἐπὶ τῆς κρεκός· πλεῖους δ’ οὐκ ἔχουσι δακτύλους. ἐπὶ μὲν οὖν τῶν ἄλλων οὖτως ἡ τῶν δακτυλῶν ἔχει θέσις, ἡ δ’ ἰνγεῖ δύο μόνον ἔχει τοὺς ἐμπροσθεν καὶ δύο τοὺς ὀπίσθεν· αὐτίων

1 <ον> Rackham, cf. l. 14 infra.
2 ὀλὸς PQU, Ogle: ὀρθὸν vulg.
3 correxí: ἔχουσιν διὰ τοῦτο πτέρυγας ἔχουσιν vulg. (πτέρυγας, δὲ altero ἔχουσιν omisso, Y, Ogle, qui post διὰ τοῦτο interpungit).

414
upright; and if it had an ischium which extended only a short way from the fundament and was followed immediately by the leg (as in man and the quadrupeds), it would be unable to stand up at all. Man can stand upright, and quadrupeds have forelegs to support their forward weight; birds, however, neither stand upright (because they are dwarf-like), nor have forelegs (because they have wings instead).a By way of compensation, Nature has made the ischium long, reaching to the middle of the body, and has fixed it fast, while beneath it she has placed the legs, so that the weight may be equally distributed on either side and the bird enabled to walk and to stand still. This shows why birds are bipeds although they are unable to stand upright. The reason why their legs are lacking in flesh is the same as for all quadrupeds and has been stated already.b

All birds, web-footed or not, have four toes on each foot. (The Libyan ostrich will be dealt with later,c and its cloven hoof and other inconsistencies with the tribe of birds will be discussed.) Of these four toes, three are in front, and the fourth is at the back instead of a heel, for stability. In the long-legged birds this toe is deficient in length, as for instance in the Crex. Still, the number of toes does not exceed four. This arrangement of the toes holds good generally, but the wryneck is an exception, for it has only two toes in front and two at the back. This is because

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a See above, 693 b 3 ff.
b See 689 b 10 ff.
c At the end of the book.
695 a  
25 δ' ὅτι ἡττόν ἐστιν αὐτῆς τὸ σῶμα προπετεῖς ἐπὶ τὸ πρόσθεν ἡ τὸ τῶν ἄλλων.

"Ορχείς δ' ἔχουσι μὲν πάντες οἱ ὀρνίθες, ἐντὸς δ' ἔχουσιν· ἡ δ' αἰτία ἐν τοῖς περὶ τὰς γενέσεις λειτοχείται τῶν ζώων.

695 b  
Τὰ μὲν οὖν τῶν ὀρνίθων μόρια τὸν τρόπον ἔχει τούτων.

XIII. Τὸ δὲ τῶν ἱχθύων γένος ἐτὶ μᾶλλον κεκολοβωταί τῶν ἐκτὸς μορίων. οὔτε γὰρ σκέλη οὔτε χείρας οὔτε πτέρυγας ἔχουσιν (εἴρηται δὲ περὶ τούτων ἡ αἰτία πρότερον), ἀλλὰ ὅλον ἀπὸ τῆς κεφαλῆς τοῦ κύτους συνεχές ἐστὶ μέχρι τῆς οὐρᾶς. ταύτην δ' οὖχ ὁμοίαν ἔχουσι πάντες, ἀλλὰ τὰ μὲν παραπλησίων, τῶν δὲ πλατέων ἑνὶ ἀκανθώδῃ καὶ μακράν ἡ ἐκείθεν γὰρ αὐξησις γίνεται εἰς τὸ πλάτος, οἶον ἐστι νάρκαις καὶ τρυγοσί καὶ εἶ τι τοιούτοις ἄλλο.

10 σελαχός ἐστιν. τῶν μὲν οὖν τοιούτων ἀκανθώδες καὶ μακρὸν τὸ οὐραῖον ἐστιν, ἑνὶς δὲ σαρκώδες μὲν βραχὺ δὲ διὰ τὴν αὐτὴν αἰτίαν δ' ἡπερ ταῖς νάρκαις· διαφέρει γὰρ οὐδὲν, ἡ βραχὺ μὲν σαρκωδέστερον δέ, ἡ μακρὸν μὲν ἀσαρκότερον δ' εἰναι.

Ἐπὶ δὲ τῶν βατράχων τὸ ἐναντίον συμβεβήκεν

15 διὰ γὰρ τὸ μὴ σαρκώδες εἰναι τὸ πλάτος αὐτῶν τὸ ἐμπρόσθιον, οἷς ἀφίηρηται σαρκώδες, πρὸς τὸ ὅπωςθεν αὐτῶν εἴθηκεν ἡ φύσις καὶ τὴν οὐράν.

Ὅτι ἐκεῖνοι δ' ἀπηρτημένα κόλα οἱ ἱχθύες διὰ τὸ νευστικὴν εἰναι τὴν φύσιν αὐτῶν κατὰ τὸν τῆς οὐσίας λόγον, ἐπεὶ οὖτε περίεργον οὐδὲν οὔτε μάτην


2 αὐτῶν U: αὐτὸ vulg.

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a See De gen. an. 714 b 4 ff., 719 b 11.
the weight of its body tends forward less than that of other birds.

All birds have testicles, but they are inside the body. The reason for this will be stated in the treatise on the different methods of generation among animals.\(^a\)

This concludes our description of the parts of Birds. (iii.) Fishes:

XIII. In the tribe of Fishes the external parts are still further stunted. Fishes have neither legs, hands, nor wings (the reason has been stated earlier), but the whole trunk has an uninterrupted line from head to tail. Not all fishes' tails are alike; but the tail, general run of them have similar tails, though some of the flat-fish have a long, spiny one, because the material for the tail's growth goes into the width of the flat body: this happens in the torpedo-fishes, in the Trygons, and any other Selachians of the same sort. These have long, spiny tails. Others have short, fleshy ones, and for the selfsame reason: it comes to the same thing whether the tail is short and has a good deal of flesh or long with little flesh.

In the fishing-frog\(^b\) the opposite has taken place. Here, the wide, flat part of the body in front is not fleshy; Nature has taken the fleshy material away from the front and added an equivalent amount at the back—in the tail.

Fishes have no separate limbs attached to the body. (a) This is because Nature never makes anything that is superfluous or needless, and by their essence and constitution\(^c\) fishes are naturally swimmers and so

\(^a\) Lophius piscatorius, known as the "goosefish" in U.S.A., erroneously included by Aristotle (De gen. an. 754 a 25) with the Selachia, though he observed that it differed in many important points.

\(^b\) Logos: see Introduction, pp. 26 f.
ARISTOTLE

695 b

20 ἡ φύσις ποιεῖ. ἐπεὶ δ’ ἐναμα ἐστὶ κατὰ τὴν οὐσίαν, διὰ μὲν τὸ νευστικὰ εἶναι πτερύγια ἔχει, διὰ δὲ τὸ μὴ πεζεύειν οὐκ ἔχει πόδας: ἡ γὰρ τῶν ποδῶν πρόσθεσις πρὸς τὴν ἐπὶ τῷ πεζῷ κίνησιν χρήσιμός ἐστιν. ἀμα δὲ πτερύγια τέτταρα καὶ πόδας οὐχ οἶνον τ’ ἔχειν, οὐδ’ ἀλλὸ κὼλον τοιοῦτον οὐδέν.

25 ἐναμα γάρ. οἱ δὲ κορδύλου βράγχια ἔχουσε πόδας ἔχουσιν. πτερύγια γὰρ οὐκ ἔχουσιν, ἀλλὰ τὴν οὐρὰν μακρὰ ἡ καὶ πλατεῖαν.

"Εξουσὶ δὲ τῶν ἰχθύων ο饬ὶ μὴ πλατεῖς, καθάπερ βάτος καὶ τρυγών, τέτταρα πτερύγια, δύο μὲν ἐν τοῖς πρανέσι, δύο δ’ ἐν τοῖς ὑπτίοισιν. πλεῖω δὲ τούτων οὐδεῖς, ἀναμοι γὰρ ἄν ἦσαν. τούτων δὲ τὰ μὲν ἐν τῷ πρανεί σχέδου πάντες ἔχουσιν, τὰ δ’ ἐν τοῖς ὑπτίοισιν ένοι τῶν μακρῶν καὶ πάχους ἐχώντων οὐκ ἔχουσιν, οἶνον ἐγχέλυς καὶ γόγγρος καὶ κεστρέων τι γένος τὸ ἐν τῇ λίμνῃ τῇ ἐν Σιφαίς. ὅσα δ’ ἐστὶ μακροφυέστερα καὶ ὄφιώδη μᾶλλον, οἶνον σμύρανα, οὐδὲν ἔχουσι πτερύγιων ἀπλῶς, ἀλλὰ ταῖς καμπαῖς κινοῦνται, χρώμεναι τῷ ὤγρῳ ὄσπερ οἱ ὀφεῖς τῇ γῇ τόν οὐτόν γὰρ οἱ ὀφεῖς τρόπον νέουσιν οὔτε πέρι τῆς γῆς ἔρπουσιν. αἰτία δὲ τοῦ μὴ ἔχειν τοὺς ὄφιώδεις τῶν ἰχθύων πτερύγια, ἦπερ καί τῶν ὀφεῶν τοῦ ἀποδας εἶναι. τὸ δ’ οὕτων ἐν τοῖς περὶ πορείας καὶ κινήσεως τῶν ζῶν εἰρηται. ἡ γὰρ κακῶς ἄν ἐκινοῦντο, τέτταρι σημεῖοι κινοῦμενα

1 τόν οὐτόν Peck: τοῦτον vulg.
2 οἱ ὀφεῖς τόν τρόπον Yb: τόν delevi: τόν τρόπον οἱ ὀφεῖς vulg.

a The Cordylus was probably the larval form of some triton or newt, such as Triton alpestris or Salamandra atra, which retains its gills till it is well grown (D’Arcy Thompson).

b i.e. pectoral.

c i.e. ventral.
need no such limbs. But also (b) they are essentially blooded creatures, which means that if they have four fins they cannot have any legs or any other limbs of the sort; so they have the fins because they are swimmers and do not have the feet because they are not walkers (when an animal has feet it has them because they are useful for moving about on land). The Cordylus, however, has feet in addition to its gills, since it has no fins, but only a scraggy flattened-out tail.

Excluding flat-fish (like the Batos and Trygon), fish have four fins: two on their under and two on their upper surface, never more, for then they would be bloodless animals. Almost all fishes have the two upper fins, but some of the large, thick-bodied fishes lack the under two—as for instance the eel and the conger, and a sort of Cestreus that is found in the lake at Siphae. Fishes that have even longer bodies than these, and are really more like serpents (as the Smyraena), have no fins at all, and move along by bending themselves about: that is, they use the water just as serpents use the ground. And in fact serpents swim in exactly the same way as they creep on the ground. The reason why these serpent-like fishes have no fins and the reason why serpents have no feet are the same, and this has been stated in the treatises on the *Locomotion and Movement of Animals*. (a) If they had four motion-points, their movement would be poor, because the fins would

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In Boeotia, on the south coast near Thespiae; now Tipha. Aristotle refers to this Cestreus of Siphae again, *De incessu an.* 708 a 5. Cf. also *Hist. An.* 504 b 33.

Probably *Muraena Helena*.

See *De incessu an.* 709 b 7; perhaps the other passage which Aristotle has in mind is 690 b 16, in this book.
ARISTOTLE

696 a

(eîte γὰρ σύνεγγυς εἶχον τὰ πτερύγια, μόνις ἂν 
15 ἐκινοῦντο, εἶτε πόρρω, διὰ τὸ πολὺ μεταχύ)· εἰ 
δὲ πλεῖω τὰ κινητικὰ σημεῖα εἶχον, ἀναίμα ἂν ἢν. 
ἡ δὲ αὐτὴ αὐτία καὶ ἐπὶ τῶν δύο μόνον ἔχον-
tων πτερύγια ἵχθύων· ὁφιώδη γάρ ἐστι καὶ εὐ-
μηκέστερα, καὶ χρῆται τῇ κάμψει ἀντὶ τῶν δύο 
πτερυγίων. διὸ καὶ ἐν τῷ ἔρημῷ ἔρπουσι καὶ ζῶσι 
20 πολὺν χρόνον, καὶ τὰ μὲν οὐκ εὐθὺ, τὰ δὲ οἰκεῖα 
τῆς πεξῆς οὖνα φύσεως ἤττον ἀσπαρίζει.

Αὐτῶν δὲ τῶν πτερυγίων τὰ ἐν τοῖς πρανέσιν ἔχει 
tὰ δύο ἐχοντα πτερύγια μόνον, ὅσα μὴ κωλύεται 
diὰ τὸ πλάτος· τὰ δὲ ἐχοντα πρὸς τῇ κεφαλῇ ἔχει 
diὰ τὸ μὴ ἔχειν μῆκος ἐν τῷ τόπῳ, ὦ ἀντὶ τούτων 
25 κωνησται· ἐπὶ γὰρ τῆς οὐραν προμήκες τὸ τῶν 
τοιούτων ἐστὶν ἵχθυων σῶμα. οἱ δὲ βάτου καὶ τὰ 
τοιαύτα ἀντὶ τῶν πτερυγίων τῷ ἐσχάτῳ πλάτει 
nέουσιν. τὰ δὲ ἤττον ἐχοντα πλάτος πτερύγια 
ἔχουσιν, οἰον ἑναν νάρκη καὶ δὲ βάτραχος, τὰ <μὲν> ἐν 
tῷ πρανεί κάτω διὰ τὸ πλάτος τῶν ἄνω, τὰ δὲ ἐν 
τοῖς ὑπτίοις πρὸς τῇ κεφαλῇ (οὐ γὰρ κωλύει κινεῖ-
30 σθαί τὸ πλάτος). ἀλλ' ἀντὶ τοῦ ἄνω ἐλάττω ταῦτα 
tῶν ἐν τῷ πρανεί ἔχει. ἡ δὲ νάρκη πρὸς τῇ οὐρά 
ἔχει τὰ δύο πτερύγια· ἀντὶ δὲ τῶν δύο τῷ πλάτει 
χρῆται ὡς δυσὶ πτερυγίοις ἐκατέρω τῷ ἡμικυκλίῳ.

Περὶ δὲ τῶν ἐν τῇ κεφαλῇ μορίων καὶ ἀἰσθητη-
rίων εἰρηταὶ πρότερον.

1 τὰ δὲ ἤττον . . . οἰον ἑ P: ἡ δὲ tantum vulg.
2 <μὲν> Langkavel.
either be very close together, or else a long way apart, and in either case would not move easily. \((b)\) On the other hand, if they had more than four motion-points they would be bloodless creatures. The same reason holds good for those fishes that have only two fins. These also are serpent-like and fairly long, and they use their power of bending instead of the two missing fins. And this enables them besides to crawl about and to live a good length of time on dry land; and it is some while before they begin to gasp; indeed, those which are akin to the land-animals are affected even less than the others.

Except for those whose width and flatness prevents it, all fishes that have only two fins have the upper \(^a\) ones; and these fins are by the head, because there is no length of body just there which they could use instead of fins for propulsion—length such as fish of this sort have towards their tail-end. The Batoi and such fishes swim by means of the edge of their flat surface which they use instead of fins. Fish which are not so flat, such as the torpedo-fish and the fishing-frog, possess fins, but they have their upper fins toward their tail-end owing to the flatness of the forepart, and their under fins near the head (since the flatness of the fish does not prevent its motion); but the under ones are smaller than the upper ones, to make up for being placed forward. The torpedo-fish has two of his fins by his tail; and instead of these two he uses the wide piece on each of his semi-circles \(^b\) as though it were a fin.

We have already spoken of the parts in the head and of the sense-organs.

\(\^a\) i.e. pectoral.

\(\^b\) Cf. De incessu an. 709 b 17.
"᾿Ιδιον δ’ ἔχει τὸ τῶν ἱχθῶν γένος πρὸς τάλλα τὰ ἐναίμα ξώα τὴν τῶν βραγχίων φύσιν. δι’ ἥν δ’ αἰτίαν, εἰρήται ἐν τοῖς περὶ ἀναπνοῆς. καὶ ἔχει δὲ τὰ ἔχοντα βράγχια τὰ μὲν ἐπικαλύμματα τοῖς βραγχίωις, τὰ δὲ σελάχη πάντα ἀκάλυπτα. αὐτίνον 5 δ’ ὅτι οἱ μὲν ἀκανθώδεις εἰσὶ, τὸ δ’ ἐπικαλύμμα ἀκανθώδες, τὰ δὲ σελάχη πάντα χονδράκανθα. ἐπὶ δ’ ἡ κίνησις τῶν μὲν νωθρὰ διὰ τὸ μὴ ἀκανθώδη εἶναι μηδὲ νευρώδη, τῶν δ’ ἀκανθωδῶν ταχεῖα. τοῦ δ’ ἐπικαλύμματος ταχεῖαν δεῖ γίνεσθαι τὴν κίνησιν ὡσπερ γὰρ πρὸς ἐκπνοὴν ἢ τῶν βραγχίων ἐστὶ φύσις. διὰ τούτῳ τοῖς σελαχώδεσι καὶ αὐτῶν τῶν πόρων ἡ συναγωγὴ γίνεται τῶν βραγχίων, καὶ οὐ δεῖ ἐπικαλύμματος, ὅπως γίνεται ταχεία.
Οἱ μὲν οὖν αὐτῶν ἔχουσι πολλὰ βράγχια οἱ δ’ ὁλίγα, καὶ οἱ μὲν διπλὰ οἱ δ’ ἀπλὰ. τὸ δ’ ἐσχατον ἀπλοῦν οἱ πλεῖστοι. (τὴν δ’ ἀκρίβειαν ἐκ τῶν ἀνατομῶν περὶ τούτων καὶ ἐν ταῖς ἱστορίαις ταῖς περὶ τὰ ξώα δεὶ θεωρεῖ.) αὐτίνον δὲ τοῦ πλῆθους καὶ τῆς ὀλιγότητος τὸ τοῦ ἐν τῇ καρδίᾳ θερμοῦ πλῆθος καὶ ὀλιγότης. βάττῳ γὰρ καὶ ἱσχυροτέραν τὴν κίνησιν δεὶ εἶναι τοῖς πλείσι ἔχουσι θερμότητα. τὰ δὲ πλείω καὶ διπλὰ βράγχια τοιαύτην ἔχει τὴν φύσιν μᾶλλον τῶν ἀπλῶν καὶ ἔλαττόνων. διὸ καὶ ἕνα αὐτῶν ἐξω ξῆν δύναται πολὺν χρόνον, τῶν ἐχόντων ἐλάττῳ καὶ ἤττον ἐγκρατῇ τὰ βράγχια, οἷον ἐγκέλους καὶ ὅσα ὀφιώδη. οὐ γὰρ πολλῆς δεόνται καταψύξεως.
"Ἔχει δὲ καὶ περὶ τὸ στόμα διαφοράς. τὰ μὲν γὰρ κατ’ ἀντικρὺ ἔχει τὸ στόμα καὶ εἰς τὸ πρόσθεν,

1 (χοινδράκανθα γὰρ) post πάντα vulg., om. P.
2 ἡ κίνησις . . . νωθρά Υ: αἱ κινήσεις . . . νωθραὶ vulg.
PARTS OF ANIMALS, IV. xiii.

The peculiarity which marks off fishes from the other blooded animals is the possession of gills. It has been explained in the treatise on Respiration why they have them. All fishes have coverings over their gills, except the Selachia, none of which have them. This is because their bones are cartilaginous, whereas other fishes’ bones are of fish-spine, and this is the substance out of which the coverings are made. And again, the Selachia move sluggishly owing to their lack of fish-spine—and of sinews—while the spinous fishes move quickly, and the movement of the covering must be a quick one, for gills are a medium for expiration of a sort. On this account in the selachian group of fishes the passages of the gills can close up by themselves, and no covering is needed to make sure they close quickly.

Now some fish have many gills, some have few; some have double ones, some single. The last one is nearly always a single one. (For precise details consult the Anatomical treatises and the Researches upon Animals.) The number of gills depends upon the amount of heat in the heart. The more heat an animal has, the quicker and stronger must be the movement of its gills; and if the gills are numerous and double they are better adapted for this than if they are few and single. And on this account, some fishes (e.g. the eels and the serpentine fishes) which need but little cooling, as is shown by their having only a few weakish gills, can live a long time out of water.

Fish differ also with regard to the mouth. Some have their mouth right at the tip, straight in front;
τα δ' ἐν τοῖς ὑπτίοις, οἷον οἱ τε δελφῖνες¹ καὶ τα ἱερά καὶ ὑπτια στρεφόμενα λαμβάνει τὴν τροφήν. φαίνεται δ' ἡ φύσις οὐ μόνον σωτηρίας ἑνεκεν ποιήσαι τοῦτο τῶν ἄλλων ζῴων (ἐν γὰρ τῇ στρέψει σώζεται τάλλα βραδυνόντων· πάντα γὰρ τὰ τοιαύτα ζωοφάγα ἐστίν), ἀλλὰ καὶ πρὸς τὸ μὴ ἀκολουθεῖν τῇ λαμαργίᾳ τῇ περὶ τὴν τροφήν· βάσον γὰρ λαμβάνοντα διεφθείρετ' ἀν διὰ τὴν πλήρωσιν ταχέως. πρὸς δὲ τούτοις περιφερή καὶ λεπτὴν ἐχοντα τὴν τοῦ ῥύγχους φύσιν οὐχ οἰον τ' εὐ- διαίρετον ἐχειν.

"Ετι δὲ καὶ τῶν ἄνω τὸ στόμα ἐχοντων τὰ μὲν ἀνερρωγὸς ἐχει τὸ στόμα τὰ δὲ μύουρον, οἷον μὲν σαρκοφάγα, ἀνερρωγὸς, ὀπερ τὰ καρχαρόδοντα, διὰ τὸ ἐν τῷ στόματι εἶναι τοὺς τοιούτοις τὴν ἵππιν, ὅσα δὲ μὴ σαρκοφάγα, μύουρον.

Τὸ δὲ δέρμα οἱ μὲν λεπιδωτῶν ἐχουσιν αὐτῶν (ἤ δὲ λεπίς διὰ λαμπρότητα καὶ λεπτότητα τοῦ σώματος ἀφίσταται), οἱ δὲ τραχῦ, οἷον ρύη καὶ βάτος καὶ τὰ τοιαῦτα· ἑλάχιστα δὲ τὰ λεῖα. τὰ δὲ σελάχη ἀλεπίδωτα μὲν τραχέα δ' ἐστὶ διὰ τὸ χονδράκανθα εἶναι· τὸ γὰρ γεώδες ἐκείθεν ἡ φύσις εἰς τὸ δέρμα κατανήλωκεν.

"Ορχείς δ' οὕδεις ἐχει ἰχθύς οὗτ' ἐκτὸς οὗτ' ἐντός

¹ δελφῖνες non probant Frantzius, Ogle; similia Hist. An. 591 b 26 secludunt Aubert et Wimmer.

* This statement about dolphins, though repeated at Hist. an. 591 b 26, is incorrect, and as Aristotle was familiar with 424
PARTS OF ANIMALS, IV. xiii.

others have it underneath (e.g. the dolphin and the selachians) and that is why they turn on to their backs to get their food. It looks as if Nature made them do this partly to preserve other animals from them, for they all prey on living things, and while they are losing time turning on to their backs the other things get away safely; but she did it also to prevent them from giving way too much to their gluttonous craving for food, since if they could get it more easily they would presently be destroyed through repletion. Another reason is that their snout is round and small and therefore cannot have much of an opening in it.

There are differences too among those that have their mouth above. With some it is a great wide opening (these are the flesh-eaters, as e.g. those with sharp interfitting teeth, whose strength is in their mouth); with others (the non-flesh-eaters) it is on a tapering snout.

As for the skin: some have a scaly skin (these scales are shiny and thin and therefore easily come loose from the body); others have a rough skin, e.g. the Rhiné and the Batos and such. Those with smooth skins are the fewest. Selachia have skins which are scaleless but rough, owing to their bones being cartilaginous: instead of using the earthy matter on the bones Nature has used it for the skin.

No fish has testicles either without or within. Nor the creature, some editors consider this reference to be an interpolation.

By this Aristotle does not mean that fish have no organ for the secretion of sperm, but that they have no organ similar in shape and consistency to those of mammalia, etc. He calls the corresponding organs in fish not testes, but tubes, or roe. Aristotle’s statement does not, of course, include the Selachia, which have compact, oval testes.
(οὐδ' ἄλλο τι τῶν ἀπόδων οὐδέν, διό οὐδ' οῖ οἴφεισ),
póron δὲ τοῦ περιττώματος καὶ τῶν περὶ τὴν
γένεσιν τὸν αὐτόν, καθάπερ καὶ τάλλα ψιτόκα
πάντα καὶ τετράποδα, διὰ τὸ μὴ ἔχειν κύστιν
μηδὲ γίνεσθαι περίττωμι αὐτοῖς ύγρόν.

15 Τὸ μὲν οὖν τῶν ἵχθυων γένος πρὸς τάλλα ξώα
taútas ἔχει τὰς διαφορὰς, οἱ δὲ δελφῖνες καὶ αἱ
φάλαινα καὶ πάντα τὰ τουαῦτα τῶν κητῶν βράγχα
μὲν οὐκ ἔχουσιν, αὐλόν δὲ διὰ τὸ πνεύμωνα ἔχειν:
dεχόμενα γὰρ κατὰ τὸ στόμα τὴν θάλασσαν ἀφιάσι
κατὰ τὸν αὐλόν. ἀνάγκη μὲν γὰρ δέξασθαι τὸ

20 ύγρόν διὰ τὸ λαμβάνειν τὴν τροφὴν ἐν τῷ ύγρῷ.
dεχόμενα δ' ἀφιέναι ἀναγκαῖον. τὰ μὲν οὖν βράγχα-
χιά ἐστι χρήσιμα τοῖς μὴ ἀναπνέουσιν; δ' ἦν δ' ἀιτίαν,
eἰρηταὶ ἐν τοῖς περὶ ἀναπνοῆς ἀδύνατον γὰρ
ἀμα τὸ αὐτὸ ἀναπνεῖν καὶ βράγχια ἔχειν. ἀλλὰ πρὸς
τὴν ἄφεσιν τοῦ ὑδατος ἔχουσι τὸν αὐλόν. κεῖται δ'

25 αὐτοῖς οὕτος πρὸ τοῦ ἔγκεφαλον διελάμβανε γὰρ
ἀν ἀπὸ τῆς ράχεως αὐτόν. αὐτοὶ δὲ τοῦ πνεύμωνα
ταῦτ' ἔχειν καὶ ἀναπνεῖν, ὅτι τὰ μεγάλα τῶν ξώων
πλείονος δεῖται θερμότητος ἵνα κινῆται. διὸ τὸν
πνεύμων ἔγκειται αὐτοῖς θερμότητος ὅτε πλήρης
αἰματικῆς. ἐστὶ δὲ ταύτα τρόπον τινα ἀπὸ καὶ

30 πεζὸν καὶ ἕνυδρα. τὸν μὲν γὰρ ἁέρα δέχεται ὡς πεζὸ,
ἀποδε δ' ἐστὶ καὶ λαμβάνει ἐκ τοῦ ύγροῦ τὴν

697 b τροφὴν ὑσπερ τὰ ἑνυδρα. καὶ αἱ ψαρὶδες δὲ καὶ
αἱ νυκτερίδες διὰ τὸ ἐπαμποτερίζειν αἱ μὲν τοῖς
ἕνυδροις καὶ πεζοῖς, αἱ δὲ τοῖς πτηνοῖς καὶ πεζοῖς,
diὰ τοῦτο ἀμφοτέρων τε μετέχουσι καὶ οὐδετέρων.

1 ζωτόκα PSUY.
2 καὶ ἀπὸ καὶ Ogle.
3 (καὶ) Rackham.
have any other footless animals, and this includes the serpents. In fish the passage for the residue and for the generative secretion is one and the same; and this is so in all other oviparous animals, four-footed ones included. This is because they have no bladder and produce no liquid residue.

Thus we have seen what are the differences to be noticed in fish as a group as compared with other animals. Dolphins and whales and all such Cetacea, however, have no gills, but they have a blowhole because they have a lung. They cannot help letting the sea-water enter the mouth because they feed in the water, and once it has got in they must get it out again, and they do so through the blowhole. Gills, of course, are of service herein to those creatures that do not breathe. The reason for this has been given in my book on Respiration: no creature can breathe and at the same time have gills; instead, these Cetacea have a blowhole for getting rid of the water. It is placed in front of the brain, otherwise it would separate the brain from the spine. The reason why these creatures have a lung and breathe is that large animals need more heat than others to enable them to move; consequently they have a lung inside them full of heat derived from the blood. They are, in a way, land-animals as well as water-animals: they inhale the air, like land-animals, but they have no feet and they get their food from the water as water-animals do. Similarly, seals and bats are in an intermediate position. Seals are between land-animals and water-animals, bats between land-animals and fliers: thus they belong to both classes or to neither.

* References given above, see on 696 b 2.
5 αἰ τε γὰρ φῶκαι ὡς μὲν ἐνυδροὶ πόδας ἔχουσίν, ὡς
dὲ πεζαὶ πτερύγια¹ (τοὺς γὰρ ὀπισθὲν πόδας ἱχνω-
 الواς ἔχουσι πάμπαν, ἔτι δὲ τοὺς ὀδόντας πάντας
cαρχαρόδοντας καὶ ὄξείς) καὶ αἱ νυκτερίδες ὡς μὲν
πτηνὰ ἔχουσι πόδας, ὡς δὲ τετράποδα οὐκ ἔχουσί,
cαὶ οὔτε κέρκων ἔχουσιν οὔτ' οὐροπύγιον, διὰ μὲν
10 τὸ πτηνὰ εἶναι κέρκων, διὰ δὲ τὸ πεζὰ οὐροπύγιον.
συμβέβηκε δ' αὕταῖς τούτ' ἔξ ἀνάγκης· εἰςι γὰρ
derμόπτεροι, οὐδὲν δ' ἔχει οὐροπύγιον μὴ σχιζό-
πτερον· ἐκ τοιούτου γὰρ πτεροῦ γίνεται τὸ οὐρο-
pύγιον. ἢ δὲ κέρκως καὶ ἐμπόδιος ἀν ἤν υπάρχουσα
ἐν τοῖς πτεροῖς.
Τὸν αὐτὸν δὲ τρόπον καὶ ὁ στρονθὸς ὁ Διβυκός·
15 τὰ μὲν γὰρ ὀρνιθὸς ἔχει, τὰ δὲ ζῴου τετράποδος.
ὡς μὲν γὰρ οὐκ ὃν τετράποντες πτερὰ ἔχει, ὡς δ' οὐκ ὃν ὀρνις ὃντε πέτασι μετεωριζόμενος, καὶ τὰ
πτερὰ ὑπ' χρήσιμα πρὸς πτῆσιν ἄλλα τριχώδη· ἔτι
dὲ ὡς μὲν τετράποντες ὃν βλεφαρίδας ἔχει τὰς
ἀνωθὲν καὶ μελός ἐστὶ τὰ περὶ τὴν κεφαλὴν καὶ τὰ
20 ἄνω τοῦ αὐχένος, ὡστε τριχωδέστερας ἔχειν τὰς
βλεφαρίδας, ὡς δ' ὀρνις ὃν τὰ κάτωθεν ἐπτέρωται· καὶ δίπους μὲν ἐστίν ὡς ὀρνις, διχαλὸς δ' ὡς
τετράποντες· οὔ γὰρ δακτύλους ἔχει ἄλλα χηλάς.
τούτον δ' αἴτιον ὦτι τὸ μέγεθος οὐκ ὀρνιθὸς ἔχει
ἄλλα τετράποδος· ἐλάχιστον γὰρ ἀναγκαῖον εἶναι τὸ
25 μέγεθος ὡς καθόλου εἰπεῖν τὸ τῶν ὀρνιθῶν· οὐ γὰρ
ῥάδιον πολὺν ὄγκου κινεῖσθαι σώματος μετέωρον.

¹ πτερύγια Ogle: πτέρυγας vulg.
Seals, if regarded as water-animals, are anomalous in having feet; if regarded as land-animals, in having fins (their hind feet are altogether like those of fishes—i.e. fins; and all their teeth too are sharp and interlocking). Bats, too, if regarded as birds, are anomalous in having feet; if regarded as quadrupeds, in not having feet; furthermore, they have neither a quadruped's tail (because they are fliers) nor a bird's tail (because they are land-animals). This their lack of a tail like a bird's is a necessary consequence, since they have membranous wings, and no creature has a tail of this sort unless it has barbed feathers: such tails are always made out of barbed feathers. And a tail of the other sort growing among feathers would be a definite impediment.

After the same style is the Libyan ostrich: in some points it resembles a bird, in others a quadruped. As not being a quadruped, it has feathers; as not being a bird, it cannot rise up and fly, and it has feathers that are like hairs and useless for flight. Again, as being a quadruped, it has upper eyelashes, and it is bald in the head and the upper part of the neck, as a result of which its eyelashes are hairier than they would otherwise be; as being a bird, it is feathered on its lower parts. Also, as a bird, it has two feet; but, as a quadruped, it has cloven hoofs (it has hoofs and not toes). The reason is that it has the size not of a bird but of a quadruped. Speaking generally, a bird has to be very small in size, because it is difficult for a body of large bulk to move off the ground.

a That is, of the sort that birds ought not to have, viz. on their wings.

b That is, of the sort that quadrupeds ought to have.
Περὶ μὲν οὖν τῶν μορίων, διὰ τὴν αἰτίαν ἐκαστὸν ἔστιν ἐν τοῖς ζωῖσιν, εἴρηται περὶ πάντων τῶν ζωῶν καθ' ἐκαστὸν· τούτων δὲ διωρισμένων ἐφεξῆς ἐστὶν τὰ περὶ τὰς γενέσεις αὐτῶν διελθεῖν.¹

¹ τούτων . . . διελθεῖν om. Yb, et statim incipiunt librum de incessu.
PARTS OF ANIMALS, IV. xiii.

We have now spoken severally of all the animals: Conclusion, we have described their parts, and stated the reason why each is present in them. Now that this is concluded, the next thing is to describe the various ways in which animals are generated.
Commentators agree that no satisfactory sense can be obtained from the first three lines of this passage as it stands in Bekker’s edition. None has so far produced a remedy; but an examination of the Arabic translation (or of Michael Scot’s Latin translation made from the Arabic) shows plainly what has happened. In neither of these two translations is there any reference whatever to a diagram until 685 a 2. Thus the ms. from which our present Greek text is derived had been corrupted through the efforts of someone who tried to improve the text of 684 b 22-27 by inserting references to a diagram here also; and the result is that these references have caused the complete loss of one important phrase (b 22) and serious corruption of another (b 24-25). Some dislocation has also been caused in the lines following, up to line 29.

The two diagrams given in the ms. Z are obviously constructed to suit the interpolated text. One of the mss. (Merton 278) of Michael Scot’s version has an entirely different diagram; the three mss. of Scot at Cambridge have no diagram at all, nor has the Arabic ms. B.M. Add. 7511.

I give below the passage as it appears in Michael Scot’s version.

*Natura ergo istorum duorum modorum est sicut diximus; et propter hoc ambulant uniformiter*\(^1\) *sicut accidit animalibus quadrupedibus et hominibus etiam. homo vero habet os in capite, scilicet in parte superiori corporis; deinde habet stomachum, deinde ventrem, et post ventrem intestinum perveniens ad locum exitus superfluitatis. iste ergo res in animalibus habentibus sanguinem sunt secundum hanc dispositionem, et post caput est clibanus, scilicet pectus, et quod vicinatur ei. alia vero membra sunt propter ista, etc.*

I am much indebted to Dr. R. Levy for his kindness in reading this passage for me in the Arabic in Brit. Mus. ms. Add. 7511.

\(^1\) *inuniformiter* Caius 109 & Camb. U.L. ii. 3. 16; fortasse *igitur scribendum uniformiter et non inuniformiter.*
Additional Note on 693 b 3

Explanation of Aristotle’s terminology for describing the bending of limbs.

When Aristotle is speaking about the bending of limbs, *backwards* and *forwards* are relative to the direction in which the whole animal moves;

*inwards* and *outwards* are relative to the bulk of the body itself.

Thus, *backwards* means that the angle of the bent joint points backwards; *inwards* means that the extremity of the limb is brought inwards towards the body, that is, the angle of the bent joint points away from the main bulk of the body. ("Inward" and "outward" bending thus have no connotation of "bandy-legs" and "knock-knees").

Example (1)

All four legs bend *inwards*;
The forelegs bend *forwards*:
The hindlegs bend *backwards*.

Example (2)

The leg bends *inwards*, and
*backwards*.

(See De incess. an. 711 a 8 ff., Hist. An. 498 a 3 ff.)
ARISTOTLE

Additional Note on the ms. Z

The following portions of the text of De partibus are contained in the Oxford ms. Z (see p. 50):

fol. 60r, 60v. I. 639 b 29 to 640 b 24. μέχρι το μᾶλλον ἂν inclusive.

fol. 61r, 61v. I. 644 a 25 to 645 a 17. καθόλου το τοῖς φυινclusive.

Between these two folios it has apparently lost four folios, as well as one at the beginning of Book I and another at the end.

fol. 1r-19r. Book II.
fol. 19v-36r. Book III, but the words οὕτω πολύ το εὐρυχώρους inclusive (675 a 30-b 27) are omitted, with no indication by the original scribe that anything has been omitted: this passage has been supplied by a later hand in the margins of fol. 35v and 36r and on 36v.

Book IV is written by yet another (later) hand, and this Book occupies fol. 37r-59v, at the end of which folio it breaks off at the words τὰ καλούμενα (694 a 13). The rest of Book IV is lost.

In the apparatus I have used the following abbreviations in quoting this ms.:

Z Books I, II and most of III (first hand, c. A.D. 1000).
Z₁ indicates the reading of the first hand where this has been altered by another.
Z² indicates later correctors of Z₁.
Z indicates the readings of the ms. in Book IV.

I have collated from photostats the whole of the portion written by the first hand, and the readings of Z quoted have been confirmed by reference to the photostats.

I have used the symbol $E$ when quoting the readings of E from 680 b 36 onwards, as this part of the ms. is written in a later hand.
MOVEMENT OF ANIMALS
INTRODUCTION

That the *De incessu animalium* is a genuine work of Aristotle himself has never been disputed. The *De motu animalium* has been regarded by many critics as a spurious work, though recent opinion has favoured its genuineness. Brandis, Rose and Zeller all condemn it, but its Aristotelian authorship has been upheld by Werner Jaeger (*Hermes*, xlviii. pp. 31 ff.), who makes out a very strong case in its favour, and by the Oxford translator, Mr. A. S. L. Farquharson. Those who deny its authenticity rely mainly on the supposition that there is a reference in 703 a 10-11 to the *De spiritu*. This treatise is generally admitted to be un-Aristotelian, but the reference, as Mr. Farquharson has pointed out, might relate equally well to numerous other passages in the Aristotelian corpus; Michael Ephesius refers it to a treatise Περὶ τροφῆς, not otherwise known. In style, vocabulary and syntax the *De motu animalium* is entirely Aristotelian, and its doctrine corresponds with that set forth in Aristotle’s genuine works.

Each treatise has its proper place in the scheme of Aristotle’s biological works. Both are theoretical, the *De incessu animalium*, like the *De partibus animalium*, dealing with the material side of living things, and the *De motu animalium*, like the *De generatione animalium*, dealing with their consequential properties.
The chief mss. of the *De motu animalium* are E, Y, P and S. Of these E, one of the most famous of Aristotelian mss., is the oldest; Y is closely related to E. P and S are similarly related and form a second group.

Of the *De incessu animalium* the principal mss. are Z, Y, U, S and P. Of these Z is the oldest, and Y is closely related to it, while the other three mss. form another group.

A full account of these mss. and their relations to one another will be found in the Introduction (pp. iv. ff.) of W. W. Jaeger’s text (Teubner, 1913).

The text used for the present translation is based on that of I. Bekker, all divergences from which are noted and the authority given for the reading adopted. Jaeger’s text and *apparatus criticus* have been consulted throughout.

The Commentary of Michael Ephesius (*Commentaria in Aristotelem Graeca*, xxii. 2; Hayduck, 1904) has been of some assistance both for the text and for the interpretation, and the Latin version of Nicholaus Leonicus (died 1599), printed in the Berlin Aristotle, Vol. III, has been constantly consulted.

The two treatises have been translated into French by J. Barthélemy-Saint-Hilaire, and into English by Mr. A. S. L. Farquharson in the Oxford translation (1912). This translation with its ample explanatory notes constitutes much the most serious attempt that has been made to interpret these two treatises, and anyone who follows in Mr. Farquharson’s footsteps must necessarily be heavily indebted to him.

E. S. F.

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a For the meanings of these symbols see pp. 439 and 483.
ANALYSIS OF CONTENTS

Chap. I. The origin of all movement must itself be unmoved. So if there is to be animal movement, something in the animal must be at rest. Hence joints are necessary.

II. There must also be a resisting medium external to the moving animal. Illustration from the rowing of a boat.

III. The nature of the "prime mover." The fable of Atlas.

IV. The "prime mover" is of necessity outside the universe. The movement of inanimate things must originate from animate things.

V. Alteration, growth, generation and corruption as forms of motion.

VI. How does the soul move the body? Animal movement lies in the sphere of action. Its limitation in comparison with eternal movement.

VII. Animal movement the result of the syllogism of action, not of the speculative syllogism. Animal movement compared with that of automatic toys.

VIII. The psychology of animal movement and the organic changes which accompany it. The cause of movement must be situated in a definite origin.

IX. The two sides of the body are similar and can move simultaneously: both are moved by the soul.

X. The motive power is "innate spirit." Comparison between the animal organism and a well-ordered civic community.

XI. Involuntary and non-voluntary movements. Conclusion.
ABBREVIATIONS USED IN THE APPARATUS CRITICUS

E = Codex Parisinus Regius 1853.
Y = Codex Vaticanus 261.
P = Codex Vaticanus 1339.
S = Codex Laurentianus 81. 1.
Leon. = Latin translation of Nicolaus Leonicus.
Mich. = Greek commentary of Michael Ephesius.
ΠΕΡΙ ΖΩΙΩΝ ΚΙΝΗΣΕΩΣ

698a Ι. Περὶ δὲ κινήσεως τῆς τῶν ζῴων, ὡσα μὲν αὐτῶν περὶ ἑκαστὸν ὑπάρχει γένος, καὶ τίνες διαφοραὶ, καὶ τίνες αὐτία τῶν καθ’ ἑκαστὸν συμβεβηκότων αὐτοῖς, ἐπέσκεπται περὶ ἀπάντων ἐν ἑτέροις· ὅλως δὲ περὶ τῆς κοινῆς αὐτίας τοῦ κυβερνᾶν δὲ νεύσθαι κύριον ὁποιανοῦν (τὰ μὲν γὰρ πτήσει κυνεῖται τὰ δὲ νεύσει τὰ δὲ πορεία τῶν ζῴων, τὰ δὲ κατ’ ἄλλους τρόπους τουούτους) ἐπισκεπτέον νῦν.

"Ὄτι μὲν οὖν ἄρχη τῶν ἄλλων κινήσεων τὸ αὐτὸ ἑαυτὸ κυνοῦν, τοῦτοι ̣ δὲ τὸ ἀκίνητον, καὶ ὅτι τὸ πρῶτον κυνοῦν ἀναγκαῖον ἀκίνητον εἶναι, διώρισται πρότερον, ὅτεπερ καὶ περὶ κινήσεως αἰώνα, πότερον ἐστιν ἡ οὐκ ἔστι, καὶ εἰ ἔστι, τίς ἔστιν. δεὶ δὲ τοῦτο μὴ μόνον τῷ λόγῳ καθόλου λαβέων, ἀλλὰ καὶ ἐπὶ τῶν καθ’ ἑκαστα καὶ τῶν αἰσθητῶν, δι’ ἄπερ καὶ τοῦς καθόλου ξητούμεν λόγους, καὶ ἐφ’ ὧν ἐφαρμόττειν ὁλόμεθα δεῖν αὐτοὺς. φανερὸν γὰρ καὶ ἐπὶ τούτων ὅτι ἀδύνατον κινεῖσθαι μηδενὸς ἠρεμοῦντος, πρῶτον μὲν ἐν αὐτοῖς τοῖς ζῴωις. δεὴ γάρ, ἐὰν κινηταὶ τὶ τῶν μορίων, ἠρεμεῖν τι· καὶ διὰ τοῦτο αἱ καμπαί
ON THE MOVEMENT OF ANIMALS

I. We have inquired elsewhere into the details of the movement of the various kinds of animals, the differences between these movements, and the causes of the characteristics which each exhibit; we must now inquire generally into the common cause of animal movement of whatever kind—for some animals move by flight, some by swimming, some by walking, and others by other such methods.

Now that the origin of all the other movements is that which moves itself, and that the origin of this is the immovable, and that the prime mover must necessarily be immovable, has already been determined when we were investigating whether or not eternal movement exists, and if it does exist what it is. And this we must apprehend not merely in theory as a general principle but also in its individual manifestations and in the objects of sense-perception, on the basis of which we search for general theories and with which we hold that these theories ought to agree. For it is clear also in the objects of sense-perception that movement is impossible if there is nothing in a state of rest, and above all in the animals themselves. For if any one of their parts moves, another part must necessarily be at rest; and

a In the De partibus animalium.

b Physics viii. 258 b 4-9.
698 a
tois 

 Aristotelian, ou para
center, kai 

counterpart, 

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and
MOVEMENT OF ANIMALS, 1.

it is on this account that animals have joints. For they use their joints as a centre, and the whole part in which the joint is situated is both one and two,\(^a\) both straight and bent, changing potentially and actually because of the joint. And when the part is being bent and moved, one of the points in the joint moves and one remains at rest, just as would happen if A and D in the diameter of a circle were to remain still while B moved, and the radius AC were formed. (In geometrical figures, however, the centre is considered to be in every respect indivisible—for movement, too, in such figures is a figment, so they say, since in mathematics nothing actually moves,—whereas the centres in the joints are, potentially and actually, sometimes one and sometimes divided.) Be that as it may, the origin\(^b\) to which the movement can be traced, \textit{qua} origin, is always at rest while the part below it is in motion—the elbow-joint, for instance, when the forearm is in motion, the shoulder when the whole arm is moved, the knee when the shin is moved, and the hip when the whole leg is moved. It is obvious, then, that every animal too must have in itself something that is at rest, in order to provide that which is moved with the origin of its movement, supported whether, as here, in a single member, or at the centre of the body, \textit{viz.} the heart (701 b 25, 29), where a further idea of "ruling" seems to be implied (\textit{e.g.} 702 a 37). It is also used sometimes in the literal sense of "beginning," and this and the meaning of "origin" of motion may occur in the same passage and cause confusion (\textit{e.g.} 702 a 36–b 2).
καὶ ὅλον ἀθρόον κινηθήσεται καὶ κατὰ μέρος, φανερῶν.

II. Ἄλλα πᾶσα ἡ ἐν αὐτῷ ἡρεμία ὠμως ἄκυρος, ἂν μὴ τι ἐξώθεν ἢ ἀπλῶς ἡρεμοῦν καὶ ἄκινητον.

10 ἄξιον δ' ἐπιστήσαντας ἐπισκέψασθαί περὶ τοῦ λεχθέντος: ἔχει γὰρ τὴν θεωρίαν οὐ μόνον ὧσον ἐπὶ τὰ ζῶα συντελοῦσαν, ἄλλα καὶ πρὸς τὴν τοῦ παντός κίνησιν καὶ φοράν. ὡσπερ γὰρ καὶ ἐν αὐτῷ δεὶ τι ἄκινητον εἶναι, εἰ μέλλει κινεῖσθαι, οὗτος ἐτι μᾶλλον ἐξω δεὶ τι εἶναι τοῦ ζῶου ἄκινητον, πρὸς δ' ἀπερειδομένου κινεῖται τὸ κινούμενον. εἰ γὰρ ὑποδώσει αὐτὶ, οἶον τοῖς μυσὶν τοῖς ἐν τῇ γῆς ἢ τοῖς ἐν τῇ ἄμμῳ πορευμένοις, οὐ πρόεισιν, οὐδὲ ἔσται οὔτε πορεία, εἰ μὴ ἡ γῆ μένων, οὔτε πτέρεις ἣ νεύσις, εἰ μὴ ὁ ἄγαρ ἡ θάλασσα ἀντερείδου. ἀνάγκη δὲ τοῦτο ἐτερον εἶναι τοῦ κινούμενον, καὶ ὅλον ὅλου, καὶ μόριον μηδὲν εἶναι 20 τοῦ κινούμενον τὸ οὖτως ἄκινητον εἰ δὲ μὴ, οὐ κινηθήσεται. μαρτύριον δὲ τοῦτο τὸ ἀποροῦμενον, διὰ τί ποτε τὸ πλοίον ἐξώθεν μὲν, ἂν τις ὡθῇ τῷ κοντῷ τὸν ἑστών ἤ τι ἄλλο προσβάλλων μόριον, κυνεί βραδίως, ἐὰν δ' ἐν αὐτῷ τις ὁν τῷ πλοίῳ τούτῳ πειράται πράττει, οὐκ ἂν κινήσειν 25 οὔτ' ἂν ὁ Τιτυνὸς οὔθ' ὁ Βορέας πνέων ἐσωθεὶν ἐκ τοῦ πλοίου, εἰ τύχοι πνέων τοῦ τρόπου τοῦτον ὃν-

1 μυσὶν libri: ἐμύσι coni. Diels.
2 γῆ libri: ζειᾷ coni. Farquharson.

It is doubtful whether the ms. reading will bear this interpretation, and ἐν τῇ γῆ is probably corrupt. It is more 444.
MOVEMENT OF ANIMALS, i.–ii.

upon which it will move both as an integral whole
and in its several parts.

II. Any quality of rest, however, in an animal is of
no effect unless there is something outside it which is
absolutely at rest and immovable. And it is worth
while to stop and consider this dictum; for the re-
fection which it involves applies not merely to animals,
but also to the motion and progression of the universe.
For just as in the animal there must be something
which is immovable if it is to have any motion, so
a fortiori there must be something which is immov-
able outside the animal, supported upon which that
which is moved moves. For if that which supports
the animal is to be always giving way (as it does when
mice walk upon loose soil and when persons walk on
sand), there will be no progress, that is, no walking,
unless the ground were to remain still, and no flying
or swimming unless the air or sea were to offer resis-
tance. And that which offers resistance must be other
than that which is moved, the whole other than the
whole, and that which is thus immovable must form
no part of that which is moved; otherwise the latter
will not move. This contention is supported by the
problem: Why can a man easily move a boat from
outside if he thrusts it along with a pole by pushing
against the mast or some other part of the boat,
but if he tries to do this when he is in the boat
itself, Tityus could not move it nor Boreas by blow-
ing from inside it, if he really blew as the artists
than likely that the comparison is with a mouse trying to
walk upon a heap of corn. Farquharson emends ἐν τῷ γγ to
ἐν τῷ ἄνω, which would bear this meaning. (The form ἄνω, cp. Petrie Pap. ii. p. 69 (3rd cent. b.c.), would be nearer to the
ms. reading.) Diels' suggestion of ὅμοιος for ὅμοιος is in-
genious, but does not give the required sense.
698 b

περ οί γραφεῖς ποιοῦσιν· ἐξ αὐτοῦ γὰρ τὸ πνεῦμα
699 a ἀφιέντα γράφοντοι. ἐάν τε γὰρ ἡρέμα βιστῆ τὸ
πνεῦμά τις ἕάν τ' ἱσχυρῶς οὕτως ὡστ' ἀνεμον
ποιεῖν τὸν μέγιστον, ἐάν τε ἄλλο τι ἢ τὸ ῥυπτον-
μένον ἢ ωθούμενον, ἀνάγκη πρῶτον μὲν πρὸς
ἡρεμοῦν τι τῶν αὐτοῦ μορίων ἀπερειδόμενον ὠθεῖν,
5 εἴτε πάλιν τούτο τὸ μόριον, ἢ αὐτὸ ἢ οὐ τυγχάνει
μόριον ὅν, πρὸς τῶν ἐξωθεῖν τι ἀποστηριζόμενον
μένειν. ὅ δὲ τὸ πλοῖον ὅθων ἐν τῷ πλοῖῳ αὐτὸς
ὡν καὶ ἀποστηριζόμενος πρὸς τὸ πλοῖον εὐλόγως
οὐ κινεῖ τὸ πλοῖον διὰ τὸ ἀναγκαίον εἶναι πρὸς ὁ
ἀποστηριζέται μένειν· συμβαίνει δ' αὐτῷ τὸ αὐτὸ
10 ὁ τε κινεῖ καὶ πρὸς ὁ ἀποστηριζέται. ἐξωθεῖν δ' ὁ
ωθῶν ἢ ἔλκων κινεῖ· οὕθεν γὰρ μέρος ἡ γῆ τοῦ
πλοίου.

III. Ἀπορηθεὶς δ' ἄν τις, ἄρ' εἰ τι κινεῖ τὸν
οἶλον οὐρανῶν, εἶναι τε δεὶ ἀκώντον τούτο καὶ
μηθεῖν εἴναι τοῦ οὐρανοῦ μόριον μηθέν ἐν τῷ
οὐρανῷ. εἴτε γὰρ αὐτὸ κινούμενον κινεῖ αὐτόν,
15 ἀνάγκη τινὸς ἀκώντος θυγανόν κινεῖν, καὶ τούτο
μηθεῖν εἴναι μόριον τοῦ κινοῦντος· εἴτε εὐθὺς ἀκώντον
ἐστὶ τὸ κινοῦν, ὀμοίως οὐθέν ἐσται τοῦ κινοῦ-
μένου μόριον. καὶ τούτο γ' ὀρθῶς λέγουσιν οἱ
λέγοντες ὅτι κύκλῳ φερομένης τῆς σφαίρας οὐθ' ὁπλῶν
μένει μόριον· ἥ γὰρ ἂν ὄλην ἀναγκαίον ᾧν
20 μένειν, ἥ διαστάσει τὸ συνεχὲς αὐτῆς. ἀλλ' ὅτι
tοῦς πόλους οἴονται τινα δύναμιν ἔχειν, οὕθεν

1 τούτο καὶ scripsi: καὶ τούτο libri.
2 ἐσται Jaeger (cum Leon.): ἐσεσθαι libri.

a Just as Odysseus’ companions while seated in the ship open the bags containing the winds, and the ship is blown out of its course (Homer, Od. x. 46 ff.).
paint him; for they make him emit the breath from his own lips. For whether one emits the breath gently or so strongly as to create the greatest gale (and the same is true if that which is thrown or pushed is something other than breath), it is necessary, first, that one should be supported upon one of one’s own members, which is at rest, when one pushes, and secondly, that either this member itself or that of which it forms part, should remain still, resting upon something which is external to it. Now the man who tries to push the boat while he himself is in it and leaning upon it, naturally does not move the boat, because it is essential that that against which he is leaning should remain still; but in this case that which he is trying to move and that against which he is leaning, is identical. If, on the other hand, he pushes or drags the boat from outside, he can move it; for the ground is no part of the boat.

III. The difficulty may be raised, whether, if something moves the whole heaven, this motive power must be unmoved and be no part of the heaven nor in the heaven. For if it is moved itself and moves the heaven, it can only move it by being itself in contact with something that is immovable, and this can be no part of that which causes the movement; or else, if that which causes the movement is from the first immovable, it will be equally no part of that which is moved. And on this point at any rate they are quite right who say that, when the sphere is moved in a circle, no part of it whatsoever remains still; for either the whole of it must remain still, or its continuity must be rent asunder. They are not right, however, in holding that the poles possess a kind of force,
699a

εἴχοντας μέγεθος ἀλλ' οὐνας ἐςχατα καὶ στυγμᾶς, οὐ καλῶς. πρὸς γὰρ τῷ μηδεμίαν οὐσίαν εἶναι τῶν τοιούτων μηδενός, καὶ κινεῖσθαι τὴν μίαν κ☒ςιν υπὸ δυνὸν ἀδύνατον τοὺς δὲ πόλους δύο

25 ποιοῦσιν. οτι μὲν οὖν ἔχει τι καὶ πρὸς τὴν ὠλὴν φύσιν οὖτως ὁσπερ ἢ γῆ πρὸς τὰ ζῷα καὶ τὰ κινούμενα δι’ αὐτῶν, ἐκ τῶν τοιούτων ἂν τὶς διαπορῆσιν. οἱ δὲ μυθικῶς τὸν "Ἀτλαντα

ποιοῦντες ἐπὶ τῆς γῆς ἐχοντα τοὺς πόδας δόξαιεν ἂν ἀπὸ διανοιας εἰρήκεναι τὸν μῆθον, ὡς τούτων ὁσπερ διάμετρον ὄντα καὶ στρέφοντα τὸν οὐρανὸν

80 περὶ τοὺς πόλους· τούτο δ’ ἂν συμβαίνοι κατὰ λόγον διὰ τὸ τῆς γῆς μένειν. ἀλλὰ τοῖς ταῦτα λέγουσιν ἀναγκαῖον φάναι μηδὲν εἶναι μόριον αὐτὴν τοῦ παντός. πρὸς δὲ τούτους δεῖ τὴν ἱσχύν

ἰσάζειν τοῦ κινούμενος καὶ τὴν τοῦ μένοντος. ἔστι

γὰρ τι πλῆθος ἱσχύος καὶ δυνάμεως καθ’ ἢν μένει

τὸ μένον, ὡσπερ καὶ καθ’ ἢν κινεῖ τὸ κινοῦν· καὶ

ἔστι τις ἀναλογία ἐξ ἀνάγκης, ὡσπερ τῶν ἑναντίων κινήσεων, οὖτω καὶ τῶν ἱρεμῶν. καὶ αἱ μὲν

699b ἵσαι ἀπαθεῖς ὑπ’ ἄλληλων, κρατοῦνται δὲ κατὰ τὴν ὑπεροχὴν. διόσπερ ἐὰν Ἀτλας ἐὰν τοιούτον ἔστω ἔτερον τὸ κινοῦν τῶν ἑντός, οὐδὲν μᾶλλον ἀντερείδειν δεῖ τῆς μονῆς ἢν ἢ γῆ τυγχάνει μένουσα·

ἡ κινήθησαι ἢ γῆ ἀπὸ τοῦ μέσου καὶ ἐκ τοῦ

αὐτῆς τόπου. ὡς γὰρ τὸ ὕδωρ ὀθεῖ, οὖτω τὸ ὕδωρ ἤμενον ὀθεῖται, καὶ ὅμοιος κατ’ ἱσχύν. κινεῖ

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<i>a i.e. their limbs. We should, however, perhaps read δ’ αὐτῶν "the things which move of themselves": Leon. renders "ea quae per se moventur."</i> 448
MOVEMENT OF ANIMALS, III.

since they have no magnitude and are only extremitities and points. For besides the fact that nothing of this kind has any substance, it is also impossible for a single movement to be started by a dual agency; and they represent the poles as two. From these considerations one may hazard the suggestion that there is something which stands in the same relation to Nature as a whole as the earth stands to the animals and the things which are moved through them.\(^a\)

Now those who in the fable represent Atlas as having his feet planted upon the earth would seem to have shown sense in the story which they tell, since they make him as it were a radius, twisting the heaven about the poles; it would be a logical account, since the earth remains still. But those who hold this view must declare that the earth is no part of the universe; and, further, the force of that which causes the motion and the force of that which remains still must be equal. For there must be a certain amount of force and strength in virtue of which that which remains still remains still, just as there is a force in virtue of which that which causes motion causes motion; and there is of necessity a similar proportion between absences of motion as there is between opposite motions, and equal forces are unaffected by one another, but are overmastered by a superiority. Therefore Atlas, or whatever else it is of like kind within that causes motion, must not exert any pressure which is too strong for the equilibrium of the earth; or else the earth will be moved away from the centre and her proper place. For as that which pushes pushes, so that which is pushed is pushed, and in exact proportion to the force exerted; but it creates

449


ARISTOTLE

699 b
dē tō ἡρεμοῦν πρῶτον, ὡστε μᾶλλον καὶ πλεῖων ἡ ἴσχὺς ἡ ὁμοία καὶ ἱσθ τῆς ἡρεμίας. ὡσαύτως δὲ καὶ τῆς 1 τοῦ κυνουμένου μὲν, μὴ κυνοῦντος δὲ. τοσαύτην οὖν δεήσει τῆν δύναμιν εἶναι τῆς γῆς ἐν τῷ ἡρεμεῖν ὅσην ὁ τε πᾶς οὖρανὸς ἔχει καὶ τὸ κυνοῦν αὐτόν. εἰ δὲ τοῦτο ἀδύνατον, ἀδύνατον καὶ τὸ κυνεῖσθαι τὸν οὖρανὸν ὑπὸ τῶν τοιούτων τῶν ἑντός.

IV. Ἐστὶ δὲ τις ἀπορία περὶ τὰς κινήσεις τῶν τοῦ οὐρανοῦ μορίων, ἣν ὡς οὖσαν οἰκείαν τοῖς εἰρημένοις ἐπισκέφθαι ἂν τις. ἐὰν γὰρ τις ὑπερβάλλῃ τῇ δυνάμει τῆς κινήσεως τῆν τῆς γῆς ἡρεμίαν, δῆλον ὅτι κινήσει αὐτήν ἀπὸ τοῦ μέσου καὶ ἡ ἴσχὺς δ’ ἄφ’ ἣς αὐτή ἡ δύναμις, ὅτι οὐκ ἀπειρὸν, φανερὸν οὖδε γὰρ ἡ γῆ ἄπειρος, ὡστε οὖδὲ τὸ βάρος αὐτῆς. ἐπεὶ δὲ τὸ ἀδύνατον λέγεται πλεοναχῶς (οὐ γὰρ ὡσαύτως τὴν τε φωνὴν ἀδύνατον φαμεν εἶναι ὀραθήναι καὶ τοὺς ἐπὶ τῆς σελήνης ὑφ’ ἡμῶν τὸ μὲν γὰρ ἐξ ἀνάγκης, τὸ δὲ πεφυκὸς ὀρᾶσθαι οὐκ ὀφθήσεται), τὸν δ’ οὖρανὸν ἀφθαρτον εἶναι καὶ ἀδιάλυτον οἰόμεθα μὲν ἐξ ἀνάγκης εἶναι, συμβαίνει δὲ κατὰ τοῦτον τὸν λόγον οὐκ ἐξ ἀνάγκης· πέφυκε γὰρ καὶ ἐνδόξεται εἶναι κίνησιν μείζων καὶ ἄφ’ ἣς ἡρεμεῖ ἡ γῆ καὶ ἄφ’ ἡς κυνοῦνται τὸ πῦρ καὶ τὸ ἄνω σώμα. εἰ μὲν οὖν εἰσὶν αἱ ὑπερέχουσαι κινήσεις, διαλυθήσεται ταῦτα ὑπ’ ἀλλήλων.

1 τῆς PS: ἡ Y: αἱ E.

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_1_ i.e. its central position in the universe.
_2_ i.e. the region between the air and the moon (Meteor. 340 b 6 ff.).
motion in that which is first at rest, so that the force exerted is greater than the immobility rather than similar and equal to it, and likewise greater than the force of that which is moved but does not create movement. Therefore the power of the earth in its immobility will necessarily be as great as that possessed by the whole heaven and that which sets it in motion. If, however, this is impossible, the movement of the heaven by any such force within it is also impossible.

IV. A problem also arises about the movements of the parts of the heaven, which might well be discussed, since it is closely connected with what has been said above. If one were to overmaster the immobility of the earth by the power of motion, one will obviously move it away from the centre. Moreover it is clear that the force from which this power is derived is not infinite; for the earth is not infinite, and so its weight is not infinite either. Now the word "impossible" is used in several senses (we are using it in different senses when we say that it is impossible to see a sound, and when we say that it is impossible for us to see the men in the moon; for the former is of necessity invisible, the latter are of such a nature as to be seen but will never be seen by us), but we hold that the heaven is of necessity impossible to destroy and dissolve, whereas according to our present argument it is not necessarily so; for it is within the nature of things and the bounds of possibility that a motive force should exist greater both than that which causes the earth to be at rest and than that which causes the fire and upper body to move. If, therefore, the overpowering motive forces exist, these will be dissolved by one another; but if they
The argument is as follows: these overpowering motive forces might exist and be dissolved by one another, because if they can be dissolved, they are not infinite, and the reason why they are not infinite is that they act upon what is finite, and the infinite cannot act on the finite (De cælo, 274 b 23 ff.).

It is discussed in the Physics and De cælo.
do not really exist, but there is a possibility of their existing (for an infinite motive force is impossible because an infinite body is also impossible), it would be possible for the heaven to be dissolved. For what is there to prevent this happening if it is not impossible? And it is not impossible, unless the opposite proposition is inevitable. But let us leave the discussion of this question for another occasion.

Must there, then, or must there not, be something immovable and at rest outside that which is moved and forming no part of it? And must this be true also of the universe? For it would perhaps seem strange if the origin of motion were inside. And so to those who hold this view Homer's words would seem appropriate:

Nay, ye could never pull down to the earth from the summit of heaven,
Zeus, the highest of all, no, not if ye toiled to the utmost.
Come, ye gods and ye goddesses all, set your hands to the hawsers.

For that which is entirely immovable cannot be moved by anything. And it is here that we must look for the solution of the problem stated some time ago, namely, whether it is possible or impossible for the composition of the heaven to be dissolved, seeing that it depends upon an origin which is immovable.

Now in the animals there must exist not only that which is immovable in this sense, but there must also be something immovable in the actual things which move from place to place and which themselves

\[^{c}\textit{Iliad} \text{viii. 20-22. The lines are quoted in the wrong order and the textus receptus reads \textit{μὴ στορ} for \textit{πάντων}.}\]

\[^{d}\textit{i.e. something immovable and at rest which is outside that which is moved and forms no part of it (cf. 699 b 32).}\]
κατὰ τὸ πον ὤσα κινεῖ αὐτὰ αὐτά. δεῖ γὰρ αὐτοῦ τὸ μὲν ἡρεμεῖν τὸ δὲ κινεῖσθαι, πρὸς ὁ ἀπερείδο-
μενον τὸ κινούμενον κινήσεται, οἷον ἂν τι κινή
tῶν μορίων· ἀπερεῖδεται γὰρ θάτερον ὡς πρὸς
mένον θάτερον. περὶ δὲ τῶν ἄφυξων οἷον κινεῖται
ἀπορήσειν ἂν τις, πότερον ἁπάντ' ἔχει ἐν ἔαυτοῖς
καὶ τὸ ἡρεμοῦντων ἀπερείδεσθαι ἀνάγκη καὶ
tάστα, ἡ ἀδύνατον, οἷον πῦρ ἢ γῆν ἢ τῶν ἄφυξων
15 τι, ἀλλ' ὕψ' ὅν τάστα κινεῖται πρῶτων. πάντα
gὰρ ὅπ' ἄλλου κινεῖται τὰ ἄφυξα, ἄρχῃ δὲ πάντων
tῶν οὕτως κινομένων τὰ αὐτὰ αὐτὰ κινοῦντα.
tῶν δὲ τοιούτων περὶ μὲν τῶν ζώων εἰρήται: τὰ
gὰρ τοιαύτα πάντα ἀνάγκη καὶ ἐν αὐτοῖς ἔχειν
tὸ ἡρεμοῦν, καὶ ἔξω πρὸς ὁ ἀπερεῖσται. εἰ δὲ
20 τι ἐστὶν ἀνωτέρω καὶ πρῶτως κινοῦν, ἂδηλον,
καὶ ἄλλος λόγος περὶ τῆς τοιαῦτης ἀρχῆς. τὰ
dὲ ζώα οἷον κινεῖται, πάντα πρὸς τὰ ἔξω ἀπερ-
eιδόμενα κινεῖται, καὶ ἀναπνέοντα καὶ ἐκπνέοντα.
αὐτὲν γὰρ διαφέρει μέγα ρίψαι βάρος ἢ μικρόν,
ὅπερ ποιοῦσιν οἱ πτύοντες καὶ βήττοντες καὶ οἱ
25 εἰσπνέοντες καὶ ἐκπνέοντες.

V. Πότερον δ' ἐν τῷ αὐτῷ κινοῦντι κατὰ τὸ πον
μόνῳ δεῖ τι μένειν, ἡ καὶ ἐν τῷ ἀλλοιουμένῳ αὐτῷ
ὕψ' αὐτοῦ καὶ αὐξανομένῳ; περὶ δὲ γενέσεως
tῆς ἐξ ἀρχῆς καὶ φθορᾶς ἄλλος λόγος· εἰ γὰρ ἔστιν

1 ἀλλ' Jaeger: ἀλλὰ P: ἀλλ' ESY.
move themselves. For while one part of the animal must be in motion, another part must be at rest, supported upon which that will be moved which is moved, if, for example, it moves one of its parts; for one part rests on another part in virtue of the fact that the latter is at rest.

But regarding inanimate things which are moved, one might raise the question whether they all possess in themselves both that which is at rest and that which creates movement, and whether they too must be supported by something external which is at rest. Or is this impossible—for example, in the case of fire or earth or any inanimate thing—but motion is due to the primary causes by which these are moved? For all inanimate things are moved by something else, and the origin of all the things that are thus moved is the things that move themselves. Among things of this class we have already dealt with animals; for all such things must necessarily have within themselves that which is at rest and something outside them on which they are to support themselves. But whether there is something higher and primary which moves them is uncertain, and the question of such an origin of movement is a matter for separate discussion. But animals which move all do so supported upon things outside themselves, as also when they draw their breath in and out. For it makes no difference whether they propel a great or a small weight, as those do who spit and cough, and breathe in and out.

V. But is it only in that which moves itself in respect of place that something must remain at rest, or is this also true of that in which alteration is caused by its own agency and in that which grows? The question of original coming into being and
ARISTOTLE

700a ἦν περι φαμέν πρώτη κίνησις, γενέσεως καὶ φθορᾶς
30 αὐτῆς αὐτία ἂν εἶη, καὶ τῶν ἄλλων δὲ κινήσεων ἵσως
πασῶν. ὡσπέρ δὲ ἐν τῷ ὄλῳ, καὶ ἐν τῷ ζῷῳ
cίνησις πρώτη αὐτῆς, ὅταν τελεωθῆ. ὡστε καὶ
αὐξήσεως, εἰ ποτὲ γίνεται, αὐτὸ αὐτῷ αὐτίοι καὶ
ἄλλοιςεως, εἰ δὲ μὴ, οὐκ ἀνάγκη. αἱ δὲ πρῶται
αὐξήσεις καὶ ἄλλοιςεις ὑπ’ ἄλλου γίνονται καὶ
dι’ ἐτέρων: γενέσεως δὲ καὶ φθορᾶς οὔδαμως οἷον
700b τε αὐτὸ αὐτίοι εἶναι αὐτῷ οὐδέν. προὐπάρχειν
γὰρ δὲ τὸ κινοῦν τοῦ κινούμενον καὶ τὸ γεννῶν
tου γεννωμένου: αὐτὸ δὲ αὐτοὶ πρότερον οὐδέν
ἐστιν.

VI. Περὶ μὲν οὖν ψυχῆς, εἰτε κινεῖται ἢ μὴ,
5 καὶ εἰ κινεῖται, πῶς κινεῖται, πρότερον εἴρηται ἐν
τοῖς διωρισμένοις περὶ αὐτῆς. ἔπει δὲ τὰ ζωνχα
πάντα κινεῖται ὑφ’ ἐτέρου, περὶ δὲ τοῦ πρώτου
κινούμενου καὶ αἱ κινούμενοι, τίνα τρόπον κινεῖται,
kαὶ πῶς κινεῖ τὸ πρώτον κινοῦν, διὰτοίς πρότερον
ἐν τοῖς περὶ τῆς πρώτης φιλοσοφίας, λοιπὸν δὲ
10 ἐστὶ θεωρῆσαι πῶς ἡ ψυχή κινεῖ τὸ σώμα, καὶ
τίς ἀρχὴ τῆς τοῦ ζωνχου κινήσεως. τῶν γὰρ ἄλλων
παρὰ τὴν τοῦ ὄλου κίνησιν τὰ ἑμενοχα αὐτία τῆς
κινήσεως, ὅσα μὴ κινεῖται ὑπ’ ἄλληλων διὰ τὸ
προσκόπτειν ἄλληλοις. διὸ καὶ πέρας ἔχουσιν
αὐτῶν πάσαι αἱ κινήσεις· καὶ γὰρ καὶ αἱ τῶν
15 ἑμενοχων. πάντα γὰρ τὰ ζώα καὶ κινεῖ καὶ
κινεῖται ἕνεκά τινος, ὥστε τούτ᾽ ἐστιν αὐτοῖς
πάσης τῆς κινήσεως πέρας, τὸ οὖ ἔνεκα. ὃρωμεν

1 δὲ ES: μὲν Y.

a τουτέστιν . . . οὐκ ἀνάγκη εἶναι τι τῶν ἄλλοιςεινων καὶ
αὐξανομένων ὑφ’ αὐτῶν ἥρεμοιν (Mich.).
b i.e. the Metaphysics.
corruption is a different one; for if there is, as we assert, a primary movement, this would be the cause of coming into being and wasting away, and perhaps of all the other movements as well. And as in the universe, so in the animal, this is primary motion, when the animal comes to perfection; so that it is itself the cause of its own growth, if this ever takes place, and of any alteration which occurs; otherwise it is not necessary that something should remain at rest. But the first growth and alteration occur through another's agency and by other means, and nothing can in any way be itself the cause of its own coming into being and wasting away; for that which moves must be prior to that which is moved, and that which begets to that which is begotten, and nothing is prior to itself.

VI. Now whether soul is moved or not, and if it is moved, how it is moved, has already been discussed in our treatise On Soul. But since all inanimate things are moved by something else—and how that which is primarily and eternally moved is moved, and how the prime mover moves it, has been already set forth in our work on First Philosophy—it remains to inquire how the soul moves the body and what is the origin of movement in an animal. For, if we exclude the movement of the universe, animate things are the cause of movement in everything else, except in things which are moved by one another through coming into collision with one another. Therefore all their movements have a limit; for the movements of animate things have a limit. For all animals move and are moved with some object, and so this, namely their object, is the limit of all their movement. Now we see that the
ARISTOTLE

700 b
dε τὰ κινοῦντα τὸ ζῴου διάνοιαν καὶ φαντασίαν καὶ προαίρεσιν καὶ βούλησιν καὶ ἐπιθυμίαν. ταῦτα
dε πάντα ἀνάγεται εἰς νοῦν καὶ ὀρέξιν. καὶ γὰρ
20 ἡ φαντασία καὶ ἡ αἰσθησις τὴν αὐτὴν τῷ νῷ χώραν
ἐχουσίν· κριτικὰ γὰρ πάντα, διαφέρουσι δὲ κατὰ
tὰς εἰρημένας ἐν ἄλλους διαφορᾶς. βούλησις δὲ
cαὶ θυμὸς καὶ ἐπιθυμία πάντα ὀρέξις, ἡ δὲ προ-
αίρεσις κοινὸν διανοίας καὶ ὀρέξεως· ὡστε κινεῖ
πρῶτον τὸ ὀρεκτὸν καὶ τὸ διανοητὸν. οὐ πάν
25 δὲ τὸ διανοητὸν, ἀλλὰ τὸ τῶν πρακτῶν τέλος.
dιὸ τὸ τοιούτον ἐστὶ τῶν ἁγαθῶν τὸ κινοῦν, ἄλλ᾿
oὐ πάν τὸ καλὸν· ἢ γὰρ ἐνεκα τοῦτον ἄλλο, καὶ
ἡ τέλος ἐστὶ τῶν ἄλλου τῶν ἁνεκα ὄντων, ταύτῃ
κινεῖ. δει δὲ τιθέασι καὶ τὸ φανομενον ἁγαθον
ἀγαθον χώραν ἐχειν, καὶ τὸ ἢδυ· φανομενον γὰρ
30 ἐστὶν ἁγαθον. ὡστε δῆλον ὅτι ἐστὶ μὲν ἢ ὁμοίως
κινεῖαι τὸ ἂει κινούμενον ύπὸ τοῦ ἂει κινοῦντος
καὶ τῶν ζῴων ἐκαστῶν, ἐστὶ δ᾿ ἢ ἄλλως, διὸ καὶ
tὰ μὲν ἂει κινεῖαι, ἢ δὲ τῶν ζῴων κίνησις ἐχει
πέρας. τὸ δὲ ἀίδιον καλὸν, καὶ τὸ ἀληθεῖς καὶ
πρῶτως ἁγαθὸν καὶ μὴ ποτὲ μὲν ποτὲ δὲ μὴ,
35 θειότερον καὶ τιμιώτερον ἡ ὡστ᾽ εἰναι πρότερον. τὶ.
Τὸ μὲν οὖν πρῶτον οὐ κινούμενον κινεῖ, ἢ δ᾿
701 a ὀρέξις καὶ τὸ ὀρεκτικὸν κινούμενον κινεῖ. τὸ δὲ
tελευταῖον τῶν κινούμενων οὐκ ἀνάγκη κινεῖν
οὐδὲν. φανερὸν δʼ ἐκ τούτων καὶ ὀτι εὑλόγως

1 πρότερον ESY : πρὸς ἐτερον P.
2 τι add. Jaeger.

a De anima, iii. 427 b 14 ff.

458
things which move the animal are intellect, imagination, purpose, wish and appetite. Now all these can
be referred to mind and desire. For imagination
and sensation cover the same ground as the mind
(since they all exercise judgement) though they
differ in certain aspects as has been defined else-
where. But will, temper, and appetite are all
forms of desire, while purpose partakes both of
intellect and of desire. So the objects of desire and
intellect first set up movement—not, however, every
object of intellect, but only the end in the sphere of
action. So amongst good things it is the good in the
sphere of action that sets up movement, and not any
and every good; for it sets up movement only in so
far as it is the motive of something else or the end
of something which has something else as its object.
And we must lay down the principle that the apparent
good can take the place of a real good, and so can the
pleasant, for it is an apparent good. So that it is
clear that in one respect that which is eternally
moved by the eternal mover, and the individual
animal, are moved in a similar manner, but that in
another respect they are moved differently; and so,
while other things move eternally, animal movement
has a limit. Now the eternally beautiful and that
which is truly and primarily good, and not at one
moment good and at another not good, is too divine
and precious to have anything prior to it.

The prime mover, then, moves without itself being
moved, but desire and the desiderative faculty set
up movement while being themselves moved. But
it is not necessary that the last of a series of things
which are moved should move anything; and from
this it is clear that it is only reasonable that pro-
ARISTOTLE

701a

η φορὰ τελευταία τῶν γνωμένων ἐν τοῖς κινομένοις· κινεῖται γὰρ καὶ πορεύεται τὸ ζῴον ὁρέξει

5 ἡ προαιρέσει, ἀλλωσβέντος τινὸς κατὰ τὴν αἰσθησιν ἡ τὴν φαντασίαν.

VII. Πῶς δὲ νοῶν ὅτε μὲν πράττει ὅτε δ᾽ οὐ πράττει, καὶ κινεῖται, ὅτε δ᾽ οὐ κινεῖται; ἔσκιε παραπλησίως συμβαίνει καὶ περὶ τῶν ἀκινήτων διανοομένων καὶ συλλογιζομένων. ἄλλ᾽ ἐκεῖ μὲν θεώρημα τὸ τέλος (ὅταν γὰρ τὰς δύο προτάσεις νοήσῃ, τὸ συμπέρασμα ἔνοικε καὶ συνέθηκεν), ἔνταῦθα δ᾽ ἐκ τῶν δύο προτάσεων τὸ συμπέρασμα γίνεται ἡ πράξεις, οἰον ὅταν νοῇ ὅτι παντὶ βαδιστέον ἀνθρώπῳ, αὐτὸς δ᾽ ἀνθρώπος, βαδίζει εὐθέως, ἀν δ᾽ ὅτι οὐδὲν βαδιστέον νῦν ἀνθρώπῳ,

10 αὐτὸς δ᾽ ἀνθρώπος, εὐθὺς ἠρέμει· καὶ ταῦτα ἀμφὸς πράττει, ἀν μὴ τι κωλύῃ ἡ ἀναγκαξία. ποιητέον μοι ἀγαθὸν, οἰκία δ᾽ ἀγαθὸν. ποιεῖ οἰκίαν εὐθὺς. σκεπάσματος δέομαι, ἰμάτιον δὲ σκέπασμα. ἰματίου δέομαι. οὐ δέομαι, ποιητέον ἰματίου δέομαι.

15 ἰματίων ποιητέον. καὶ τὸ συμπέρασμα, τὸ ἰμάτιον ποιητέον, πράξει ἔστων. πράττει δ᾽ ἀπ᾽ ἀρχῆς. εἰ ἰματίων ἔσται, ἀνάγκη τὸδε πρῶτον, εἰ δὲ τόδε, τόδε καὶ τοῦτο πράττει εὐθὺς. ὅτι μὲν οὖν ἡ πράξεις τὸ συμπέρασμα, φανερῶν· αἱ δὲ προτάσεις αἱ ποιητικαὶ διὰ δύο εἰδῶν γίνονται, διὰ τε τοῦ ἀγαθοῦ καὶ διὰ τοῦ δυνατοῦ.

"Ωσπερ δὲ τῶν ἐρωτῶντων ἐνιού, οὐτω τὴν ἐτέραν

1 κινομένοις Jaeger: γιγνομένοις libri.

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* a i.e. the objects of science; cf. An. Post. 71 b 18 ff.

460
progression should be the last thing to happen in things that are moved, since the animal is moved and walks from desire or purpose, when some alteration has been caused as the result of sensation or imagination.

VII. But why is it that thought sometimes results in action and sometimes does not, sometimes in movement and sometimes not? Apparently the same kind of thing happens as when one thinks and forms an inference about immovable objects. But in the latter case, the end is speculation (for when you have conceived the two premisses, you immediately conceive and infer the conclusion); but in the former case the conclusion drawn from the two premisses becomes the action. For example, when you conceive that every man ought to walk and you yourself are a man, you immediately walk; or if you conceive that on a particular occasion no man ought to walk, and you yourself are a man, you immediately remain at rest. In both instances action follows unless there is some hindrance or compulsion. Again, I ought to create a good, and a house is a good, I immediately create a house. Again, I need a covering, and a cloak is a covering; I need a cloak. What I need I ought to make; I need a cloak, I ought to make a cloak. And the conclusion "I ought to make a cloak" is an action. The action results from the beginning of the train of thought. If there is to be a cloak, such and such a thing is necessary, if this thing then something else; and one immediately acts accordingly. That the action is the conclusion is quite clear; but the premisses which lead to the doing of something are of two kinds, through the good and through the possible.

And as those sometimes do who are eliciting con-
πρότασιν τὴν δὴ λην υδὲ γνώσιμη ἐφίστασα σκοπεῖ
οὐδὲν οἷον εἰ τὸ βαδίζειν ἁγαθὸν ἀνθρώπων, ὅτι
ἀυτὸς ἀνθρώπος, οὐκ ἐνδιάτησε. διὸ καὶ ὁ σαμι
λογισάμενον πράττομεν, ταχύως πράττομεν. ὅταν γὰρ
ἐνεργῆσῃ ἡ τῇ αἰσθήσει πρὸς τὸ οὐ ἐνεκα ἡ τῇ
30 φαντασία ἡ τῷ νόῳ, οὐ δὲ όρεται, εὐθὺς ποιεῖ. ἀντ' ἐρωτήσεως γὰρ ἡ νοῆσεως ἡ τῆς ὀρέξεως γίνεται ἐν-
ἐργεία. ποτέον μοι, ἡ ἐπιθυμία λέγει· τοδὲ δὲ ποτὸν,
ἡ αἰσθήσεις εἰπεν ἡ ἡ φαντασία ἡ ὁ νος· εὐθὺς πίνει.
οὔτως μὲν οὖν ἔπλα τὸ κινεῖσθαι καὶ πράττειν τὰ
35 ζώα ὀρμῶσι, τῆς μὲν ἐσχάτης αἰτίας τοῦ κινεῖσθαι
ὁρέξεως οὐσίας, ταύτης δὲ γνωμήνης ἡ δι' ἡ αἰσθήσεως
ἡ διὰ φαντασίας καὶ νοῆσεως. τῶν δὲ ὀργομένων
πράττειν τὰ μὲν δὲ ἐπιθυμίαν ἡ θυμὸν τὰ δὲ δὴ
301 a ὁρέξιν ἡ βούλησιν τὰ μὲν ποιοῦσι, τὰ δὲ πράττουσι.
"Ὄσπερ δὲ τὰ αὐτόματα κινεῖται μικρᾶς κινήσεως
γνωμῆνης, λυμένων τῶν στρεβλῶν καὶ κρονουσῶν
ἀλλήλας [τὰς στρέβλας], καὶ τὸ ἀμάξιον, ὅπερ
5 <τὸ> ὀχούμενον αὐτὸ κινεῖ εἰς εὐθὺ, καὶ πάλιν
cύκλω κινεῖται τῶν ἀνύσων ἐχεῖν τοὺς τροχοὺς
(ὅ γὰρ ἐλάττων ὀσπέρ κέντρον γίνεται, καθάπερ
ἐν τοῖς κυλινδροῖς), οὔτω καὶ τὰ ζώα κινεῖται.
ἐχεῖ γὰρ ὀργανά τοιαύτα τὴν τε τῶν νεύρων
φύσιν καὶ τὴν τῶν ὀστῶν, τὰ μὲν ὣς ἐκεῖ τὰ

1 κρονουσῶν scripsi (Leon. renders laxatis seque mutuo im-
pellentibus vertebris): κρονοῦτων libri.
2 τὰς στρέβλας seclusi. 3 τὸ addidi.

For this technical use of ἐρωταν cf. An. Prior. 24 a 24.
By the removal of the pegs (ξύλα), cf. below, 701 b 9, 10.
The context seems to show that the toy-carriage was
on an axle which coupled two wheels of unequal diameter.
There is, however, no evidence for the existence of such
toy-carriages in antiquity.
462
MOVEMENT OF ANIMALS, vii.

clusions by questioning, so here the mind does not stop and consider at all one of the two premisses, namely, the obvious one; for example, if walking is good for a man, one does not waste time over the premiss "I am myself a man." Hence such things as we do without calculation, we do quickly. For when a man acts for the object which he has in view from either perception or imagination or thought, he immediately does what he desires; the carrying out of his desire takes the place of inquiry or thought. My appetite says, I must drink; this is drink, says sensation or imagination or thought, and one immediately drinks. It is in this manner that animals are impelled to move and act, the final cause of their movement being desire; and this comes into being through either sensation or imagination and thought. And things which desire to act, at one time create something, and at another act, by reason either of appetite or of passion, or else through desire or wish.

The movement of animals resembles that of marionettes which move as the result of a small movement, when the strings are released and strike one another; or a toy-carriage which the child that is riding upon it himself sets in motion in a straight direction, and which afterwards moves in a circle because its wheels are unequal, for the smaller wheel acts as a centre, as happens also in the cylinders. Animals have similar parts in their organs, namely, the growth of their sinews and bones, the latter corresponding to the pegs in the marionettes and the

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The marionettes seem to have been worked by means of cylinders round which weighted strings were wound, the cylinders being set in motion by the removal of pegs.
ARISTOTLE

701 b

εύλα καὶ ὁ σίδηρος, τὰ δὲ νεῦρα ὡς αἱ στρέβλαι.
10 ὃν λυομένων καὶ ἀνιεμένων κινοῦνται. ἐν μὲν
οὖν τοῖς αὐτομάτοις καὶ τοῖς ἁμαξίοις οὐκ ἔστιν
ἀλλοώσις, ἐπεὶ εἰ ἐγίνοντο ἐλάττουσι οἱ ἐντὸς
tροχοὶ καὶ πάλιν μείζους, κἂν κύκλῳ τὸ αὐτὸ
ἐκινεῖτο. ἐν δὲ τῷ ζώῳ δύναται τὸ αὐτὸ καὶ
μείζον καὶ ἐλαττὸν γίνεσθαι καὶ τὰ σχῆματα μετα-
βάλλειν, αὐξανομένων τῶν μορίων διὰ θερμότητα
καὶ πάλιν συστελλομένων διὰ ψύξιν καὶ ἀλλοιω-
μένων. ἀλλοιώσι δ' αἱ φαντασίαι καὶ αἱ αἰσθήσεις
καὶ αἱ ἐννοιαι. αἱ μὲν γὰρ αἰσθήσεις εὐθὺς ὑπὲ-
アルバム ἀλλοώσεις τινὲς οὐσιν, ἣ δὲ φαντασία καὶ
ἡ νόησις τὴν τῶν πραγμάτων ἔχουσι δύναμιν. τρό-
πον γὰρ τινὰ τὸ εἴδος τὸ νοούμενον τὸ τοῦ θερμοῦ
ἡ ψυχρὸν ἡ ἡδέος ἡ φοβερὸν τοιοῦτον τυγχάνει
ὅν οἰκὸν περ καὶ τῶν πραγμάτων ἐκαστον, διὸ καὶ
φρύττουσι καὶ φοβοῦνται νοῆσαι μόνον. ταῦτα
δὲ πάντα πάθη καὶ ἀλλοώσεις εἰσίν. ἀλλοιω-
μένων δ' ἐν τῷ σώματι τὰ μὲν μείζω τὰ δ' ἐλαττῶ
γίνεται. ὅτι δὲ μικρὰ μεταβολὴ γινομένη ἐν ἀρχῇ
μεγάλας καὶ πολλὰς ποιεῖ διαφορὰς ἀποθεῖν, οὐκ
ἀδηλον. οἷον τοῦ ὀίκου ἀκαριαῖον τι μεθυσταμένου
πολλὴ ἡ τῆς πρώτας γίνεται μετάστασις. ἐτὶ δὲ
κατὰ θερμότητα ἡ ψύξιν ἡ κατ' ἀλλο τοιοῦτον
πάθος ὅταν γένηται ἀλλοώσεις περὶ τὴν καρδίαν,
καὶ ἐν ταύτῃ κατὰ μέγεθος ἐν ἀνασθήτω μορίω,
pολλὴν ποιεῖ τοῦ σώματος διαφορὰν ἐρυθήμασι
καὶ ωχρότησι καὶ φρίκαις καὶ τρόμοις καὶ τοῖς
tούτων ἐναντίοις.

VIII. Ἀρχὴ μὲν οὖν, ωσπερ ἐϊρηται, τῆς

a The reference is probably to some part of the toy-
carriage.

464
MOVEMENT OF ANIMALS, vii.–viii.

iron,\(^a\) while the sinews correspond to the strings, the setting free and loosening of which causes the movement. In the marionettes and the toy-carriages no alteration takes place, though, if the inner wheels were to become smaller and then again larger, the same circular movement would take place. In the animal, however, the same part can become both greater and smaller and change its form, the members increasing through heat and contracting again through cold and thus altering. Alteration is caused by imagination and sensations and thoughts. For sensations are from the first a kind of alteration, and imagination and thought have the effect of the objects which they present; for in a way the idea conceived—of hot or cold or pleasant or terrible—is really of the same kind as an object possessing one of these qualities, and so we shudder and feel fear simply by conceiving an idea; and all these affections are alterations, and when an alteration takes place in the body some parts become larger, others smaller. Now it is clear that a small change taking place in an origin of movement\(^b\) causes great and numerous changes at a distance; just as, if the rudder of a boat is moved to an infinitesimal extent, the change resulting in the position of the bows is considerable. Furthermore, when, owing to heat or cold or a similar affection, an alteration is caused in the region of the heart—and even in an imperceptibly small part of it—it gives rise to a considerable change in the body, causing blushing or pallor or shuddering or trembling or the opposites of these.

VIII. The origin, then, of movement, as has already

\(^a\) i.e. here, the heart, cf. below, 701 b 30; see also note on 698 b 1.

465
κινήσεως τὸ ἐν τῷ πρακτῷ διωκτῶν καὶ φευκτῶν·
ἐξ ἀνάγκης δ’ ἀκολουθεῖ τῇ νοῦτεί καὶ τῇ φαντασίᾳ
αὐτῶν θερμότης καὶ ψύξις. τὸ μὲν γὰρ λυπηρὸν
φευκτὸν, τὸ δ’ ἤδιν διωκτὸν (ἀλλὰ λανθάνει περὶ
τὰ μικρὰ τοῦτο συμβαίνον), ἔστι δὲ τὰ λυπηρὰ
καὶ ἢδεα πάντα σχέδον μετὰ ψύξεώς τινος καὶ
θερμότητος. τούτο δὲ δῆλον ἐκ τῶν παθημάτων.
θάρρη γὰρ καὶ φόβοι καὶ ἀφροδισιασμοί καὶ τάλλα
τὰ σωματικὰ λυπηρὰ καὶ ἢδεα τὰ μὲν κατὰ μόριον
μετὰ θερμότητος ἡ ψύξεώς ἐστι, τὰ δὲ καθ’ ὅλον
τὸ σώμα· μνημαί δὲ καὶ ἐλπίδες, οἶνον εἰδώλως
χρώμεναι τοῖς τοιούτοις, ὅτε μὲν ἤττον ὅτε δὲ
μᾶλλον αἰτία τῶν αὐτῶν εἰσίν. ὡσ’ εὐλόγως
ἡγή δημιουργεῖται τὰ ἐντός καὶ τὰ περὶ τὰς ἀρχὰς
τῶν ὀργανικῶν μορίων μεταβάλλοντα ἐκ πεπηγῶτων
ὐγρὰ καὶ εἷς ὑγρῶν πεπηγῶτα καὶ μαλακὰ καὶ
σκληρὰ ἐξ ἀλλήλων. τούτων δὲ συμβαίνοντων
τὸν τρόπον τούτον, καὶ ἐτι τοῦ παθητικοῦ καὶ
ποιητικοῦ τοιαύτῃ ἐχόντων τῆν φύσιν οἷαν πολ-
λαχοὶ εἰρήκαμεν, ὁπόταν συμβῇ ὡσ’ εἰναὶ τὸ
μὲν ποιητικὸν τὸ δὲ παθητικὸν, καὶ μὴ δὲν ἀπολίπῃ
αὐτῶν ἐκάτερον τῶν ἐν τῷ λόγῳ, εὐθὺς τὸ μὲν
ποιεῖ τὸ δὲ πάσχει. διὰ τούτο δ’ ἁμα οἷς ἐπείρον
νοεὶ ὅτι πορευόταν καὶ πορεύεται, ἀν μὴ τι ἐμ-
ποδῖζῃ ἐτερον. τὰ μὲν γὰρ ὀργανικὰ μέρη παρα-
σκευάζει ἐπιτηδείως τὰ πάθη, ἡ δ’ ὀρεξὶς τὰ
πάθη, τῆν δ’ ὀρεξὶν ἡ φαντασία· αὐτὴ δὲ γίνεται
ἡ διὰ νοῦτεῖς ἡ δ’ αἰσθήσεως. ἁμα δὲ καὶ ταχὺ
diā τὸ <τὸ>1 ποιητικὸν καὶ παθητικὸν τῶν πρὸς
ἀλληλα εἰναὶ τῆν φύσιν.

1 τὸ add. Bonitz.
been said, is the object of pursuit or avoidance in the sphere of action, and heat and cold necessarily follow the thought and imagination of these objects. For what is painful is avoided, and what is pleasant is pursued. We do not, it is true, notice the effect of this in the minute parts of the body; but practically anything painful or pleasant is accompanied by some degree of chilling or heating. This is clear from the effects produced. Reckless daring, terrors, sexual emotions and the other bodily affections, both painful and pleasant, are accompanied by heating or chilling, either local or throughout the body. Recollections too and anticipations, employing, as it were, the images of such feelings, are to a greater or less degree the cause of the same effects. So it is with good reason that the inner portions of the body and those which are situated near the origins of the motion of the organic parts are created as they are, changing as they do from solid to liquid and from liquid to solid and from soft to hard and vice versa. Since, then, these processes occur in this way, and since, moreover, the passive and the active principles have the nature which we have frequently ascribed to them, whenever it so happens that the one is active and the other passive and neither fails to fulfil its definition, immediately the one acts and the other is acted upon. So a man thinks he ought to go, and goes, practically at the same time, unless something else hinders him. For the affections fittingly prepare the organic parts, the desire prepares the affections, and the imagination prepares the desire, while the imagination is due to thought or sensation. The process is simultaneous and quick, because the active and the passive are by nature closely interrelated.
ARISTOTLE

702a  Τὸ δὲ κυοῦν πρῶτον τὸ ζῷον ἀνάγκη εἶναι ἐν τινὶ ἀρχῇ. ἡ δὲ καμπή ὅτι μὲν ἐστὶ τοῦ μὲν ἀρχῆ τοῦ δὲ τελευτῆ, εἴρηται. διό καὶ ἐστὶ μὲν ὃς ἐνὶ, ἐστὶ δὲ ὃς δυσὶ χρῆται ἡ φύσις αὐτῇ. ὅταν γὰρ κυνήται ένυπεθεν, ἀνάγκη τὸ μὲν ἡρέμειν τῶν σημείων τῶν ἐσχάτων, τὸ δὲ κυνείσθαι ὅτι γὰρ πρὸς ἡρεμοῦν δεῖ ἀπερείδεσθαι τὸ κυοῦν, εἴρηται πρότερον. κυνείται μὲν σὺν καὶ οὐ κυνεῖ τὸ ἐσχάτων τοῦ βραχίωνος, τῆς δὲ ἐν τῷ ὑλεκράνῳ κάμμεως τὸ μὲν κυνεῖται τὸ ἐν αὐτῷ τῷ ὑλῳ κυνομένῳ, ἀνάγκη δ' εἶναι τι καὶ ἁκώντων, δ' δὴ φαμεν δυνάμει μὲν ἐν εἶναι σημείων, ἐνεργείᾳ δὲ γίνεσθαι δύον. ὥστ' εἰ τὸ ζῷον ἢν βραχίων, ἐν- ταῦθ' ἀν ποὺ ἢν ἡ ἀρχὴ τῆς ψυχῆς ἡ κυνοῦσα. ἔπει δ' ἐνδέχεται καὶ πρὸς τὴν χειρὰ ἐχειν τι οὕτως τῶν ἀψύχων, οἷον εἰ κυνοὶ τὴν βακτηρίαν ἐν τῇ χειρὶ, φανερῶν ὅτι οὐκ ἂν εἴη ἐν οὐδετέρῳ ή ἡ ψυχή τῶν ἐσχάτων, οὔτ' ἐν τῷ ἐσχάτῳ τοῦ κυνομένου οὔτ' ἐν τῇ ἕτερᾳ ἀρχῇ. καὶ γὰρ τὸ 702b ἐξὸλον ἑχει καὶ ἀρχὴ καὶ τέλος πρὸς τὴν χειρὰ. ἀστε διὰ γε τούτο, εἰ μὴ ἐν τῇ βακτηρίᾳ ἡ κυνουσα ἀπὸ τῆς ψυχῆς ἀρχὴν ἑνεστὶν, οὖδ' ἐν τῇ χειρὶ ομοίως γὰρ ἑχει καὶ τὸ ἀκρον τῆς χειρὸς πρὸς τὸν καρπὸν, καὶ τούτῳ τὸ μέρος πρὸς τὸ ὑλεκράνον. οὔδὲν γὰρ διαφέρει τὰ προσπεφυκότα τῶν μη

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a i.e. the same relation as the forearm has to the elbow.
b i.e. the end of the stick where it meets the hand.
c i.e. the origin of the movement of the hand which is situated in the wrist.
d It is impossible to find a word in English which covers the double meaning given to ἀρχή here and in the previous line (see note on 698 b 1). The sentence καὶ γὰρ τὸ ἐξόλον . . . χειρὰ explains why the ἀρχή κωνήσεως of the hand is called ἡ ἕτερα ἀρχή, viz. that there is another ἀρχή (in the sense of “beginning”) in the stick, namely, the point nearest the hand.

468
MOVEMENT OF ANIMALS, viii.

Now that which first causes movement in the animal must be situated in a definite beginning. Now it has already been stated that the joint is the beginning of one thing and the end of another; wherefore nature employs it sometimes as one and sometimes as two. For when movement is being originated from it, one of its extreme points must be at rest, while the other must move; for we have already said that what causes movement must be supported on something which is at rest. The extremity, therefore, of the forearm is moved and does not cause movement, but in the elbow-joint one part, namely that which is situated in the actual whole which is in motion, is moved, but there must also be something which is unmoved; and this is what we mean when we say that a point is potentially one but becomes actually two. So if the forearm were a living creature, it is somewhere near this point that the origin of movement set in motion by the soul would be situated. Since, however, it is possible for an inanimate object to bear this same relation to the hand, a for instance if one moves a stick in one's hand, it is clear that the soul could not be situated in either of the extremities, neither in the extremity of that which is moved b nor in the other origin of movement (dρχγ) c; for the stick has an end and a beginning (dρχγ) d in relation to the hand. So, for this reason, if the origin of movement set up by the soul is not situated in the stick, it is not situated in the hand either; for the extremity of the hand e bears the same relation to the wrist as the latter does to the elbow. For there is no difference between what is attached by growth and what is not

* i.e. the point where the hand joins the stick.
This is simply a restatement of the doctrine of 702 b 1-4. The true ἀρχή is not situated in the extremity of the stick nearest to the hand (which is an ἀρχή as being the place where the stick begins in relation to the hand), nor yet in any other member, such as the wrist, which is still farther away from the stick and is an ἀρχή as being the origin of motion in the hand. The wrist, elbow, and shoulder are all of them...
so attached; for the stick becomes a kind of detached member. The origin of movement, therefore, cannot be situated in any origin which is the termination of something else, nor in any other part which is farther from it; for example, the origin of movement of the extremity of the stick is in the hand, but the origin of the movement of the hand is in the wrist. And so if the origin of movement is not in the hand, because it is still higher up, neither is it in this higher position; for, again, if the elbow is at rest, the continuous part below it can be set in motion as a whole.

IX. Now since there is similarity in the left and the right sides of the body, and the opposite parts can be moved simultaneously, so that it is impossible for the right side to move just because the left is at rest or vice versa, and the origin of movement must be in that which lies above both sides, it necessarily follows that the origin of movement in the moving soul must be between them; for the middle is the limit of both extremes. And it stands in the same relation to the movements above as to those below, to those, for example, which proceed from the head and to those which proceed from the spine in animals which have a spine. And there is good reason for this; for we say that the organ of sensation is also situated in the centre of the body; and so if the region round about the origin of movement is altered by sense-perception and undergoes change, the parts which are attached to it change with it by extension or contraction, so that in this way movement necessarily takes place in animals. And the central part of the ἄρχαί in relation to the parts below them, but the true ἄρχή is situated in the soul, which lies in the centre of the body.

b i.e. the wrist.
μέρος δυνάμει μὲν ἐν, ἐνεργεῖα δ’ ἀνάγκη γίνεσθαι πλείως: καὶ γὰρ ἀμα κινεῖται τὰ κώλια ἀπὸ τῆς ἀρχῆς, καὶ θατέρου ἥρμοδντος θάτερον κινεῖται. λέγω δ’ οἶδον ἐπὶ τῆς ΑΒΓ τὸ Β κινεῖται, κινεῖ δὲ τὸ Α. ἀλλὰ μὴν δεῖ γε τι ἡρμοεῖν, εἰ μέλλει τὸ μὲν κινεῖσθαι τὸ δὲ κινεῖν. ἐν ἄρα δυνάμει ὃν τὸ Α ἐνεργεία δύο ἔσται, ὡστ’ ἀνάγκη μὴ στιγμὴν ἀλλὰ μέγεθος τι εἶναι. ἀλλὰ μὴν ἐνδέχεται τὸ Γ ἀμα τῷ Β κινεῖσθαι, ὡστ’ ἀνάγκη ἀμφοτέρας τὰς ἀρχὰς τὰς ἐν τῷ Α κινουμένως κινεῖν. δεῖ τι ἄρα εἶναι παρὰ ταῦτα ἐτερον τὸ κινοῦν καὶ μὴ κινοῦ-μενον. ἀπερείδουτο μὲν γὰρ ἄν τὰ ἄκρα καὶ αἱ ἀρχαί αἱ ἐν τῷ Α πρὸς ἀλλήλας κινουμένων, ὡσπερ ἄν εἴ τινες τὰ νότα ἀπερείδουτες κινοῦν τὰ σκῆλη. ἀλλὰ τὸ κινοῦν ἀμφω ἀναγκαῖον εἶναι. τοῦτο δ’ ἐστὶν ἡ ψυχὴ, ἐτερον μὲν οὐσα τοῦ μεγέθους τοῦ τοιούτου, ἐν τούτῳ δ’ οὐσα.

Χ. Κατὰ μὲν οὖν τὸν λόγον τὸν λέγοντα τὴν αἰτίαν τῆς κινήσεως ἐστὶν ἡ ὁρεξία τὸ μέσον, ὁ κινεῖ κινοῦμενον· ἐν δὲ τοῖς ἐμψύχους σώμασι δεῖ τι εἶναι σῶμα τοιοῦτον. τὸ μὲν οὖν κινοῦμενον μὲν μὴ πεφυκός δὲ κινεῖν δύναται πάσχειν κατ’ ἀλλοτρίαν δύναμιν· τὸ δὲ κινοῦν ἀναγκαῖον ἔχειν τινὰ δύναμιν καὶ ἰσχύν. πάντα δὲ φαίνεται τὰ ἑώρα καὶ ἐχοντα πνεῦμα σύμφωνον καὶ ἰσχύοντα τούτω. (τὸς μὲν οὖν ἡ σωτηρία τοῦ συμφότου πνεύματος, εἴρηται ἐν ἄλλοις.) τοῦτο δὲ πρὸς τὴν ἀρχὴν τὴν ψυχικὴν ἐοικεῖν ὁμοίως ἔχειν ὡσπερ

*See Introd. p. 436.*
MOVEMENT OF ANIMALS, ix.–x.

body is potentially one, but actually must necessarily become more than one; for the limbs are set in motion simultaneously from the origin of movement, and when one is at rest the other is in motion. For example, in ABC, B is moved and A moves it; there must, however, be something at rest if one thing is to be moved and another is to move it. So A, though potentially one, will be actually two, so that it must be not a point but a magnitude. Again, C may be moved simultaneously with B, so that both the origins in A must cause movement by being moved; there must, therefore, be something other than these origins which causes movement without being itself moved. Otherwise, when movement took place, the extremities, or origins, in A would rest upon one another, like men standing back to back and moving their limbs. There must be something which moves them both, namely the soul, other than such a magnitude as we have described but situated in it.

X. In accordance with the definition which defines the cause of motion, desire is the central origin, which moves by being itself moved; but in animate bodies there must be some bodily substance which has these characteristics. That, then, which is moved but does not possess the natural quality of setting up movement may be affected by a power external to it, and that which causes movement must possess some power and strength. Now all animals clearly both possess an innate spirit and exercise their strength in virtue of it. (What it is that conserves the innate spirit has been explained elsewhere.) This spirit seems to bear the same relation to the origin in the
ARISTOTLE

703a
to eν ταις καμπαίς σημειων, το κινον και κινού-
μενου, προς το άκινητων. ἐπεὶ δ' ἡ ἀρχη τοις
μεν εν τῇ καρδίᾳ τοις δ' εν τῷ ἀνάλογον, διὰ τούτο
και τὸ πνεῦμα τὸ σύμφωνον ἐνταῦθα φαίνεται οὖν.

15 πότερον μεν οὖν ταύτων ἐστὶ τὸ πνεῦμα ἄει ἦ
γίνεται ἄει ἐτερον, ἐστω ἄλλος λόγος (δ' αὐτὸς
γάρ ἐστι καὶ περὶ τῶν ἄλλων μορίων)· φαίνεται δ'
evφυς ἐχον πρὸς τὸ κινητικὸν εἰναι καὶ παρέχειν
ἰσχὺν. τὰ δ' ἔργα τῆς κινῆσεως ὑδατι καὶ ἔλξις,

20 ὥστε δεὶ τὸ ὄργανον αὐξάνεσθαι τε δύνασθαι καὶ
συστέλλεσθαι. τοιαύτη δ' ἐστὶν ἡ τοῦ πνεύματος
φύσις· καὶ γάρ ἁβίαστος συστελλομένη, καὶ
βιαστική καὶ ὡστική διὰ τὴν αὐτὴν αἰτίαν, καὶ
ἐχει καὶ βάρος πρὸς τὰ πυρόδη καὶ κοινότητα
πρὸς τὰ ἐναντία. δεὶ δεὶ τὸ μέλλον κινεῖν μὴ

25 ἀλλοιωσει τοιοῦτων εἴναι· κρατεῖ γάρ κατὰ τὴν
ὑπεροχήν τὰ φυσικὰ σώματα ἄλληλων, τὸ μὲν
κοῦφον κάτω ὑπὸ τοῦ βαρύτερου ἀπονικώμενον,
tὸ δὲ βαρύν ἀνω ὑπὸ τοῦ κοινοτέρου.

'Ωμεν οὖν κινεῖ κινομένως μορίῳ ἡ ψυχή, εἴρηται,
cαι δι' ἦν αἰτίαν· ὑποληπτέον δὲ συνεστάναι τὸ

30 ξῴων ὡσπερ πόλυν εὐνομομένην. ἐν τὲ γάρ τῇ πόλει
ὅταν ἀπαξ συντῇ ή τάξις, ύστερ δεῖ κεχωρισμένον
μονάρχου, ὰν δεῖ παρεῖναι παρ' ἐκαστῶν τῶν
γινομένων, ἄλλ' αὐτὸς ἐκαστὸς ποιεῖ τὰ αὐτῶν
ὁς τετακται, καὶ γίνεται τὸδε μετὰ τὸδε διὰ

1 συντῇ P: στῇ ESY.

a For this meaning of ἀβλαστός cf. Plato, Tim. 61 a. The
action of the πνεῦμα is represented as resembling that of the
breath in the lungs; when the breath contracts it lacks force
and the lungs collapse, when it expands it thrusts outwards
and exercises force.

b Namely, expansion.

474
soul as the point in the joints, which moves and is moved, bears to that which is unmoved. Now since the origin is in some animals situated in the heart, in others in what corresponds to the heart, it is therefore clear that the innate spirit also is situated there. Whether the spirit is always the same or is always changing must be discussed elsewhere (for the same question arises about the other parts of the body); at any rate it is clearly well adapted by nature to be a motive power and to exercise strength. Now the functions of movement are thrusting and pulling, so that the organ of movement must be able to increase and contract. And the nature of spirit has these qualities; for when it contracts it is without force, and one and the same cause gives it force and enables it to thrust, and it possesses weight as compared with the fiery element, and lightness as compared with the contrary elements. Now that which is to create movement without causing alteration must be of this kind; for the natural bodies overcome one another according as one of them prevails, the light being conquered and borne down by the heavier and the heavy borne up by the lighter.

We have now stated what is the part by the movement of which the soul creates movement and for what reason. The constitution of an animal must be regarded as resembling that of a well-governed city-state. For when order is once established in a city there is no need of a special ruler with arbitrary powers to be present at every activity, but each individual performs his own task as he is ordered, and one act succeeds another because of custom. And in the

The contrary of fire is water, cf. De gen. et corrupt. 331 a 1. 

i.e. the elements.
ARISTOTLE

703a τὸ ἔθος· ἐν τε τοῖς ζῴωις τὸ αὐτὸ τοῦτο διὰ τὴν
35 φύσιν γίνεται καὶ τῷ πεφυκέναι ἐκαστὸν οὕτως
συστάντων ποιεῖν τὸ αὐτὸν ἔργον, ὡστε μηδὲν
dεῦν ἐν ἐκάστῳ εἶναι ψυχήν, ἀλλ’ ἐν τινὶ ἀρχῇ τοῦ
703b σώματος οὗσις τάλλα ζῆν μὲν τῷ προσπεφυκέναι,
pοιεῖν δὲ τὸ ἔργον τὸ αὐτῶν διὰ τὴν φύσιν.

XI. Πῶς μὲν οὖν κινεῖται τὰς ἐκοινωνίας κινήσεις
τὰ ζώα, καὶ διὰ τινὰς αἰτίας, εἴρηται· κινεῖται δὲ
5 τινας καὶ ἀκοινοῦσις ἐνιὰ τῶν μερῶν, τὰς δὲ
πλείστας οὕχ ἐκοινωνίας. λέγω δ’ ἀκοινούσις μὲν
οἶν Τὴν τῆς καρδίας τε καὶ τῆς τοῦ αἴδοιου (πολλάκις
γὰρ φανέντος τινός, οὐ μέντοι κελεύσαντος τοῦ
νοῦ κινοῦνται), οὐχ ἐκοινωνίας δ’ οἶον ὑπνοι καὶ
ἐγρήγορσιν καὶ ἀναπνοῆν, καὶ ὅσι πάλαι τοιαῦτα
10 εἰσιν. οὐθενὸς γὰρ τούτων κυρία ἄπλως ἐστὶν
οὐθ’ ἡ φαντασία οὐθ’ ἡ ὀρέξις, ἀλλ’ ἐπειδὴ ἀνάγκη
ἀλλοιουσθαί τὰ ζώα φυσικὴν ἀλλοίωσιν, ἀλλοιού-
μένων δὲ τῶν μορίων τὰ μὲν αὔξεσθαι τὰ δὲ φθίνειν,
ὡστ’ ἦδη κινεῖσθαι καὶ μεταβάλλειν τὰς περιντιας
ἐχεοθαί μεταβολὰς ἀλλήλων (αἰτία νῦν τῶν
15 κινήσεως θερμοτήτες τε καὶ ψυχεῖς, αἱ τε θύραθεν
καὶ αἱ ἐντὸς υπάρχονσα φυσικαί), καὶ αἱ παρὰ
τὸν λόγον δὴ γινόμεναι κινήσεις τῶν ῥηθέντων
μορίων ἀλλοιωσθεῖσας συμπεσοῦσι γίνονται. ἡ γὰρ
νόησις καὶ ἡ φαντασία, ὥσπερ εἰρηται πρῶτον, τὰ
ποιητικὰ τῶν παθημάτων προσφέρουσιν· τὰ γὰρ εἴδη
20 τῶν ποιητικῶν προσφέρουσι. μάλιστα δὲ τῶν
μορίων ταῦτα ποιεῖ ἐπίδηλως διὰ τὸ ὑσπερ ζῴου
κεχωρισμένον ἐκάτερον εἶναι τῶν μορίων [· τοῦτον

a See note on 698 b 1.
b Viz. the heart and the privy member.
c 701 b 18 ff.
animals the same process goes on because of nature, and because each part of them, since they are so constituted, is naturally suited to perform its own function; so that there is no need of soul in each part, but since it is situated in a central origin of authority over the body, the other parts live by their structural attachment to it and perform their own functions in the course of nature.

XI. We have now discussed the manner of the voluntary movements of animals, and the cause of them. Some of their parts, however, undergo certain involuntary movements, though most of these are really non-voluntary. By involuntary I mean such movements as those of the heart and of the privy member, which are often moved by the presentation of some image and not at the bidding of reason. By non-voluntary I mean sleeping and waking and respiration and the like. For neither imagination nor desire is strictly speaking responsible for any of these movements; but, since animals must necessarily undergo physical alteration, and, when their parts undergo alteration, some increase and others decrease, and so their bodies immediately move and undergo the natural sequence of changes (the causes of their movements being the natural heatings and chillings, both external and internal), the movements too of the above-mentioned parts which occur contrary to reason are due to the occurrence of a change. For thought and imagination, as has already been said, induce the states which cause the affections; for they present the images of the things which cause them. Now these parts act in this way much more conspicuously than any others, because each is as it were a separate vital organism, the reason being that
ARISTOTLE

703b

δ' αὐτίον ὅτι ἔχουσιν υγρότητα [ζωτικήν]. ἦ μὲν οὖν καρδία φανερὸν δι’ ἡν αἰτίαν· τὰς γὰρ ἀρχὰς ἔχει τῶν αἰσθήσεων· τὸ δὲ μόριον τὸ γεννητικὸν ὅτι 25 τουτότων ἐστι, σημεῖον· καὶ γὰρ ἐξέρχεται ἐξ αὐτοῦ ὁσπερ ζῷον τι ἡ τοῦ σπέρματος δύναμις. αἱ δὲ κινήσεις τῇ τε ἀρχῇ ἀπὸ τῶν μορίων καὶ τῶν μορίων ἀπὸ τῆς ἀρχῆς εὐλόγως συμβαίνουσι, καὶ πρὸς ἀλλήλας ὁπῶς ἀφικνοῦται. δει γὰρ νοῆσαι τὸ Α ἀρχὴν. αἱ οὖν κινήσεις καθ’ ἐκαστόν 30 στοιχεῖον τῶν ἐπιγεγραμμένων ἐπὶ τὴν ἀρχὴν ἀφικνοῦται, καὶ ἀπὸ τῆς ἀρχῆς κινούμενης καὶ μεταβαλλούσης, ἐπειδὴ πολλὰ δυνάμει ἐστίν, ἦ μὲν τοῦ Β ἀρχῆ ἐπὶ τὸ Β, ἢ δὲ τοῦ Γ ἐπὶ τὸ Γ, ἢ δ’ ἀμφότερον ἐπὶ ἀμφῶς. ἀπὸ δὲ τοῦ Β ἐπὶ τὸ Γ τῶν 35 ἀπὸ μὲν τοῦ Β ἐπὶ τὸ Α ἐλθεῖν ὡς ἐπὶ ἀρχήν, ἀπὸ δὲ τοῦ Α ἐπὶ τὸ Γ ὡς ἀπ’ ἀρχῆς. ὅτι δὲ ὅτε μὲν ταῦτα νοησάνουσιν γίνεται ἡ κίνησις ἡ παρὰ τὸν λόγον ἐν τοῖς μορίοις, ὅτε δ’ οὖ, αὐτίον τὸ ὅτε μὲν ὑπάρχειν τὴν παθητικήν ὑλήν ὅτε δὲ μὴ τοσαυτήν ἢ τοσαυτήν. Περὶ μὲν οὖν τῶν μορίων ἐκάστου τῶν ζῴων, 704a καὶ περὶ ψυχῆς, ἐτί δὲ περὶ αἰσθήσεως καὶ ὑπονομοῦ καὶ μνήμης καὶ τῆς κοινῆς κινήσεως, εἰρήκαμεν τὰς αἰτίας· λοιπὸν δὲ περὶ γενέσεως εἴπετο.

1 τούτου . . . ζωτικὴν ut interpolamentum del. Jaeger.
2 γὰρ om. EY.
3 τῷ EP: τῷ δὲ Y: τὸ δὲ S.
4 ταῦτα Jaeger: τὰ αὐτὰ P: ταῦτα ESY.

* These words are probably an interpolated gloss; they
MOVEMENT OF ANIMALS, xi.

each contains vital moisture]. The reason for this as regards the heart is plain, for it contains the origins of the senses. That the generative organ is of the same nature is shown by the fact that the seminal force comes forth from it, being as it were a living thing. Now it is only in accordance with reason that movements are set up both in the central origin by the parts and in the parts by the central origin, and thus reach one another. Let A be the central origin; the movements at each letter in the diagram drawn above reach the central origin, and from the central origin, when it is moved or undergoes change (for it is potentially many), the origin of movement in B goes to B, and the origin of movement is C to C, and of both to both; but from B to C it travels by going from B to A as to a central origin, and from A to C as from a central origin. Movement, however, contrary to reason, sometimes takes place and sometimes does not take place in the organs as the result of the same thoughts, the reason being that the matter which is liable to be affected is sometimes present and sometimes not present in the proper quantity and quality.

We have now dealt with the reasons for the parts of each animal, the soul, and also sense-perception, sleep, memory, and general movement. It remains to deal with the generation of animals.

are unnecessary in view of the following sentences and contradictory in doctrine to them.

b See figure on p. 473.
PROGRESSION OF ANIMALS
ANALYSIS OF CONTENTS

Chap. I. Introduction. Problems which arise about animal locomotion. Different number of limbs and different modes of bending them found in different animals.

II. Assumption of generally-accepted principles and definitions.

III. Animal movement requires (1) a resisting surface against which the limbs can press, (2) a distinction of active and passive parts in the animal.

IV. The dimensions of living bodies. Superior and inferior determined by function and not by position. Plants and animals compared. Distinction of front and back, right and left. The right, as the source of movement, superior to the left. Man the most highly differentiated of the animals.

V. Bipeds, quadrupeds, polypods and footless animals distinguished. Quadrupeds inferior to bipeds. Man the highest form of biped, being the most "natural."

VI. All movement in the animal must originate in a common centre, equidistant from the centres of movement in the limbs.

VII. Red-blooded animals move at four points: such animals are a continuous whole, while bloodless animals and polypods are composed of a number of separate entities. Even limbless red-blooded animals move at four points.

VIII. Reason for the absence of limbs in snakes. Limbs necessarily even in number.

IX. Flexion necessary to movement, even in limbless animals. Its mechanism explained. Illustrations from leaping, flying, and swimming animals.

X. Movement of birds. Use of the tail to guide flight.
PROGRESSION OF ANIMALS

XI. Man, the only erect animal, compared with the birds. Winged human beings an impossible invention of the artists.

XII. Differences of flexion in the limbs of man and of the quadrupeds explained.

XIII. The different modes of flexion enumerated and illustrated by diagrams.

XIV. "Diagonal" movement of the legs of quadrupeds. Movement of crabs.

XV. Birds and quadrupeds compared. The structure of the legs of birds. Oblique attachment of wings and fins. The structure of oviparous quadrupeds.

XVI. Movement of bloodless animals. The peculiar movement of the crab.

XVII. Crabs, lobsters, flat-fish, and web-footed birds.

XVIII. Why birds have feet, while fishes have not. Fins and wings compared.

XIX. The movement of testaceans. Conclusion.

ABBREVIATIONS USED IN THE APPARATUS CRITICUS

Z = Codex Oxoniensis Collegii Corporis Christi W.A. 2. 7.
U = Codex Vaticanus 260.
S = Codex Laurentianus 81. 1.
P = Codex Vaticanus 1339.
Y = Codex Vaticanus 261.
Leon. = Latin translation of Nicholas Leonicus.
Mich. = Greek commentary of Michael Ephésius.
ΠΕΡΙ ΠΟΡΕΙΑΣ ΖΩΙΩΝ

1. Περὶ δὲ τῶν χρησίμων μορίων τοῖς ζῴων
5 πρὸς τὴν κάινην τὴν κατὰ τόπον ἐπισκεπτέον διὰ
tίν’ αἰτίαν τοιοῦτον ἔστιν ἐκαστὸν αὐτῶν καὶ τῶν
ἐνεκεν ὑπάρχει αὐτοῖς, ἐτὶ δὲ περὶ τῶν διαφορῶν
tῶν τε πρὸς ἄλλα τοῖς τοῦ αὐτοῦ καὶ ἕνὸς ζῴου
μορίων, καὶ πρὸς τὰ τῶν ἄλλων τῶν τῷ γένει δια-
φόρων. πρῶτον δὲ λάβωμεν περὶ ὅσων ἐπι-
σκεπτέον.

10 Ἔστι δὲ πρῶτον μὲν πόσοις ἑλαχίστοις τὰ ζῷα
κινεῖται σημείοις, ἐπειτὰ διὰ τὸ τὰ μὲν ἑναίμα
τέταρτα τὰ δ’ ἄναιμα πλεῖσσι, καὶ καθόλου δὲ διὰ
tίν’ αἰτίαν τὰ μὲν ἀποδα τὰ δὲ διόποδα τὰ δὲ
tετράποδα τὰ δὲ πολύποδα τῶν ζῴων ἔστι, καὶ
diὰ τὶ πάντ’ ἄρτιους ἔχει τοὺς πόδας, ὁσαπερ ἔχει
15 πόδας αὐτῶν· ὅλως δ’ οἰς κινεῖται σημείοις, ἄρτια
ταῦτ’ ἐστιν.

'Ετὶ δὲ διὰ τίν’ αἰτίαν ἄνθρωπος μὲν καὶ ὅρνις
dίπους, οἱ δ’ ἰχθῦες ἀποδέεισιν· καὶ τὰς κάμψεις
ὁ τε ἄνθρωπος καὶ ὁ ὅρνις δίποδες ὄντες ἐναντίας
ἐχοῦσι τῶν σκελῶν. ὁ μὲν γὰρ ἄνθρωπος ἐπὶ
20 τὴν περιφέρειαν κάμπτει τὸ σκέλος, ὁ δ’ ὅρνις
ἐπὶ τὸ κοῖλον. καὶ ὁ ἄνθρωπος αὐτὸς αὐτῷ

484
I. We must next discuss the parts which are useful to animals for their movement from place to place, and consider why each part is of the nature which it is, and why they possess them, and further the differences in the various parts of one and the same animal and in those of animals of different species compared with one another. We must first decide what questions we have to discuss.

One question is, what is the smallest number of points at which animals move; the next is, why red-blooded animals move at four points, while bloodless animals move at more than four; and, in general, why some animals are without feet, others biped, others quadrupeds, and others polypods, and why all that have feet at all have an even number of feet; and, in general, why the points at which movement is made are even in number.

We must further consider why a man and a bird are bipeds, while fishes are without feet; and why a man and a bird, being both bipeds, have opposite bendings of the legs. For a man bends his legs in a convex direction, a bird in a concave direction; and a man
ARISTOTLE

704a ἐναντίως τὰ σκέλη καὶ τοὺς βραχίονας τοὺς μὲν γάρ ἐπὶ τὸ κοιλον, τὰ δὲ γόνατα ἐπὶ τὴν περιφέρειαν κάμπτει. καὶ τὰ τετράποδα τὰ ζωότοκα τοῖς τ’ ἀνθρώποις ἐναντίως κάμπτει καὶ αὐτὰ ἀυτοῖς. τὰ μὲν γὰρ πρόσθια σκέλη ἐπὶ τὸ κυρτὸν

704b τῆς περιφερείας κάμπτει, τὰ δ’ ὀπίσθια ἐπὶ τὸ 5 κοιλον. ἐτί δὲ τῶν τετραπόδων ὁσα μὴ ζωοτοκεῖ ἄλλ’ χωτοκεῖ, ὡσ’ καὶ εἰς τὸ πλάγιον κάμπτει. πρὸς δὲ τούτοις διὰ τὸν’ αἰτίαν τὰ τετράποδα κυνεῖται κατὰ διάμετρον. περὶ δὴ πάντων τούτων, καὶ ὡσα ἄλλα συγγενῆ τούτως, τὰς αἰτίας θεωρητέον. ὦτι μὲν γὰρ οὖτω ταῦτα συμβαίνει, δὴ λογον ἐκ 10 τῆς ἱστορίας τῆς φυσικῆς, διότι δὲ, νῦν σκεπτέον.

Π. Ἀρχή δὲ τῆς σκέψεως ὑποθέμενοι ὡς εἰσώθησαν χρήσθαι πολλάκις πρὸς τὴν μέθοδον τῆς φυσικῆς, λαβόντες τὰ τούτων ἔχοντα τὸν τρόπον ἐν πάσι τοῖς τῆς φύσεως ἕργοις. τούτων 15 δ’ ἐν μὲν ἑστιν ὃτι ἡ φύσις οὐθὲν ποιεῖ μάτην, ἄλλ’ ἀεὶ ἐκ τῶν ἐνδεχομένων τῇ οὔσια περὶ ἕκαστον γένος ξώοι τὸ ἀριστον. διόπερ εἰ βέλτιον ἄδι, οὔτως καὶ ἔχει κατὰ φύσιν. ἐτι τὰς διαστάσεις τοῦ μεγέθους, πόσαι καὶ ποῖα ποίου ὑπάρχουσι, δεὶ λάβειν. εἰσὶ γὰρ διαστάσεις μὲν ἔξ, συζυγία 20 δὲ τρεῖς, μία μὲν τὸ ἄνω καὶ τὸ κάτω, δευτέρα δὲ τὸ ἐμπρόσθεν καὶ τὸ ὀπίσθεν, τρίτη δὲ τὸ δεξίον καὶ τὸ ἀριστέρον. πρὸς δὲ τούτοις ὧτι τῶν κινήσεων τῶν κατὰ τόπον ἀρχαι ὅσις καὶ ἐλξίς. καθ’ αὐτάς μὲν οὖν αὐταί, κατὰ συμβεβηκὸς δὲ κυνει-  

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a i.e. the front right foot with the left back foot, and the left front with the right back.  
b The Historia Animalium.  
c Leon. renders eodem ... modo which seems to imply that he was translating τὸν αὐτὸν ἔχοντα τρόπον.

486
himself bends his legs and his arms in opposite directions, the arms concavely and the knees convexly. And viviparous quadrupeds bend their limbs in the opposite way to a man's and in opposite ways to one another; for they bend their front legs convexly and their back legs concavely. Further, quadrupeds which are not viviparous but oviparous have the peculiarity of bending their legs sideways. A further question is why do quadrupeds move their legs diagonally.a

We must examine the reasons of all these and similar facts; that they are facts is clear from our Natural History,b and we have now to examine their causes.

II. We must begin our inquiry by assuming the principles which we are frequently accustomed to employ in natural investigation, namely, by accepting as true what occurs in accordance with these principles c in all the works of nature. One of these principles is that nature never creates anything without a purpose, but always what is best in view of the possibilities allowed by the essence of each kind of animal; therefore, if it is better to do a thing in a particular manner, it is also in accordance with nature. Further, we must accept the dimensions of magnitude in the size and quality in which they are present in various objects. For there are six dimensions grouped in three pairs, the first being the superior and the inferior, the second the front and the back, and the third the right and the left. We must further postulate that the origins of movement from place to place are thrusting and pulling. These are movements per se; that which is carried by

487
ARISTOTLE

704b
tai to feroimenvon up' allou. ou gar auton dokei
705 a kinein auton all' up' allou kineisthai to upo tivos
feroimenvon.

III. Touton de diωroioménon léghmev ta toúton
efezeis. twν de ἐξων ὅσα μεταβάλλει κατά
tópon, ta méν ἀθρόω panti tω sómati μεταβάλλει,
katháper tá állômena, tα de káta méros,1 katháper
twν πορευομένων ēkaston. ēn ámorphérais de taïs
metabolaiâs taútais åei metaβálλει τò kwnouimenv
aposthrizómenon pro's to úpokéimenvon autòw. dióper
eán te úpoféρηtai toúto ðâttov ë wót'
10 échein áperieíasasai to poioúmenon ëp' autòu tîn
kînhsîn, éán th' olôs μηðemîn ëxh toîs kwnoumêños
ántereisw, ouðên ëp' autòu dúvatai kineîn éautô.
kaî gar to állômenon kai pro's autò2 áperieidôme-
non to ånw kai pro's to úpò tòus pódas poieîtau
tîn ál law. échei gar tîa àntereisw pròs állhla
tâ môria en tâs kámpaîs, kai olôs to piezovan
pro's to piezómenon. diô kai oi pêntatblw allontai
pleiwn éxontes toûs àlthras h mî éxontes, kai
oi ðeîontes ðâttov ðèouîn paraðeîontes ðàs ñeîras,
gînetai gar tîs àntereisw en tî ðiâtâsê pròs tâs
ìeîras kai tòus kámpous. åei de to kwnouimenv
dwov ñlaxîstois khrômenon õrganikoiâs môresi
poieîtau tîn metabôlhn, tûw méν wô speranei ðlîbontoi,
tûw de ðlîboméwv. to méν gar ménou ðlîbetai dia

1 kâta méros Z: mérei S: τoîs μoploûs cet.
2 autò PUY: autò S: éautò Z.

Special weights ( álthres) or sometimes stones were held
in the hands and thrown backwards by jumpers while in the
air to add to their impetus; cf. Norman Gardiner, Greek
488
something else is only moved accidentally, for what is carried by something else is regarded not as moving itself but as being moved by something else.

III. These points having been decided, let us proceed to the considerations which follow from them. Of the animals, then, which change their local position, some do so with their whole body at the same time, for instance those which jump; others move part by part, for example those that walk. In both these changes the animal that moves makes its change of position by pressing against that which is beneath it; and so, if the latter slips away too quickly to allow that which is setting itself in motion upon it to press against it, or if it offers no resistance at all to that which is moving, the animal cannot move itself at all upon it. For that which jumps performs that movement by pressing both on its own upper part and on that which is beneath its feet; for the parts in a way lean upon one another at their joints, and, in general, that which presses leans on that which is pressed. Hence athletes jump farther if they have the weights in their hands than if they have not, and runners run faster if they swing their arms; for in the extension of the arms there is a kind of leaning upon the hands and wrists. Now that which moves always makes its change of place by the employment of at least two organic parts, one as it were compressing and the other being compressed. For the part which remains still is compressed by

Athletic Sports and Festivals, pp. 298 ff., who proves by experiment the truth of the statement made in the present passage.

On the importance attached by the Greeks to arm-action in running, especially in short races, cf. N. Gardiner, op. cit. p. 282.
ARISTOTLE

705a

τό φέρειν, τό δ’ αἰρόμενον τείνεται τῷ φέροντι
to φορτίον. διόπερ ἀμερές οὐδὲν οὔτω κινηθήναι
dυνατόν· οὐ γὰρ ἔχει τὴν τοῦ πεισομένου καὶ τοῦ
25 ποιήσοντος ἐν αὐτῷ1 διάληψιν.

IV. Ἐπεὶ δ’ εἶσιν αἱ διαστάσεις τὸν ἄριθμὸν
ὲξ, αἰς ὁρίζονται πέφυκε τὰ ζῷα, 2 τὸ τε ἄνω καὶ
catw καὶ τῷ ἐμπροσθεν καὶ ὀπισθεν, ἐτ’ ἐδεξιὸν
καὶ ἀριστερῶν, τὸ μέν ἄνω καὶ κάτω μόριον πάντω
ἔχει τὰ ζῶντα. οὐ μόνον γὰρ ἐν τοῖς ζῴοις ἔστι
to ἄνω καὶ κάτω, ἀλλὰ καὶ ἐν τοῖς φυτοῖς. di-
30 εἶληπται δ’ ἔργω, καὶ οὐ θέσει μόνον τῇ πρὸς τε
τῆν γῆν καὶ τοῖς συρανσί. οἶδεν μὲν γὰρ ἡ τῆς τροφῆς
diádosis καὶ η ἀνεξίσις ἐκάστοις, ἄνω τοῦτ’ ἔστιν.

705b

πρὸς δ’ ὅτι ἐσχάτον αὐτῇ περαινεῖ, τοῦτο κατω.
to μὲν γὰρ ἀρχὴ τις, τὸ δὲ πέρας. ἀρχὴ δὲ τὸ ἄνω.
catói δόξειν ἂν τοῖς φυτοῖς οἰκεῖσιν εἶναι τὸ κάτω
μᾶλλον. οὐχ ὁμοίως γὰρ ἔχει τῇ θέσει τὸ ἄνω καὶ
catów τούτως καὶ τοῖς ζῴοις. ἔχει δὲ πρὸς μὲν
5 τὸ ὅλον οὐχ ὁμοίως, κατὰ δὲ τὸ ἔργον ὅμοιως.
aὶ γὰρ ὅτι εἰσὶ τὸ ἄνω τοῖς φυτοῖς· ἐκείθεν γὰρ
ἡ τροφή διαδίδοται τοῖς φυομένοις, καὶ λαμβάνει
ταῦτας αὐτήν, καθάπερ τὰ ζῷα τοῖς στόμαισιν.

"Οσα δὲ μὴ μόνον ζῆ ἀλλὰ καὶ ἥμα στῆ, τοῖς
touj tujoi ύπάρχει το τε ἐμπροσθεν καὶ το ὀπισθεν.
10 αὐσθησιν γὰρ ἔχει ταῦτα πάντα, ὁρίζεται δὲ κατά
tauTa το τε ἐμπροσθεν καὶ το ὀπισθεν· ἐφ’ δ’
μὲν γὰρ ἡ αὐσθησις πέφυκε καὶ οἴδεν ἔστιν ἐκάστοις,

1 αὐτῷ Jaeger: αὐτῷ libri. 2 ζῆ Y: ζῶντα ceteri.

a Cf. above, 704 b 19 ff. b Cf. De caelo, 294 b 17.
c More literally "personal."
d Cf. De vit. long. et brev. 467 b 2; Phys. 199 a 28.

490
PROGRESSION OF ANIMALS, iii.—iv.

having to carry the weight, and the part which is raised is extended by that which carries the weight. And so nothing that is without parts can move in this manner; for it does not contain in itself the distinction between what is to be passive and what is to be active.

IV. Now the dimensions by which animals are naturally bounded are six in number, namely, superior and inferior, front and back, and also right and left. Now all living things have a superior and an inferior part; for the superior and the inferior is found not only in the animals but also in plants. The distinction is one of function and not merely of position in relation to the earth and heavens. For the part from which is derived the distribution of nutriment and the growth in any particular thing is the superior; the part to which the growth extends and in which it finally ends is the inferior. The one is a kind of origin, the other a termination; and it is the superior which is an origin. It might, however, seem that in plants the inferior is the more essential part; for the superior and the inferior are not in the same position in them as in the animals. Though in relation to the universe they have not the same position, they are similarly situated as regards function. For in plants the roots are the superior part; for it is from them that the nutriment is distributed to the parts that grow, and it is from their roots that plants receive it, as do animals from their mouths.

Things which not only live but are also animals have both a front and a back. For all animals have sense-perception, and it is on account of sense-perception that the front and the back are distinguished; for the parts in which the sense-perception is implanted
705b ἐμπροσθεν ταῦτ' ἐστὶ, τὰ δ' ἀντικείμενα τούτοις ὁπισθεν.

"Ὅσα δὲ τῶν ζῷων μὴ μόνον αἰσθήσεως κωνωνεῖ,
15 ἄλλα δύναται ποιεῖσθαι τὴν κατὰ τόπον μετα-
βολὴν αὐτὰ δι' αὐτῶν, ἐν τούτοις δὴ διώρισται
πρὸς τοῖς πρὸτερον καὶ τὸ δεξίον,
ὀμοίως τοῖς πρότερον εἰρημένοις ἔργω τυν καὶ οὐ
θέσει διωρισμένον ἑκάτερον αὐτῶν· οἶδεν μὲν γάρ
ἔστι τοῦ σώματος ἡ τῆς κατὰ τόπον μεταβολὴς ἀρχὴ
20 φύσει, τούτο μὲν δεξίον ἐκάστω, τὸ δ' ἀντικείμενον
καὶ τούτω πεφυκὸς ἀκολουθεῖ ἀριστερῶν. τοῦτο
δὲ διηρθρωται μᾶλλον ἐτέροις ἐτέρων. ὅσα μὲν
γὰρ ὀργανικὸς μέρεςι χρώμενα (λέγω δ' οἶδον
ποσὶν ἡ πτέρυξιν ἢ τινὶ ἄλλω τοιοῦτω) τὴν εἰρη-
μενὴν μεταβολὴν ποιεῖται, περὶ μὲν τὰ τοιαῦτα
25 μᾶλλον διηρθρωταί τὸ λεχθὲν· ὅσα δὲ μὴ τοιοῦτοις
μορίοις, αὐτῷ δὲ τῷ σώματι διαλίθεις ποιούμενα
προέρχεται, καθάπερ ἑνα τῶν ἀπόδων, οἶδον οὐ
τε ὅσις καὶ τὸ τῶν καμπῶν γένος, καὶ πρὸς τούτοις
ἀ καλοῦσι γῆς ἐντερα, ὑπάρχει μὲν καὶ ἐν τούτοις
tὸ λεχθὲν, ὅμως, ὅπου διασεσάφηται γ' ὀμοίως.

80 "Ὅτι δ' ἐκ τῶν δεξιῶν ἡ ἀρχὴ τῆς κινήσεως ἐστι,
σημεῖον καὶ τὸ φέρειν τὰ φορτία πάντας ἐπὶ τοῖς
ἀριστεροῖς· οὕτως γὰρ ἐνδέχεται κινεῖσθαι τὸ φέρον,
λελυμένου τοῦ κινήσεως. (διὸ καὶ ἀσκωλιάζουσι
ῥᾶν ἐπὶ τοῖς ἀριστεροῖς: κινεῖν γὰρ πέφυκε τὸ
δεξιόν, κινεῖσθαι δὲ τὸ ἀριστερῶν,) ὡστε καὶ τὸ
φορτίον ὅπως ἐπὶ τῷ κινήσεως ἀλλ' ἐπὶ τῷ κινησο-

1 ὅ' Jaeger: ὅ' libri.

a Viz. superior and inferior.
b i.e. from place to place.
and whence every kind of creature derives it are at the front, and the opposite parts to these are at the back.

Those animals which not only partake of sense-perception but can also of themselves make the change from place to place, in addition to the distinctions already mentioned, have a further distinction of left and right, these being each, like the above, distinctions of function and not of position. For the part of the body where the origin of change from place to place naturally arises is the right in each kind of animal, while the part which is opposed to this and naturally follows its lead is the left.

There is a greater differentiation between right and left in some animals than in others. All animals which make the above-mentioned change by the use of instrumental parts—for example, feet or wings or the like—show a greater differentiation between right and left in such parts; those, on the other hand, that progress not by means of such parts but by moving the body itself in sections—like some of the footless animals, such as snakes and the caterpillars, and also earthworms—possess, it is true, this differentiation, but it is not nearly so clearly defined.

That the origin of movement is from the right side is shown by the fact that men always carry burdens on the left shoulder; for then it is possible for that which bears the weight to be set in motion, that which is to initiate the movement being free. (For this reason, too, it is easier to hop on the left leg; for it is natural to the right leg to initiate movement, and to the left to be set in motion.) The burden, therefore, must rest not on the part which is to initiate movement, but on that which is to be set in
μένω δεὶ ἐπικείσθαι· ἐὰν δ' ἐπὶ τῷ κινοῦντι καὶ τῇ ἀρχῇ τῆς κινήσεως ἐπιτεθῇ, ήτοι ὅλως οὐ κινήσεται
5 ἡ χαλεπώτερον. σημεῖον δ' ὅτι ἀπὸ τῶν δεξιῶν ἡ ἀρχῇ τῆς κινήσεως καὶ αἱ προβολαί· πάντες γὰρ τὰ ἀριστερὰ προβάλλονται, καὶ ἐστώτες προ-

Aristotle

1 προβεβήκασι PSU: προβεβήκασι YZ.

a i.e. in the sense that man is right-handed.
PROGRESSION OF ANIMALS, iv.

motion; and if it be placed on that which causes and is the origin of movement, it will either not be moved at all or with greater difficulty. The manner in which we step out also shows that the origin of movement is in the right side; for all men put the left foot foremost, and, when standing, preferably place the left foot in front, unless they do otherwise accidentally. For they are moved, not by the foot which they put in front, but by that with which they step off; also they defend themselves with their right limbs. Therefore the right is the same in all; for that from which the origin of movement is derived is the same in all and has its position by nature in the same place, and it is from the right that the origin of movement is derived. For this reason, too, the stromboid testaceans all have their shells on the right; for they all move not in the direction of the spiral but in the opposite direction, the purple-fish, for example, and the trumpet-shell. Since, then, movement in all animals starts from the right, and the right moves in the same direction as the animal itself, they must all alike be right-sided. Now man more than any other animal has his left limbs detached, because of all animals he is most in accordance with nature, and the right is naturally better than the left and separated from it. Therefore the right is most right-sided in man. And since the right is differentiated, it is only reasonable that the left is less easily set in motion and most detached in man. Moreover the other principles, the superior and the front, are in man most in accord with nature and most differentiated.

" The ἀρχαί here are the διαστάσεις of 704 b 19, 705 a 26, from the point of view of function rather than position."
V. Ois men oun to anw kai to emprossethein di-

wrystai, kathaper tois antrwpois kai tois ornyi,
tauta men diopoda (twn de teptarpwn ta duo simeia
tois men pterugyes tois de cheires kai braxionves

eisyn). Osas 6' epi to auto to prouthein exei kai
to anw, teptrapoda kai polupoda kai apoda.
kalw gar poda meros epi simeiw peziw kynhtikw
kata topou kai gar to onoma eoiakasin elhfevai
apo tov pedon oi podes. Enia 6' epi to auto
exei to prouthisin kai to oipthion, oion ta te

malakia kai ta stromboudh twn ostrokkedermov

eirhtai de peri auton proteron en eteirous.

Trwv 6' ontwn topwn, tov anw kai mesou
kai katw, t纳入 diopoda to anw prous to tov
olou anw exei, ta de polupoda h apoda prous
5 to meson, ta de futa prous to katw. aitwv 6'
stoi t纳入 men akwneta, prous tin trofhi de to anw,

η de trophi ek tis gia. ta de teptrapoda epiv
to meson, kai ta polupoda kai apoda, dia to
mu ortha einai. ta de diopoda prous to anw dia

10 to ortha einai, malista 6' 6 antrwpos malista
gar kata phywv esti diopous. evlogos de kai ai
arxai eisyn apw touwv twn morwv h men gar
arxi timiw, to 6' anw tov katw kai to prouthein
tou oipithen kai to deixin tov aristerou timiwteron.
kalwv 6' exei kai to anapalw legein peri auton,

496

a The whole of man is “front,” and his “front” is divided

into superior and inferior; in a quadruped only that part

is “front” which is superior in man.

b P.A. 684 b 14 ff.; H.A. 523 b 21 ff.

c 'Arxh has here the double meaning of “starting-point”

and “centre of authority”; see note on De mot. anim.

698 b 1.
V. Animals in which the superior and the front are differentiated, man, for example, and the birds, are bipeds (two of the four points being wings in birds, and hands and arms in man). But the animals in which the superior and the front are in the same position a are four-footed (quadrupeds), many-footed (polypods), and footless. By "foot" I mean the part that is at a point which has connexion with the ground and gives movement from place to place; for the feet (πόδες) seem to have derived their name from the ground (πέδων). Some animals have their front and their back in the same position, for example the molluses and the stromboid testaceans; with these we have already dealt elsewhere. b

Now since there are three regions, the superior, the middle, and the inferior, bipeds have their superior part in a position corresponding to the superior region of the universe, polypods and footless animals in a position corresponding to the middle region, and plants in a position corresponding to the inferior region. The reason is that plants lack movement, and the superior part is situated with a view to nutriment, and their nutriment comes from the earth. Quadrupeds, polypods, and footless animals have their superior part in a position corresponding to the middle region because they are not erect; bipeds have it in a position corresponding to the superior region because they are erect, especially man, the biped most in accordance with nature. And it is only reasonable that the origins c should come from these parts; for the origin is honourable, and the superior is more honourable than the inferior, and the front than the back, and the right than the left. It is also true if we reverse the proposition and assert
ARISTOTLE

15 ὃς διὰ τὸ τὰς ἄρχας ἐν τούτοις εἶναι ταῦτα τιμώτερα τῶν ἀντικειμένων μορίων ἐστὶν.

VI. "Ὅτι μὲν οὖν ἐκ τῶν δεξιῶν ἢ τῆς κινήσεως ἐστὶν ἄρχη, φανερῶν ἐκ τῶν εἰρημένων. ἐπεὶ δ’ ἀνάγκη παντὸς συνεχοῦς, οὐ τὸ μὲν κινεῖται τὸ δ’ ἤρεμετ’ ὅλου δυναμένου κινεῖσθαι ἐστῶτος θατέρου, ἢ ἀμφω κινεῖται ἐναντίας κινήσεις, εἶναι τι κοινὸν καθ’ ὅ συνεχῆ ταῦτ’ ἐστὶν ἀλλήλους, κἀνταῦθ’ ύπάρχειν τὴν ἄρχην τῆς ἐκατέρου τῶν μερῶν κινήσεως (ὁμοίως δὲ καὶ τῆς στάσεως), δῆλον ὅτι, καθ’ ὅσας τῶν λεχθεισῶν ἀντιδέσεων ίδια κίνησις ύπάρχει τῶν ἀντικειμένων μερῶν ἐκατέρω, πάντα ταῦτα κοινὴν ἄρχην ἔχει κατὰ τὴν τῶν εἰρημένων μερῶν σύμφωσιν, λέγω δὲ τῶν τε δεξιῶν καὶ ἀριστερῶν καὶ τῶν ἀνω καὶ κάτω καὶ τῶν ἐμπροσθεν καὶ τῶν ὑποσθεν. κατὰ μὲν οὖν τὸ ἐμπροσθεν καὶ τὸ ὑποσθεν διάληψις οὐκ ἐστὶ τοιαύτη περὶ τὸ κινοῦν έαυτό, διὰ τὸ μηθεῖν φυσικῆν ύπάρχειν κίνησιν εἰς τὸ ὑποσθεν, μηδὲ διωρισμὸν ἐχειν τὸ κινούμενον καθ’ ὅν τὴν ἐφ’ ἐκάτερα τούτων μεταβολὴν ποιεῖται κατὰ δὲ τὸ δεξιόν γε καὶ ἀριστερὸν καὶ τὸ ἀνω καὶ τὸ κάτω ἐστὶν. διὸ τῶν ξύων ὅσα μέρεσιν ὀργανικὸς χρόμενα προέρχεται, τῇ μὲν τοῦ ἐμπροσθεν καὶ ὑποσθεν διαφορά οὐκ ἔχει διωρισμένα ταῦτα, ταῖς δὲ λοιπαῖς, ἀμφοτέραις μὲν, προτέρα δὲ τῇ κατὰ τὸ δεξιόν καὶ ἀριστερὸν διωρίζουσθε, διὰ τὸ τὴν

1 δῆλον ὅτι (Leon. manifestum est quod, etc.): δηλοντοτ libri.
2 κατὰ P Leon.: om. ceteri.

a i.e. the three pairs of "dimensions" (704 b 19).
that, because the origins are situated in these parts, they are therefore more honourable than the opposite parts.

VI. It is clear, then, from what has been said that the origin of movement is on the right. Now in anything continuous of which part is in motion and part at rest (the whole being able to move while one part stands still), there must be, at the point where both parts move in opposite movements, something common to both which makes these parts continuous with one another (and at this point must be situated the origin of the movement of each of these parts, and likewise also of their immobility): it is evident, therefore, that in respect of whichever of the above-mentioned contraries the individual movement of each of the opposite parts takes place, there is in all these cases a common origin of movement by reason of the interconnexion of the said parts, namely, of the right and the left, the superior and the inferior, the front and the back. The differentiation according to front and back is not one which applies to that which moves itself, because nothing possesses a natural movement backwards nor has the moving animal any distinction in accordance with which it can make a change from place to place in each of these two directions; but there is a differentiation of right and left, superior and inferior. All animals, therefore, which progress by the employment of instrumental parts have these parts differentiated, not by the distinction between front and back, but by the other two pairs, first, by the distinction of right and left (for this must immediately exist where there are

\textsuperscript{b} In other words an animal cannot divide itself into two parts, one of which goes forwards and the other backwards.
μὲν ἐν τοῖς δυσὶν εὐθέως ἀναγκαῖον εἶναι ὑπ’ ἀρχεῖν, τὴν δ’ ἐν τοῖς τέτταρσι πρῶτοις.

'Επεὶ οὖν τὸ τε ἄνω καὶ κάτω καὶ τὸ δεξιὸν καὶ ἀριστερὸν τῇ αὐτῇ ἀρχῇ καὶ κοινῇ συνήρτηται πρὸς αὐτὰ (λέγω δὲ ταύτῃ τὴν τῆς κινήσεως κυρίαν), δει δ’ ἐν ἀπαντὶ τῷ μέλλοντι κατὰ τρόπον ποιεῖσθαι τὴν ἀφ’ ἐκάστου κίνησιν ὀρίσθαι πως καὶ τετάχθαι ταῖς ἀποστάσεσι ταῖς πρὸς τὰς ῥηθείσας ἀρχάς, τὰς τὸ ἀντιστάχους καὶ τὰς συστοιχοὺς τῶν ἐν τοῖς μέρεσι τοῦτοις, τὸ τῶν λεχθεισῶν κινήσεων ἀπασῶν αἰτίων (αὐτῇ δ’ ἐστὶν ἀφ’ ἢς ἀρχῆς κοινῆς τῶν ἐν τῷ ἐξώ ἢ τοῦ δεξιοῦ καὶ ἀριστεροῦ κίνησις ἐστὶν, ὡμοίως δὲ καὶ ἢ τοῦ ἄνω καὶ κάτω), ταύτῃν δ’ ἡμεῖς ἐκάστην ἢ παραπλησίως ἐχεῖ, πρὸς ἐκάστην τῶν ἐν τοῖς ῥηθείσι μέρεσιν ἀρχῶν, VII. δῆλον οὖν ός ἡ μόνοις ἡ μάλιστα τοῦτοις ὑπάρχει τῶν ἐξών ἢ κατὰ τόπον κίνησις, ὅ δυσὶν ἢ τέτταρσι ποιεῖται σημεῖος τὴν κατὰ τόπον μεταβολήν. ὡστ’ ἐπεὶ σχεδὸν τοῖς ἐναῖμοις τοῦτο μάλιστα συμβέβηκε, φανερὸν ὅτι πλείον τε σημείοις τέτταρὼν οὐθέν οἶνος τοὺς κινεῖσθαι τῶν ἐναίμων ἐξών, καὶ εἰ τι τέτταρσι σημείοις κινεῖσθαι πέφυκε μόνον, ἀναγκαῖον τοῦτ’ εἶναι ἐναίμων.

‘Ομολογεῖ δὲ τοῖς λεχθείσι καὶ τὰ συμβαίνοντα περὶ τὰ ἐξώα. τῶν μὲν γὰρ ἐναίμων οὐθέν εἰς πλείω διαφοροῦμενον δύναται ἡ ὀθένα χρόνων

1 δ’ PUZ: om. SY. 2 ἐχεῖ Z: om. cet.

a i.e. the distinction of superior and inferior.
b Namely, the soul situated in the heart (Mich.).
c The legs move in pairs, either the front and back legs on the same side together, or the front leg on one side with the back leg on the other (cf. 704 b 7).
PROGRESSION OF ANIMALS, vi.-vii.

two things), and, secondly, by the distinction which must arise as soon as there are four things.\(^a\)

Since, then, the superior and the inferior, and the right and the left are connected with one another by the same common origin (and by this I mean that which controls their movement \(^b\)), and since in anything which is to carry out the movement of each part properly the cause of all the said movements must be somehow defined and arranged at the right distance in relation to the said origins, namely, those in the limbs, which are in pairs opposite or diagonal to one another;\(^c\) (and the cause of their movement is the common origin from which the movement of left and right and likewise of superior and inferior in the animal's limbs is derived), and since this origin must in each animal be at a point where it is in more or less the same relation to each of the origins in the said parts,\(^d\) (VII.) it is, therefore, clear that movement from place to place belongs either solely or chiefly to those animals which make their change of place by means of two or four points. And so, since this condition occurs almost exclusively in red-blooded animals, it is clear that no red-blooded animal can move by means of more than four points, and if an animal is so constituted by nature as to move by means of four points only, it must necessarily be red-blooded.

What actually occurs in animals is also in agreement with the above statement. For no red-blooded animal can live for any time worth mentioning if it be

\(^a\) There are two kinds of \(\dot{a}p\chi\alpha i\) in, e.g., a quadruped, \((a)\) those in each of the four legs and \((b)\) the central \(\dot{a}p\chi\gamma\) in the heart; the former must each be approximately equidistant from the latter.
707 a ὃς εἶπεν, τῆς τε κατὰ τόπον κινήσεως, καθ’ ἦν ἐκνεύτο συνεχεῖς ὃν καὶ μὴ διηρημένον, οὐ δύναται κοινωνεῖν τῶν δ’ ἀναίμων τε καὶ πολυπόδων ἕνα διαιρούμενα δύναται ζῆν πολὺν χρόνον ἐκάστῳ τῶν μερῶν, καὶ κινεῖσθαι τὴν αὐτὴν ἤπερ καὶ πρὶν δαιρεθῆναι κίνησιν, οἴον αἱ τε καλοῦμενα σκολόπενδρα καὶ ἄλλα τῶν ἐντόμων καὶ προμηχῶν· πάντων γὰρ τούτων καὶ τὸ ὀπίσθεν μέρος ἐπὶ ταῦτα ποιεῖται τὴν πορείαν τῷ ἐμπροσθεν. αἰτίων δὲ τοῦ διαιρούμενα ζῆν ὅτι, καθάπερ ἂν εἴ τι συνεχεῖς ἐκ πολλῶν εἶχε ἥμειν συγκείμενον, οὕτως ἐκαστὸν αὐτῶν συνεστηκεν. φανερὸν δὲ τούτῳ ἐκ τῶν πρότερον εἰρημένων, διότι τούτων ἔχει τὸν τρόπον.

Δυοὶ γὰρ ἡ τέτταροι σημείοις πέφυκε κινεῖσθαι τὰ μάλιστα συνεστηκότα κατὰ φύσιν, ὅμωσι δὲ καὶ ὅσα τῶν ἐναίμων ἀποδὰ ἔστων. καὶ γὰρ ταῦτα κινεῖται τέτταροι σημείοις, δι’ ὅν τὴν κίνησιν ποιεῖται. δυοὶ γὰρ χρώμενα προέρχεται καμ- παῖς· τὸ γὰρ δεξιὸν καὶ ἀριστερὸν καὶ τὸ πρόσθεν καὶ ὀπίσθιον ἐν τῷ πλάτει ἐστὶν ἐν ἑκατέρα τῇ καμπάθῳ αὐτοῖς, ἐν μὲν τῷ πρός τὴν κεφαλὴν μέρει τὸ πρόσθιον σημεῖον δεξιὸν τε καὶ ἀριστερόν, ἐν δὲ τῷ πρὸς τὴν οὐρὰν τὰ ὀπίσθια σημεῖα. δοκεῖ δὲ δυοῖν σημείοις κινεῖσθαι, τῇ τ’ ἐμπροσθεν ἄφη καὶ τῇ ὑστερον. αἰτίων δ’ ὅτι ὁ στενὸν κατὰ πλάτος ἔστιν, ἐπεὶ καὶ ἐν τούτοις τὸ δεξιὸν ἦγείται, καὶ ἀνταποδίδωσι κατὰ τὸ ὀπίσθεν, ὡσπερ ἐν τοῖς τετράποσιν. τῶν δὲ κάμψεων αἰτίων τὸ μῆκος· ὡσπερ γὰρ οἱ μακροὶ τῶν ἀν- θρώπων λορδοὶ βαδίζουσι, καὶ τοῦ δεξιοῦ ὠμοῦ

502

a Centipedes.
PROGRESSION OF ANIMALS, vii.

divided into several parts, and can no longer partake of the motion from place to place whereby it moved while it was still continuous and undivided. On the other hand, some of the bloodless animals and poly-pods can, when they are divided, live in each of these parts for a considerable time and move with the same motion as before they were divided, the so-called scolopendrae, a for example, and other elongated insects; for the hinder part of all these continues to progress in the same direction as the fore-part. The reason why they live when they are divided is that each of them consists as it were of a continuous body made up of many animals. And the reason why they are of this kind is clear from what has been said above.

Animals which are constituted most in accordance with nature naturally move by means of two or four points, and likewise also those among the red-blooded animals which are footless; for they too move at four points and so effect locomotion. For they progress by means of two bends; for in each of their bends there is a right and a left, a front and a back in their breadth—a front point on the right and another on the left in the part towards the head, and the two hinder points in the part towards the tail. They appear to move at two points only, namely, the points of contact with the ground in front and behind. The reason for this is that they are narrow in breadth; for in these animals too, as in the quadrupeds, the right leads the way and sets up a corresponding movement behind. The reason of their bendings is their length; for just as tall men walk with their backs hollowed b and, while their right shoulder leads the

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a scolopendrae

b λοφός is the opposite of κυφός, hunchbacked (Hippocr. Fract. 763).
et?

On the Boeotian coast of the Corinthian Gulf, the Tipha of Paus. ix. 32. 3.

b i.e. two of its “points” are fins and the other two are made by bends.
way forward, their left hip inclines towards the rear and the middle of the body becomes concave and hollow, so we must suppose that snakes too move upon the ground with their backs hollowed. And that they move in the same manner as quadrupeds is shown by the fact that they change the concave into the convex and the convex into the concave. For when the left forward point is again leading the way, the concavity comes in turn on the other side, for the right again becomes the inner. Let the front point on the right be A, and that on the left B, and the rear point on the right C, and that on the left D.

This is the way that snakes move as land-animals, and eels, conger-eels and lampreys and all the other snake-like creatures as water-animals. Some water-animals, however, of this class, lampreys for example, have no fin and use the sea as snakes use both the sea and the land; for snakes swim in just the same manner as when they move on land. Others have two fins only, conger-eels for example, and ordinary eels and a species of mullet which occurs in the lake at Siphæ. For this reason too those which are accustomed to live on land, the eels for example, move with fewer bends in the water than on dry land. The kind of mullet which has only two fins makes up the number of four points in the water by its bends. VIII. The reason why snakes are footless is, first, that nature creates nothing without
ARISTOTLE

708a ἄλλα πάντα πρὸς τὸ ἀριστον ἀποβλέπουσαν ἐκάστῳ τῶν ἐνδεχομένων, διασώζουσαν ἐκάστου τὴν ἰδίαν οὐσίαν καὶ τὸ τῇ ἂν αὐτῶ εἶναι· ἐτι δὲ καὶ τὸ πρότερον ἡμῖν εἰρημένον, τὸ τῶν ἐναίμων μὴθεν οἶον τ' εἶναι πλείοσοι κινεῖσθαι σημεῖος ἢ τέτταρσιν. ἐκ τούτων γὰρ φανερὸν ὅτι τῶν ἐναίμων ὡσα κατὰ τὸ μῆκος ἀσύμμετρά ἐστι πρὸς τὴν ἀλλήν τοῦ σώματος φύσιν, καθάπερ οἱ ὁφείς, οὔθεν αὐτῶν οἶον θ' ὑπόπουν εἶναι. πλείους μὲν γὰρ τεττάρων οὐχ οἶον τε αὐτὰ πόδας ἔχειν (ἄναιμα γὰρ ἂν ἤν), ἐχοντα δὲ δύο πόδας ἢ τέτταρας σχεδὸν ἢν ἂν ἀκίνητα πάμπαν· οὐτω βραδείαν ἀναγκαῖον εἶναι καὶ ἀμφελή την κίνησιν.

Ἀπαν δὲ τὸ ὑπόπουν εἴ ἀνάγκης ἀρτίους ἔχει τοὺς πόδας· ὡσα μὲν γὰρ ἀλσει χρώμενα μόνον ποιεῖται τῇν κατὰ τόπον μεταβολήν, οὔθεν ποδῶν πρὸς γε τῇν τοιαύτην δεῖται κίνησιν· ὡσα δὲ χρηταί μὲν ἀλσει, μὴ ἐστὶ δ' αὐτοῖς αὐτάρκης αὐτή ἡ κίνησις ἄλλα καὶ πορείας προσδέονται, δήλον ως τοῖς μὲν βέλτιον τοῖς δ' (ἀλλως) ὄλως ἀδύνατον1 πορεύεσθαι. [διότι πᾶν ξων ἀναγκαίον ἀρτίους ἔχειν τοὺς πόδας.]2 οὐσίς γὰρ τῆς τοιαύτης μεταβολῆς κατὰ μέρος, ἀλλ' οὐκ ἄθροῶ παντὶ τῷ σώματι καθάπερ τῆς ἄλσεως, ἀναγκαῖον ἐστὶ τοῖς μὲν μένειν μεταβαλλόντων τῶν ποδῶν τοῖς δὲ κινεῖσθαι, καὶ τοῖς ἀντικειμένοις τούτων ποιεῖν ἐκάτερον, μεταβάλλον ἀπὸ τῶν κινομενῶν ἐπὶ τὰ μένοντα τὸ βάρος. διόπερ οὔτε τρισὶ μὲν

1 <ἀλλως> ὄλως ἀδύνατον] ὄλως ἀδύνατον <ἀλλως> Farquharson.

Mich.'s explanation of this passage is that certain poly-pods, which can walk with an uneven number of legs (cf. 506
a purpose but always with a view to what is best for each thing within the bounds of possibility, preserving the particular essence and purpose of each; and, secondly, as we have already said, because no red-blooded animal can move by means of more than four points. It is clear from this that all red-blooded animals whose length is out of proportion to the rest of their bodily constitution, like the snakes, can none of them have feet; for they cannot have more than four feet (for if they had, they would be bloodless), whereas, if they had two or four feet, they would be practically incapable of any movement at all, so slow and useless would their movement necessarily be.

Every animal which has feet must necessarily have an even number of feet; for those which move from place to place by jumping only do not require feet (at least not for this movement), while those which jump but do not find this mode of locomotion sufficient by itself and need to walk also, must clearly either progress better with an even number of legs or else cannot otherwise progress at all. For since this kind of change from place to place is carried out by a part and not, like jumping, with the whole of the body at once, some of the feet during the change of position must remain at rest while others are in motion, and the animal must rest and move with opposite legs, transferring the weight from the legs in motion to those at rest. Hence no animal can

Farquharson’s insertion of ἀλλαξεῖσθαι seems therefore a certain emendation: the omission of ἀλλαξεῖσθαι, however, in our mss. would be better accounted for if it is inserted before ἀλλαξεῖσθαι rather than before πορεύεσθαι.
οὐθὲν οὖθ' ἐνι 1 χρώμενον βαδίζειν οἷόν τε· τὸ μὲν γὰρ οὐθὲν ὅλως ὑπόστημα ἔχει ἐφ' ὥ τὸ τοῦ σώματος ἔξει βάρος, τὸ δὲ κατὰ τὴν ἐτέραν ἀντίθεσιν μόνην, ὥστε ἀναγκαίον αὐτὸ ὦταις ἐπιχειροῦν κινεῖσθαι πίπτειν. ὥσα δὲ πολύποδα 5 ἔστων, οἷον αἱ σκολόπενδραι, τούτοις δυνατὸν μὲν καὶ ἀπὸ περιττῶν ποδῶν πορεῖαι γίνεσθαι, καθάπερ φαίνεται ποιούμενα καὶ νῦν, ἃν τις αὐτῶν ἔνα πηρώσῃ τῶν ποδῶν, διὰ τὸ τὴν τῶν ἀντιστοίχων ποδῶν κολόβωσιν ἵκασθαί τῷ λοιπῷ πλήθει τῶν ἐφ' ἐκάτερα ποδῶν· γίνεται γὰρ τούτοις οἷον

10 ἑφελξις τοῦ πεπηρωμένου μορίου τοῖς ἀλλοις, ἀλλ' οὕτ' βάδισις. οὐ μὴν ἀλλὰ φανερὸν ὅτι βέλτιον ἂν καὶ ταῦτα ποιοῖτο τὴν μεταβολὴν ἄρτιος ἔχοντα τοὺς πόδας, καὶ μηθενὸς ἐλλείποντος, ἀλλ' ἀντιστοίχους ἔχοντα τοὺς πόδας· οὕτω γὰρ ἔννοια 2 αὐτῶν ἀνισάξεως τε δύνατον 3 τὸ βάρος καὶ μὴ

15 ταλαντέων ἐπὶ θάτερα μᾶλλον, εἰ ἀντίστοιχα ἐρείσματι ἔχοι καὶ μὴ κενή τὴν ἐτέραν χώραν τῶν ἀντικειμένων. προβαίνει δ' ἄφ' ἐκάτερον τῶν μερῶν ἐναλλάξ τὸ πορευόμενον· οὕτω γὰρ εἰς ταύτο τῷ ἐξ ἀρχῆς σχήματι γίνεται η ἑκατά-στασις.

20 Ὡτι μὲν οὖν ἄρτιος ἔχει τοὺς πόδας πάντα, καὶ διὰ τῶν αὐτῶν, οἴρηται· IX. ὅτι δ' εἰ μηθὲν ἢν ἢμεροῦν, οὐκ ἢν ἢν κάμψις οὖθ' εὐθυνοῦσιν, ἐκ τῶνδε δῆλον. ἔστι γὰρ κάμψις μὲν ἢ εἶς εὐθείας ἢ εἰς περιφερεῖς ἢ εἰς γωνίαν μεταβολήν, εὐθυνοῦσιν δ' ἢ ἐκ θατέρου τούτων εἶνε εὐθύ. ἐν ἀπάσαις δὲ 25 ταῖς εἰρημέναις μεταβολαῖς ἀνάγκη πρὸς ἐν σημεῖον

1 οὔστε τρισὶ μὲν οὐθὲν οὖθ' ἐνι Jaeger: οὐθὲ (οὖθ' om. PYZ) τρισὶ μὲν οὐθὲν οὐθενι libri. 2 ἐν add. Jaeger.

508
walk using either three legs or one leg; for if it uses one leg it has absolutely no support on which it is to rest the weight of the body, and if it uses three it will rest it on a pair of opposite legs, so that, if it attempts to move thus, it necessarily falls. Polypods, however, for instance the scolopendrae, can achieve progression with an odd number of legs, as they can be immediately seen to do if you mutilate one of their feet, because the maiming of some of the feet in the opposing rows is compensated by the greater number of feet still remaining on either side; the result is that the maimed leg is as it were dragged along by the others, and the animal does not walk properly. However, it is clear that these maimed animals would achieve the change of position better if they had an even number of feet, that is, if none were lacking and they had all the feet in the corresponding rows; for then they would be able to distribute their weight evenly and would not sway to one side, if they had corresponding supports on each side and had not one space in the opposite rows devoid of a leg. An animal, then, when it walks progresses by means of each of its limbs alternately; for thus its state is restored so as to be identical with its original form.

It has now been established that all animals have an even number of feet, and the reason for this has been stated. IX. That, if nothing were at rest, there could be no bending or straightening is clear from the following considerations. Bending is the change from what is straight to what is curved or angular; straightening is the change of either of these to what is straight. In all the above changes the bending or straightening

3 δύνατο scripsi: δύναται Z: δύναντο ceteri. 4 την ante τῶν add. Z.
It does not actually do so because it is not long enough to reach the ground: and so, as is explained below, the other leg must be bent to enable it to do so.

Greek text:

"έν γὰρ βιβλίον: locus corruptus et lacuna mutilatus."
must necessarily be relative to a single point. Further, if there were no bending, there would be no walking or swimming or flying. For since animals with feet stand and rest their weight alternately on each of their two opposite legs, as one leg advances the other must necessarily be bent. For the corresponding legs on either side are naturally equal in length, and the leg which supports the weight must be straight, at right angles, as it were, to the ground. But when a leg advances, it is assuming the position of the side subtending a right angle,\textsuperscript{a} the square upon which equals the squares \textsuperscript{b} on the side which is at rest and the line between the two legs; but since the legs are equal, the leg which is at rest must bend either at the knee or, in any kneeless animal that walks, at the joint. That this is so is shown by the fact that if a man were to walk on the ground alongside a wall [with a reed dipped in ink attached to his head],\textsuperscript{c} the line traced [by the reed] would not be straight but zigzag, because it goes lower when he bends and higher when he stands upright and raises himself.

It is possible, however, to move even if the leg has no bend in it, as happens when children crawl. (The old account attributed such motion to elephants, but it is untrue.) Movement of this kind takes place through a bending in the shoulders or hips. But no creature could walk erect in this way continuously and safely, but could only move like those who drag themselves forward through the dust in the wrestling-school on their knees. For the upper portion of the can be formed by constructing squares on the side of, \textit{e.g.} a triangle.

\textsuperscript{a} The text here is corrupt and something has fallen out in all our mss.: the words here bracketed are supplied from the explanation given by Mich.
Let AB be the stationary leg and AC the advanced leg, which are by hypothesis of equal length. If the right-angled triangle ABD is constructed its hypotenuse AD must be longer than AC.
body is large, and therefore the leg must be long; and if this is so, there must necessarily be a bending. For since a standing position is perpendicular, the leg which is moved forward, if it is to be unbent, will either fall as the right angle becomes less, or else it will not advance at all; for if, while one leg is at right angles, the other is advanced, the advanced leg will be greater and at the same time equal; for it will be equal to the leg which is at rest and also to the side subtending the right angle. The advancing leg must therefore be bent, and the animal, as it bends it, must at the same time stretch the other leg and lean forward and make a stride and remain in the perpendicular; for the legs form an isosceles triangle and the head becomes lower when it is perpendicular to the base of the triangle.

Of animals which are footless, some advance with an undulating motion—this can be of two kinds, for some animals, for example snakes, make their bends on the ground, while others, for instance caterpillars, make them upwards—and undulation is bending. Others move by crawling, like the earthworms and leeches; for these advance with one part leading the way, and then draw up all the rest of their body to it, and in this manner make the change from place to place. It is plain that, if the two lines which they

\[ \text{When the stride has been completed the result is an isosceles triangle formed by the two legs and the ground; the head, which is necessarily lower than when the legs were together, is perpendicularly above the base.} \]
οὐκ ἄν ἐδύναντο κυμαίνοντα τῶν ἐκταθείσης γὰρ τῆς καμπῆς, εἰ ἴσην κατείχεν, οὐθὲν ἄν προῆσαν· τῶν δὲ ὑπερβάλλει ἐκταθείσα, καὶ ἡρεμήσαντος τοῦτον ἔπαγε τὸ λοιπὸν.

Ἐν πάσαις δὲ ταῖς λεγθείσαις μεταβολαῖς τὸ κινούμενον ὅτε μὲν ἐκτεινόμενον εἰς εὐθὺ προέρχεται, ὅτε δὲ συγκαμπτόμενον, τοῖς μὲν ἡγουμένοις μέρεσιν εὐθὺ γινόμενον, τοῖς δὲ ἐπομένοις συγκαμπτόν. ποιεῖται δὲ καὶ τὰ ἀλλόμενα πάντα κάμψιν ἐν τῷ ὑποκειμένῳ μέρει τοῦ σώματος, καὶ τούτον τὸν πρόπον ἔχοντα ἀλλεται. καὶ τὰ πετόμενα δὲ καὶ τὰ νέοντα, τὰ μὲν τὰς πτέρυγας εὐθύνοντα καὶ κάμπτοντα πέταται, τὰ δὲ τοῖς πτερυγίοις, καὶ τούτων τὰ μὲν τέτταρα τὰ δὲ δυσών, ὅσα προμηκέστερα τὴν μορφήν, ὡσπερ τὸ τῶν ἐγχελέων γένος· τὴν δὲ λοιπὴν κίνησιν ἀντὶ τῶν δύο πτερυγίων τῷ λοιπῷ τοῦ σώματος καμπτόμενα νεί, καθάπερ εἰρηται πρότερον. οἱ δὲ πλατεῖς τῶν ἰχθύων τῇ μὲν τῷ πλάτει κρῶνται τοῦ σώματος ἀντὶ πτερυγίων, τῇ δὲ πτερυγίοις δυσῶν. τὰ δὲ πάμπαν πλατέα, καθάπερ ὁ βάτος, αὐτοῖς τοῖς πτερυγίοις καὶ ταῖς ἐσχάταις τοῦ σώματος περιφερείαις εὐθύνοντα καὶ κάμπτοντα ποιεῖται τὴν νεύσιν.  

Χ. Ἀπορήσεις δ’ ἂν τις ὢσις πῶς κινοῦνται τέτταροι σημείοις οἱ ὅρνιθες, ἡ πετόμενοι ἡ πορευόμενοι, ὡς εἰρημένον ὅτι πάντα τὰ ἑναίμα κυμαίνεται τέτταροι. οὐκ εἰρηται δὲ, ἀλλ’ ὅτι οὐ πλείονως. οὐ μήν ἀλλ’ οὔτ’ ἄν πέτεσθαι δύναντο ἀφαίρε

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*a The bend is represented as two lines forming an angle;*
form were not greater than the one, a movement would be impossible for animals which advance by undulations. For, when the bend is extended, they would not have made any advance, if it subtended an equal line; whereas, in fact, it is longer when it is extended, and then, when this part has come to a standstill, the animal draws up the rest.

In all the above-mentioned changes that which moves advances by first extending itself straight out and then curving itself—straightening itself out with its leading parts and curving itself in the parts which follow. All animals, too, which jump make a bend in the lower part of their body and jump in this manner. Animals also which fly and those which swim, fly by straightening and bending their wings and swim with their fins, some fish having four fins and others, namely those which are of a more elongated form (eels for example), having two fins. The latter accomplish the rest of their movement by bending themselves in the rest of their body, as a substitute for the second pair of fins, as has already been said. Flat-fish use their two fins, and the flat part of their body instead of the second pair. Fish that are entirely flat, like the ray, manage to swim by using their actual fins and the outer periphery of their body, which they alternately straighten and bend.

X. A question might perhaps be asked as to how birds, whether flying or walking, can move at four points, in view of the statement that “all red-blooded animals move at four points.” But this is not exactly what we stated; what we said was “at not more than four points.” However, they could not fly if their these two lines together must be longer than the line which subtends their angle.
ARISTOTLE

709 b
θέντων τῶν κάλων οὔτε πορεύεσθαι τῶν πτερύγων
25 ἀφαιρεθεῖσσων, ἐπεὶ οὖδ’ ἀνθρώπος βαδίζει μὴ
κινών τοὺς ὁμοὺς. ἀλλὰ πάντα γε, καθάπερ
εἴρηται, κάμψει καὶ ἐκτάσει πορεύεσθαι τὴν μετα-
βολήν. ἀπαντά γὰρ εἰς τὸ ὑποκείμενον μέχρι τῶν
οἰόνελ συνυπείκουν proérχεται, ὡστ’ ἀναγκαῖον,
εἰ μὴ καὶ κατ’ ἄλλο μόριον γίνεται ἡ κάμψις, ἀλλ’
30 οὖθεν γε ἢ ἀρχὴ τοῖς μὲν ὀλοπτέροις τοῦ πτεροῦ,
τοῖς δ’ ὀρνισὶ τῆς πτέρυγας, τοῖς δ’ ἄλλοις τοῦ
ἀνάλογον μορίον, καθάπερ τοῖς ἠχθύσιν. τοῖς δ’,
ὡσπερ οἱ ὁφεις, εἰ ταῖς καμπαῖς τοῦ σωμάτος
710 a ἐστιν ἢ ἀρχὴ τῆς κάμψεως. τὸ δ’ ὑφοπυγιόν ἐστι
τοῖς πτηνοῖς πρὸς τὸ κατευθύνειν τὴν πτησιν,
καθάπερ τὰ πτηδάλια τοῖς πλοίοις. ἀναγκαῖον δὲ
καὶ ταῦτα ἐν τῇ προσφύσει κάμπτεν. διόπερ τὰ
5 το ὀλοπτερα καὶ τῶν σχίζοπτερών οῖς τὸ ὑφοπυγιόν
ἀφυώς ἔχει πρὸς τὴν εἰρημένην χρῆσιν, οἷον τοῖς τε
tαῖς καὶ τοῖς ἀλεκτρούσι καὶ ὅλως τοῖς μὴ πτητι-
κοῖς, οὐκ εὐθυποροῦσιν. τῶν μὲν ὀλοπτέρων
ἀπλῶς οὖθεν ἔχει ὑφοπυγιόν, ὡστε καθάπερ ἀ-
πηδάλιον πλοῖον φέρεται, καὶ ὅπου ἄν τύχῃ ἔκαστον
10 αὐτῶν προσπίπτει, ὄρμοις τὰ τε κολεόπτερα,
οἷον κάνθαροι καὶ μηλολόθαι, καὶ τὰ ἀνέλυτα,
οἷον μέλιται καὶ σφῆκες. καὶ τοῖς μὴ πτητικοῖς
ἀχρείοι τὸ ὑφοπυγιόν ἐστιν, οἷον τοῖς τε πορφυ-
ρίοις καὶ ἑρωδιοῖς καὶ πᾶσι τοῖς πλωτοῖς. ἀλλ’
ἀντὶ τοῦ ὑφοπυγιοῦ πέτανται τοὺς πόδας ἀπο-

1 oíonel συνυπείκον Z: oíon eis υπείκον ceteri.

a Lit. “creatures with undivided wings.” (The Greek here has different words for the wings of insects and those of birds.)
b Lit. creatures with cloven wings (i.e. made up of feathers) as opposed to insects which have undivided wings.
516
legs were taken from them, or walk if their wings were taken from them, just as a man cannot walk without moving his shoulders to some extent. All things, as has been said, make their change of position by bending and stretching; for they all progress upon that which, being beneath them, also as it were gives way to them up to a certain point; so that, even if the bending does not take place in any other part, it must at any rate do so at the point where the wing begins in flying insects and in birds, and where the analogous part begins in other animals, such as fishes. In other animals, snakes for example, the beginning of their bending is in the joints of the body.

In winged creatures the tail is used, like the rudder in a ship, to direct the flight; and this too must bend at the point where it joins the body. Flying insects also, therefore, and those birds whose tails are ill-adapted for the purpose just mentioned, peacocks, for example, and domestic fowls and, generally, those birds which are not adapted for flight, cannot keep a straight course. Of the flying insects not a single one possesses a tail, so that they are carried along like rudderless ships and collide with anything that they happen to meet. The same is true of sheath-winged insects, such as beetles and cockchafers, and the sheathless insects, such as bees and wasps. The tail is useless in such birds as are not adapted to flight, the porphyrio, for example, and the heron and water-fowls in general; these fly stretching out

c Coleoptera.

d The identity of this bird is disputed. W. W. Merry (on Aristoph. Aves, 707) suggests some kind of coot; D’A. W. Thompson (on H.A. 509 a 11, 595 a 13) suggests the purple coot or the flamingo.
ARISTOTLE

710a τείνοντα, καὶ χρῶνται ἀντ’ οὐροπυγίου τοῖς
15 σκέλεσι πρὸς τὸ κατευθύνειν τὴν πτήσιν. βρα-
δέα δ’ ἡ πτήσις τῶν ὀλοπτέρων ἐστὶ καὶ ἀσθενής
diὰ τὸ μὴ κατὰ λόγον ἔχειν τὴν τῶν πτερῶν φύσιν
πρὸς τὸ τοῦ σώματος βάρος, ἀλλὰ τὸ μὲν πολύ,
tὰ δὲ μικρὰ καὶ ἀσθενὴ. ὀσπερ ἃν οὖν εἰ ὀλ-
καδικόν πλοῖον ἑπιχειροῖ κάποις ποιεῖσθαι τὸν
πλοῦν, οὕτω ταύτα τῇ πτήσεi χρῆται. καὶ ἡ
ἀσθένεια δὲ αὐτῶν τε τῶν πτερῶν καὶ ἡ τῆς
ἐκφύσεως συμβάλλει τι πρὸς τὸ λεχθὲν. τῶν
δ’ ὄρνιθων τῷ μὲν ταῷ τὸ οὐροπύγιον ὅτε μὲν
diὰ τὸ μέγεθος ἄχρητον, ὅτε δὲ diὰ τὸ ἀπο-
βάλλειν οὐθὲν ὡφελεῖ. ὑπεναντίως δ’ ἔχουσιν ὦι
ὄρνιθες τοῖς ὀλοπτέροις τὴν τῶν πτερῶν φύσιν,
μάλιστα δ’ οἱ τάχιστα αὐτῶν πετοῦνε. τοιοῦτοι
δ’ οἱ γαμηφόνυχες· τοὺς γὰρ ἡ ταχυτής τῆς
πτήσεως χρήσιμος πρὸς τὸν βίον. ἀκόλουθα δ’
αὐτῶν ἐοικεν εἶναι καὶ τὰ λοιπὰ μόρια τοῦ σώ-
ματος πρὸς τὴν οἰκείαν κίνησιν, κεφαλὴ μὲν
30 ἀπάντων μικρὰ καὶ αὐχήν οὐ παχύς, στήθος δ’
ἰσχυρὸν καὶ ὃξυ, ὃξυ μὲν πρὸς τὸ εὐτονον εἶναι,
καθάπερ ἄν εἰ πλοῖον πρῶρα λεμβώδους, ἴσχυρὸν
dὲ τῇ περιφύσει τῆς σαρκός, ἆν ἀπώθειν δύνηται
710b τὸν προσπίπτοντα ἀέρα, καὶ τοῦτο ἐκδίως καὶ μὴ
μετὰ πόνου. τὰ δ’ ὀπίσθεν κούφα καὶ συνήκοντα
πάλιν εἰς στενόν, ἄν ἐπακολούθη τοῖς ἐμπροσθεν,
μὴ σύροντα τὸν ἀέρα διὰ τὸ πλάτος.
5 ΧΙ. Καὶ περὶ μὲν τούτων διωρίσθω τὸν τρόπον
τούτων, τὸ δὲ μέλλειν ζῷον ὁρθὸν βαδιεῖσθαι διότι
dίπον τε ἀναγκαῖον ἑστὶν εἶναι, καὶ τὰ μὲν ἄνω
τοῦ σώματος μέρη κουφότερα ἔχειν τὰ δ’ ὡφεστῶτα
tούτως βαρύτερα, δῆλον· μόνως γὰρ ἃν οὕτως
518
their feet in place of a tail and use their legs instead of a tail to direct their flight. The flight of flying insects is slow and weak, because the growth of their wings is not in proportion to the weight of their body; for their weight is considerable, while their wings are small and weak; so they use their power of flight like a merchant-ship attempting to travel by means of oars. The weakness also of the wings themselves and of their manner of growth contributes to some extent to the result which we have described. Among birds, the peacock’s tail is at one season of no service because of its size, at another useless because the bird moult. But birds are the exact opposite of winged insects in the nature of their wings, especially the swiftest flyers among them, namely, those with curved talons; for their swiftness of flight is useful in enabling them to gain their livelihood. The other parts of their body, too, seem to be similarly adapted for their particular movement, the head being always small and the neck not thick and the breast strong and sharp—sharp so as to be compact like the prow of a light-built ship, and strong owing to the way the flesh grows—so as to thrust aside the air which meets it, and that easily and without effort; but the hinder parts are light and contract again to a narrow point, in order that they may follow the forward parts without sweeping the air by their breadth.

XI. So much for the discussion of these topics. The reason why an animal which is to walk erect must both be a biped and also have the upper part of its body lighter and the parts situated beneath these heavier is obvious; for only if it were so
ARISTOTLE

710 b

ἐχον οἷον τ’ εἴη φέρειν ἐαυτῷ ῥαδίως. διόπερ
10 ἀνθρώπος μόνον ὅρθων τῶν ζῴων ἄν τὰ σκελή
cата λόγον ἔχει πρὸς τὰ ἄνω τοῦ σώματος μέγιστα
tῶν ὑποπόδων καὶ ἱσχυρότατα. δῆλον δὲ ποιεῖ
tοῦτο καὶ τὸ συμβαίνον τοῖς παιδίσκοις. οὐ γὰρ
dύνανται βαδίζειν ὅρθα διὰ τὸ πάντα νανώδη εἶναι
καὶ μείζω καὶ ἱσχυρότερα ἔχειν ἣ κατὰ λόγον τὰ
15 ἄνω μέρη τοῦ σώματος τῶν κάτωθεν. προίοσθις
dὲ τῆς ἡλικίας αὐξήσων λαμβάνει τὰ κάτω μάλλον,
μέχρι περ ἀν λάβωσι τὸ προσήκον μέγεθος, καὶ
πουοῦνται τότε τοῖς σώμασι τῆν βάδισιν ὀρθὴν.
οἱ δ’ ὄρνιθες κούφοι οὖntes δίποδες εἰσὶ διὰ τὸ
ὅπωθεν αὐτοίς τὸ βάρος εἶναι, καθάπερ ἑργάζονται
20 τοὺς ἵππους τοὺς χαλκοὺς τοὺς τὰ πρόσθια ἱρκότας
τῶν σκελῶν. αἰτίων δὲ μάλιστα τοῦ δίποδας
όντας δύνασθαι ἔσταναι τὸ ἔχειν τὸ ἱσχίον ὁμοιον
μηρῷ καὶ τηλικούτων ὦστε δοκεῖν δύο μηροὺς
ἔχειν, τὸν τ’ ἐν τῷ σκέλει πρὸ τῆς καμπῆς καὶ τὸν
πρὸς τοῦτο τὸ μέρος ἀπὸ τῆς ἐδρας. ἔστι δ’ οὐ
μηρὸς ἀλλ’ ἱσχίον. εἰ γὰρ μη τηλικοῦτον ἦν,
25 οὐκ ἂν ἦν ὄρνις δίπους. ὦσπερ γὰρ τοῖς ἀνθρώ-
ποις καὶ τοῖς τετράποσὶ ζῷοις, εὐθὺς ἂν ἦν ἄπο
βραχέως οὖν τοῦ ἱσχίου ὁ μηρὸς καὶ τὸ ἄλλο
σκέλος. λίαν οὖν ἦν ἂν τὸ σῶμα πάν προπετές
αὐτῶν. νῦν δὲ μακρὸν ὃν μέχρι ὑπὸ μέσην παρα-
τείνει τὴν γαστέρα, ὦστ’ ἐντεῦθην τὰ σκέλη ὑπ-
30 ερημεισμένα φέρει τὸ σῶμα πάν. φανερὸν δ’
ἐκ τούτων καὶ ὅτι ὅρθον οὐκ ἐνδέχεται τὸν
ὄρνιθα εἶναι ἦσπερ τῶν ἀνθρωπον. ἦ γὰρ τῶν
πτερῶν φύσις ὡς ἔχουσι τὸ σῶμα νῦν οὕτως
711 a αὐτοῖς χρήσιμός ἐστιν, ὅρθοὶς δ’ οὕτων ἄχρηστος

1 ἢ κατὰ λόγον om. PY.
constituted would it be able to carry itself easily. Therefore man, the only erect animal, has legs larger and stronger in proportion to the upper part of his body than any of the other animals which have legs. What happens with children illustrates this: they cannot walk erect because they are always dwarfish and have the upper parts of their body too big and too strong in proportion to the lower parts. As they grow older, the lower parts increase more quickly, until they attain their proper size; and it is only then that they can walk with their bodies erect. Birds are lightly built but can stand on two feet because their weight is at the back, just like bronze horses which are made by sculptors with their fore-legs raised in the air. The chief reason why birds can stand although they are bipeds is that their hip-joint resembles a thigh and is of such a size that they seem to have two thighs, one on the leg above the joint and the other between this and the fundament; but it is not really a thigh but a hip. If it were not so large, a bird could not be a biped; for then, just as in man and the quadrupeds, the thigh and the rest of the leg would be directly attached to a short hip, and so the whole body would tend to fall forward too much. But, as it is, the hip, being long, extends up to the middle of the belly, and so the legs form supports at that point and carry the whole body. It is clear too from this that it is impossible for a bird to stand erect in the way that a man stands; for the way that birds’ wings grow is useful to them in the position in which they now hold themselves, but if they stood erect,
ΑΡΙΣΤΟΤΕΛΗΣ

711 α ἰν ἂν, ὦσπερ γράφουσι τοὺς ἔρωτας ἔχοντας πτέρυγας.

"Αμα γὰρ τοῖς εἰρημένοις δῆλον ὅτι οὐδ' ἄνθρωπον οὐδ' εἰ ἀλλο τι τουούτων ἐστὶ τὴν μορφὴν δυνατὸν εἶναι πτερωτόν, οὐ μόνον ὅτι πλείοσι σημεῖοι κινή-
5 ἑτει ἡ τέτταρα ἐναιμον ὅν, ἀλλ' ὅτι ἄχρηστος ἀυτοῖς ἡ τῶν πτερύγων ἐξις κατὰ φύσιν κινου-
μένον. ἡ δὲ φύσις οὐδὲν ποιεῖ παρὰ φύσιν.

XII. "Ὅτι μὲν οὖν εἰ μὴ κάμψις ἢν ἐν τοῖς
σκέλεσιν ἥ ἐν ταῖς ὁμοπλάταις καὶ ἵσχίοις, οὐθὲν
οἴῳν τ' ἢν ἂν τῶν ἐναίμων καὶ ὑποπόδων προ-
10 βαίνειν, εἰρηται πρότερον, καὶ ὅτι κάμψις οὐκ ἂν
ἡ μηθενὸς ἁρμειντός, ὅτι τε ἐναυτίως οἱ τε
ἀνθρώποι δίποδες οὐτε καὶ οἱ ὀρνιθες ὑπὶ τῶν
σκελῶν πουοῦνται κάμψιν, ἐτὶ δὲ τὰ τετράποδα
ὑπεναντίως καὶ ἀυτοῖς καὶ τῶν ἄνθρωποι. οἱ
μὲν γὰρ ἄνθρωποι τοὺς μὲν βραχιόνας κάμπτουσιν
15 ἐπὶ τὰ κοῖλα, τὰ δὲ σκέλη ἐπὶ τὸ κυρτον, τὰ δὲ
τετράποδα τὰ μὲν πρόσθια σκέλη ἐπὶ τὸ κυρτον,
tὰ δ' ὀπίσθια ἐπὶ τὸ κοῖλον ὅμοιως δὲ καὶ οἱ
ὀρνιθες. αὐτοὶ δ' ὅτι ἡ φύσις οὐδὲν ὅμιοιρητε
μάτην, ὦσπερ εἰρηται πρότερον, ἀλλὰ πάντα πρὸς
tὸ βελτιστὸν ἐκ τῶν ἐνδεχομένων. ὡς τ' ἐπεί
20 πάσιν ὅσοις ὑπάρχει κατὰ φύσιν ἡ κατὰ τόπον
μεταβολὴ τοῖν σκελῶν, ἐστῶτος μὲν ἐκάστου τὸ
βάρος ἐν τούτῳ ἐστὶ, κινουμένοις δ' εἰς τὸ πρόσθεν
dεῖ τὸν πόδα τὸν ἡγούμενον τῇ θέσει κούφον εἶναι,
συνεχοῦς δὲ τῆς πορείας γνωμένης αὐθίς ἐν τούτῳ
τὸ βάρος ἀπολαμβάνειν, δῆλον ὡς ἀναγκαῖον ἐκ
25 τοῦ κεκάμμφαι τὸ σκέλος αὐθίς τε εὐθὺ γίνεσθαι,
μένοντος τοῦ τε κατὰ τὸν πρωσθέντα πόδα
σημείον καὶ τῆς κινῆς. τούτο δὲ συμβαίνειν ἀμα
522
as winged cupids are represented in pictures, the wings would serve no purpose.

At the same time it is clear from what has been said that man, or any other creature of like form, cannot be winged, not only because, being red-blooded, he would then move at more points than four, but also because the possession of wings would be useless to him when moving in a natural manner.

Now nature creates nothing unnatural.

XII. It has already been stated that, if there were no bending in the legs or shoulders and hips, none of the animals which are red-blooded and have feet could progress; and that bending would be impossible if something were not at rest; and that men and birds, being both bipeds, bend their legs in opposite directions; and, furthermore, that quadrupeds bend their pairs of legs in opposite directions to one another and in an opposite manner to men. For men bend their arms concavely and their legs convexly, but quadrupeds bend their front legs convexly and their back legs concavely; birds too do the latter. The reason is that nature never does anything without a purpose, as has been said before, but creates all things with a view to the best that circumstances allow. And so since in all creatures which possess by nature the power of locomotion by means of their two legs, when each leg is stationary the weight must be upon it, but when they move forward, the leading leg must have no weight upon it, and as progression continues it is necessary to transfer the weight on to this leg; it is clearly essential that the leg after being bent should become straight again, the point at which the leg is thrust forward and the shin remaining at rest. And it is possible
ARISTOTLE

711 a καὶ προϊέναι τὸ ζῷον εἰς τοὺς προσθεν μὲν ἔχοντος τὴν καμπῆν τοῦ ἡγομένου σκέλους δυνατόν, εἰς τοῦπισθεὶν δὴ ἀδύνατον. οὕτω μὲν γὰρ προενεχθέν·
30 τοσὸ τοῦ σώματος ἡ ἐκτασις τοῦ σκέλους ἔσται, ἐκεῖνως δὲ ἀνενεχθέντος. ἔτι δὲ εἰς τὸ ὄπισθεν μὲν τῆς καμπῆς οὔσης διὰ δύο κινήσεως ἐγίνεν·
ἀν ἡ τοῦ ποδὸς θέσις ὑπεναντίων τε αὐταῖς, καὶ τῆς μὲν εἰς τὸ ὄπισθεν τῆς δὲ εἰς τὸ ἐμπροσθεν·
ἀναγκαίον γὰρ εν τῇ συγκάμψει τοῦ σκέλους τοῦ μὲν μηροῦ τὸ ἐσχατον εἰς τοῦ πισθεῖν προάγειν, τὴν δὲ κινήμην ἀπὸ τῆς καμπῆς εἰς τὸ ἐμπροσθέν τῶν πόδα πουείν. εἰς τὸ ἐμπροσθέν δὲ τῆς καμπῆς
5 οὔσης, οὖθεν ὑπεναντίας κινήσει μιᾷ τῇ εἰς τῇ εἰς τὸ ἐμπροσθέν ἡ λεχθεῖσα πορεία συμβῇσται.

Ὁ μὲν οὖν ἄνθρωπος δύνατος ὃν καὶ τὴν κατὰ τόπον μεταβολὴν κατὰ ψύχαν τοῖς σκέλεις ποιούμενος διὰ τὴν εἰρημένην αὐτίαν κάμπτει εἰς τὸ ἐμπροσθέν τὰ σκέλη, τοὺς δὲ βραχύνας ἐπὶ τὸ κολλον
10 εὐλόγως· ἄχρηστοι γὰρ ἂν ἦσαν καμπτόμενοι τοῦνταν πρὸς τε τὴν τῶν χειρῶν χρῆσιν καὶ πρὸς τὴν τῆς τροφῆς λήψιν. τὰ δὲ τετράποδα καὶ ζωοτόκα τὰ μὲν ἐμπροσθέν σκέλη, ἑπειδὴ ἤγεται τῇ πορείᾳ αὐτῶν καὶ ἔστι ταῦτ' ἐν τῷ μέρει τῶ ἐμπροσθέν τοῦ σώματος, ἀνάγκη κάμπτειν
15 ἔπετο τὴν περιφέρειαν διὰ τὴν αὐτὴν αὐτίαν ἦπερ καὶ οἱ ἄνθρωποι· κατὰ γὰρ τοῦτο ὁμοίως ἔχουσιν.
διόπερ καὶ τὰ τετράποδα κάμπτομεν εἰς τὸ πρόσθεν τῶν εἰρημένων τρόπον. καὶ γὰρ οὕτως μὲν τῆς κάμψεως αὐτῶν γνωμένης ἐπὶ πολὺ
dυνητισταὶ τοὺς πόδας μετεωρίζειν· ἐναντίως δὲ

1 ὑπεναντίων τε αὐταῖς Jaeger: ὑπεναντίως τε (δὲ UZ) αὐταῖ libri.

524
for this to happen and for the animal at the same time to progress if the leading leg can bend forward, but impossible if it bends backwards. For in the first case the extension of the leg will take place with the forward movement of the body, in the second case with its backward movement. Further, if the bending were backwards, the planting of the foot would be carried out by two movements contrary to one another, one backwards and the other forwards. For in bending the leg it is necessary to draw the extremity of the thigh backwards, and the shin would move the foot forwards from the point of bending; but if the bending be forward, the progression described above will take place not by two contrary movements but by a single forward movement.

Man then, being a biped and carrying out the change from place to place in a natural manner by means of his legs, bends his legs forwards for the reason already stated, but bends his arms concavely. This is only in accordance with reason; for if they were bent in the opposite direction, they would be useless for the purpose of the hands and for taking food. But viviparous quadrupeds of necessity bend their front legs in an outward curve, because these legs lead the way when they walk, and are also situated in the front part of their bodies; and the reason is the same as in man, for in this they resemble man. Thus the quadrupeds too bend their legs forward in the manner already described; for indeed, since they bend their legs in this way, they will be able to raise their feet high in the air, whereas, if they bent them in the opposite direction, they would
ARISTOTLE

711a 20 κάμπτοντες μικρόν ἀπὸ τῆς γῆς ἀν αὐτοὺς ἐμετεώριζον διὰ τὸ τὸν τὲ μηρὸν ὅλον καὶ τὴν καμπτὴν, ἂφ’ ἦς ἡ κνήμη πέφυκεν, ὑπὸ τῇ γαστρὶ γίγνεσθαι προϊόντος αὐτοῦ. τῶν δ’ ὀπισθεν σκελῶν εἰ μὲν ἤν εἰς τὸ ἐμπροσθεν ἡ κάμψις, τῶν ποδῶν ὁ μετεωρισμὸς ὀμοίως ἀν αὐτοῖς εἶχε τοῖς προ- 25 θίοις (ἐπὶ βραχὺ γὰρ ἂν ἐγίγνετο καὶ τούτους κατὰ τὴν ἄρσιν τῶν σκελῶν, τοῦ τε μηροῦ καὶ τῆς καμπτῆς ἀμφοτέρων ὑπὸ τὸν τῆς γαστρὸς τόπον ὑποπτιπτόντων), εἰ δ’ εἰς τὸ ὀπισθεν, καθάπερ καὶ νῦν κάμπτουσιν, οὐθὲν ἐμπόδιον αὐτοῖς γίγνεται πρὸς τὴν πορείαν ἐν τῇ τοιαύτῃ κινήσει τῶν ποδῶν. ἔτι τοῖς γε θηλαζομένοις αὐτῶν καὶ πρὸς τὴν 30 τοιαύτην λειτουργίαν ἄναγκαιον ἢ βελτιῶν γ’ οὕτω κεκάμφθαι τὰ σκέλη. οὐ γὰρ ῥάδιον τὴν κάμψιν ποιουμένων ἐντὸς υφ’ αὐτὰ ἐχειν τὰ τέκνα καὶ σκεπάζειν.

712a XIII. "Οντων δὲ τεττάρων τρόπων τῆς κάμψιν κατὰ τοὺς συνδυασμοὺς τ的灵魂 ἂπὶ τὸ κοῖλον καὶ τὰ πρόσθια καὶ τὰ ὀπίσθια, καθάπερ ἐφ’ οἷς Α, ἢ ἐπὶ τοῦνατίον ἐπὶ τὸ κυρτὸν, καθάπερ ἐφ’ οἷς Β, ἢ ἀντεστραμμένως καὶ μὴ ἐπὶ 5 τὰ αὐτά, ἀλλὰ τὰ μὲν πρόσθια ἐπὶ τὸ κυρτὸν, τὰ δ’ ὀπίσθια ἐπὶ τὸ κοῖλον, καθάπερ ἐφ’ οἷς τὸ Γ, ἢ τοῦνατίον τούτους τὰ μὲν κυρτὰ πρὸς ἀλληλα.

1 συνδυασμούς Ζ: συνδέσμους ceteri.
lift them only a little way from the ground, because the whole of the thigh and the joint from which the shin grows would come up against the belly as the animal advanced. On the other hand, if the bending of the back legs were forward, the raising of the feet would be similar to that of the front feet (for they could only be raised a short distance by lifting the legs, since the thigh and the joint of both legs would come up under the region of the belly), but the bending being, as it is, backwards, there is nothing to hinder their progression as they move the feet in this manner. Again, for those animals which are suckling their young, it is necessary, or at any rate better, that their legs should bend in this way with a view to this function; for if they bent their legs inwards, it would not be easy for them to keep their young underneath them and to protect them.

XIII. Now there are four ways of bending the legs taking them in pairs. Both the fore and the hind legs must bend either concavely, as in figure A; or in the opposite manner, that is convexly, as in B:

A

B

C

D

(Mich. supplies the figures which are lacking in the mss. In each group the front legs are the left pair, the hind legs the right.)

or inversely, that is to say, not in the same direction, but the forelegs bend convexly and the back legs concavely, as in C; or (the converse of C) with the convexities towards one another and the concavities
ta de koila ektos, kathaper exei ef' ois to Δ),
ws men exei ef' ois to A  h to B, outhein kampitesai
ou'te twv dipoidon ou'te twv tetrapodwn, wos de
10 to Γ, ta tetrapoda, wos de to Δ, twv men tetrapo-
idwn outhen plhn eléphas, de d' anthropos tous prai-
khonas kai ta skelh' tous men gar epi to koilon
kampitei, ta de skelh' epi to kurtón.
'Aei d' enallag' enantwos exei ta koila tas
kamphes tois anthropois, oion to ulékranon epi to
15 koilon, o de karpod tis cheiros epi to kurtón, kai
paliw o  dmos epi to kurtón. oustwos de kai epi
twv skelwn o meros epi to koilon, to de gony epi
to kurtón, o de pouz touvantaion epi to koilon. kai
ta katois dh' pros ta auw faneiron oste enantwos:
'gara arxh' upenantaion, o men  dmos epi to kurtón,
20 o de meros epi to koilon. dio kai o men pouz
epi to koilon, o de karpod tis cheiros epi to
kurtón.

XIV. Ai men ouv kamphes twv skelwn touiton
to ton trópon ouchoi kai dia tas aitias tas
eirhmenas, kinei kai de ta opištia pros ta em-
25 prosbhev katad diámetrov. metax gar to deziw twn
emprosbhev to aristeiron twn opisbehv kynousin,
epi to aristeiron twn emprosbhev, metax de toouto to
dezidion twn opisbehv. aitioi d' ostei eim na
emprosbhein amia kai prouton, diostato an  h kai
propehtis an eniveto h batidias oion efelkomewos
tois opisbehv. epi d' ou pereia alla alasia to
30 toioouton. xalipon de synexh' poieisai tin mete-
bolh' allomena. smeion de' tachy gar apagoreousi
kai nyn twv uppon osou toon trópon toouton
piountai tin kínhsin, oion oi pompeontes. xorís
528
outwards, as in D. No biped or quadruped bends its limbs as in figure A or B, but quadrupeds bend them as in C. The bendings illustrated by figure D occur in none of the quadrupeds except the elephant, and in the movement of the arms and legs by man, for he bends his arms concavely and his legs convexly.

In man the bendings of the limbs always take place alternately in opposite directions; for example, the elbow bends concavely but the wrist convexly, and the shoulder again convexly. Similarly in the legs, the thigh bends concavely, the knee convexly, and the foot, on the other hand, concavely. And obviously the lower limbs bend in opposite directions to the upper; for the origin of movement bends in opposite directions, the shoulder convexly and the thigh concavely; therefore also the foot bends concavely and the wrist convexly.

XIV. The bendings, then, of the legs take place in this manner and for the reasons stated. But the back legs move diagonally in relation to the front legs; for after the right fore leg animals move the left hind leg, then the left fore leg, and after it the right hind leg. The reason is that, if they moved the fore legs at the same time and first, their progression would be interrupted or they would even stumble forward, with their hind legs as it were trailing behind. Further, such movement would not be walking but jumping; and it is difficult to keep up a continuous movement from place to place by jumping. An illustration of this is that, in actual fact, horses that move in this manner, for example in religious processions, soon become tired. For this reason, then, animals do

\[ a \text{ i.e. prancing instead of walking.} \]
μὲν οὖν τοὺς ἐμπροσθεν καὶ ὅπισθεν διὰ ταῦτα
οὐποιοῦνται τὴν κίνησιν· εἰ δὲ τοὺς δεξιῶς ἀμφοτέροις πρῶτοις, ἔξω ἄν ἐγίγνοντο τῶν ἐρευνάτων καὶ ἐπιπτον ἄν. εἰ δὴ ἀνάγκη μὲν ἥ τούτων τῶν τρόπων ὀποτερονοῦ ὑποκείεθαι τὴν κίνησιν ἥ κατὰ διάμετρον, μὴ ἐνδεχέται δ′ ἐκείνων μηδέτερον, ἀνάγκη κινεῖσθαι κατὰ διάμετρον· οὕτω γὰρ κινούμενα ὁσπερ εἰρήται οὐδέτερα τούτων οἰόν τε πάσχειν. καὶ διὰ τοῦτο οἱ ἢπποι καὶ ὅσα τουὰτα, ἵσταται προβεβηκότα κατὰ διάμετρον, καὶ οὐ τοῖς δεξιῶς ἥ τοῖς ἀριστεροῖς ἀμφοτέροις ἁμα. τὸν αὐτὸν δὲ τρόπον καὶ ὅσα πλείους ἔχει πόδας τεττάρων ποιεῖται τὴν κίνησιν. ἀεὶ γὰρ ἐν τοῖς τέτταρις τοῖς ἐφεξῆς τὰ ὀπίσθια πρὸς τὰ ἐμπροσθεν κινεῖται κατὰ διάμετρον. δὴλον δ′ ἐπὶ τοῖς βραδέως κινούμενοι. καὶ οἱ καρκίνοι γὰρ τὸν αὐτὸν τρόπον κινοῦνται· τῶν πολυπόδων γὰρ εἰσιν. ἀεὶ γὰρ καὶ οὗτοι κατὰ διάμετρον κινοῦνται, ἐφ᾽ ὅπερ ἄν ποιεῖται τὴν πορείαν. ἰδίως γὰρ τοῦτο τὸ ζώον ποιεῖται τὴν κίνησιν· μόνον γὰρ οὐ κινεῖται ἐπὶ τὸ πρόσθεν τῶν ζῴων, ἀλλ᾽ ἐπὶ τὸ πλάγιον. ἀλλ᾽ ἐπεὶ τοῖς ὀμμασὶ διώρισται τὸ πρόσθιον, ἢ φύσις πεποίηκεν ἀκολουθεῖν δυναμένους τοὺς ὀφθαλμοὺς τοὺς κάλοις· κινοῦνται γὰρ εἰς τὸ πλάγιον αὐτοῖς, ὡστε τρόπον τινὰ καὶ τοὺς καρκίνους κινεῖσθαι διὰ τοῦτ ἐπὶ τὸ ἐμπροσθεν.

ΧV. Οἱ δ᾽ ὀρνιθες τὰ σκελῆ καθάπερ τὰ τετράποδα κάμπτουσιν. τρόπον γὰρ τινὰ παραπλησίως

1 οὗ Ρ: om. SYUZ.
not move separately with their front and back legs; and, if they moved with both their right legs first, they would not be above their supporting limbs and would fall. If, then, they must necessarily move in one or other of these two ways or else diagonally, and neither of the first two ways is possible, they must necessarily move diagonally; for if they move thus they cannot, as has been explained, suffer either of the above ill results. For this reason horses and similar animals stand at rest with their legs advanced diagonally and not with both right or both left legs advanced at the same time. And those animals which have more than four legs move in the same manner; for in any four adjoining legs the back legs move diagonally with the fore legs, as can be plainly seen in those which move slowly.

Crabs too move in the same fashion, for they are among the polypods. They, too, always move on the diagonal principle in whatever direction they are proceeding. For this animal moves in a peculiar manner, being the only animal to move obliquely and not forward. But since "forward" is determined in relation to the vision, nature has made the crab's eyes able to conform with its limbs; for its eyes move obliquely, and so, for this reason, crabs too can, in a sense, be said to move "forward."

XV. Birds bend their legs in the same manner as quadrupeds; for in a way their nature is closely

\(^a\) *i.e.* do not move first the front legs together and then their back legs together. The ms. authority is strongly in favour of the omission of the negative; but 712 b 4 "one or other of these two ways" implies the alternative of movement with the front legs together and then the back legs together, or else with the right legs together and then the left legs together.
712b ἡ φύσις αὐτῶν ἔχει τοῖς γὰρ ὀρνισθαίναι αἰ πτέρυγες ἀντὶ τῶν προσβλητῶν σκελῶν εἰσών. διὸ καὶ κεκαμ- 
25 μέναι τὸν αὐτὸν εἰοί τρόπον ὠσπερ ἐκεῖνος τὰ πρόσβλημα σκέλη, ἐπεὶ τῆς ἐν τῇ πορείᾳ κινήσεως 
tούτοις ἀπὸ τῶν πτερύγων ἡ κατὰ φύσιν ἀρχὴ 
tῆς μεταβολῆς ἐστὶν. πτήσεως γὰρ ἐστὶν ἡ τούτων 
οἰκεία κίνησις. διόπερ ἀφαίρεσθαι τούτων οὐθ' 
33 ἔστάναι οὐτε προϊέναι δύνατ' ἂν οὐθεὶς ὄρνις.

'Ετι διποδὸς ὄντος καὶ οὐκ ὅρθου, καὶ τὰ ἐμ-

713a προσθεν μέρη τοῦ σώματος κονδυλετά ἐχοντος, ἢ 
ἀναγκαίον ἡ βέλτιον πρὸς τὸ ἐστάναι δύνασθαι τὸν 
μηρόν οὕτως ὑποκείμενον ἔχειν ὡς τών ἔχει, λέγω 
δ' ὅτι εἰς τὸ ὄπισθεν πεφυκότα. ἀλλὰ μὴν εἰ ἐδε 
tούτον ἔχειν τὸν τρόπον, ἀνάγκη τῆς κάμψιν ἐπὶ 

5 Ὀλως δὲ οἱ τε ὄρνιθες καὶ τὰ ὀλόπτερα τῶν πε-

tομένων καὶ τὰ ἐν τῷ ὕγρῳ νευστικά, ὅσα αὐτῶν 
δι' ὄργανον τῆς ἐπὶ τοῦ ὕγρου ποιεῖται πορείαν, οὐ 
χαλεπὸν ἵδειν ὅτι βέλτιον ἐκ πλαγίου τῆς τῶν εἰ-
ρημένων μερῶν πρόσφυσιν ἔχειν, καθάπερ καὶ 
φαίνεται τῶν ὑπάρχειν αὐτοῖς ἐπὶ τε τῶν ὄρνιθων 
καὶ τῶν ὀλόπτερων. ταύτῳ δὲ τούτῳ καὶ ἐπὶ 
τῶν ἰχθύων τοῖς μὲν γὰρ ὀρνισθαίναι πτερύγες, τοῖς δ' 

10 ἐνυδροῖς τὰ πτερύγια, τὰ δὲ πτῖλα τοῖς ὀλόπτεροι 
ἐκ τοῦ πλαγίου προσπέφυκεν. οὕτω γὰρ ἂν τὰ-
χιστα καὶ ἱσχυρότατα διαστελλόντα τὰ μὲν τῶν 
ἀέρα τὰ δὲ τὸ ὕγρον ποιοῦτο τὴν κίνησιν εἰς γὰρ 
τὸ ἐμπροσθεν καὶ τὰ ὄπισθεν μόρια τοῦ σώματος 
ἐπακολουθοῦσιν ἄν ὑπεύκοντι φερόμενα τὰ μὲν ἐν 

15 τῷ ὕγρῷ τὰ δ' ἐν τῷ ἀέρι. τὰ δὲ τρωγλοδυτικά
similar. For in birds the wings serve instead of front legs, and so they are bent in the same manner as the front legs of quadrupeds, since in the movement involved in progression the natural beginning of the change is from the wings, for their particular form of movement is flight. Hence, if the wings were taken away, no bird could stand or progress forward.

Further, since the bird is a biped and not erect, and the front parts of its body are lighter, it is either necessary (or at any rate more desirable), in order to enable it to stand, that the thigh should be placed, as it actually is, underneath, by which I mean growing towards the hinder part. But if the thigh is necessarily in this position, the bending of the leg must be in a concave direction, as in the back legs of quadrupeds, and for the same reason as we gave in dealing with viviparous quadrupeds.

Generally in birds and winged insects and creatures that swim in the water (all, that is to say, that progress in the water by means of their instrumental parts), it is not difficult to see that it is better that the attachment of such parts should be oblique, as in fact it seems actually to be in the birds and the flying insects. The same is also true of the fishes; for the wings in birds, the fins in fishes, and the wings in flying insects all grow obliquely. This enables them to cleave the air or water with the greatest speed and force, and so effect their movement; for the hinder parts, too, can thus follow in a forward direction, being carried along in the yielding water or air.

The oviparous quadrupeds which live in holes,
713a τῶν τετραπόδων καὶ ψωτόκων, οἱ οἱ τε κρο-κόδειλοι καὶ σαύροι καὶ ἀσκαλαβώταται καὶ ἐμύδες
tε καὶ χελώναι, πάντα ἐκ τοῦ πλαγίου προσπε-
φυκότα τὰ σκέλη ἔχει καὶ ἔπι τῇ γῇ κατατεταμένα,
καὶ κάμπτει εἰς τὸ πλάγιον, διὰ τὸ οὕτω χρῆσιμα
eῖναι πρὸς τὴν τῆς ύποδύσεως ραστώνην καὶ πρὸς
tὴν ἐπὶ τούτοις ψωτές ἑφεδρεῖα καὶ φυλακήν. ἔξω
δ’ ὅντων αὐτῶν, ἀναγκαῖον τοὺς μηροὺς προσ-
στέλλονταμεν ὑφ’ αὐτὰ τὸν μετεω-
ρισμὸν τοῦ ὄλου σώματος ποιεῖσθαι. τούτου δὲ
γνωμένου κάμπτειν αὐτὰ οὖχ οἴον τε ἀλλως ἦ
ἐξω.

XVI. Τὰ δ’ ἄναμμα τῶν ὑποπόδων ὃτι μὲν
πολύποδα ἐστὶ καὶ οὐθὲν αὐτῶν τετράπον, πρότερον ἡμῖν εἰρηται. διότι δ’ αὐτῶν ἀναγκαίον
ἡν τὰ σκέλη πλην τῶν ἐσχάτων ἐκ τε τοῦ πλαγίου
προσπεφυκέναι καὶ εἰς τὸ ἀνώ τὸς καμπᾶς ἔχειν,
καὶ αὐτά ὑπόβλαισα εῖναι εἰς τὸ ὀπισθεν, φανερόν.
ἀπάντων γὰρ τῶν τοιούτων ἀναγκαίον ἐστὶ τὰ
μέσα τῶν σκελῶν καὶ ἡγοῦμενα εἰναι καὶ ἐπόμενα.
eἰ οὖν ὑπ’ αὐτοῖς ἦν, ἔστει αὐτὰ καὶ εἰς τὸ ἐμ-
προσθεν καὶ εἰς τὸ ὀπισθεν τὴν καμπῆν ἔχειν, διὰ
μὲν τὸ ἡγεῖσθαι εἰς τὸ ἐμπροσθεν, διὰ δὲ τὸ
ἀκολουθεῖν εἰς τὸ ὀπισθεν. ἐπεὶ δ’ ἀμφότερα
συμβαίνειν ἀναγκαῖον αὐτοῖς, διὰ τούτῳ βεβλαίσω-
ται τε καὶ εἰς τὸ πλάγιον ἔχει τὰς καμπᾶς, πλὴν
τῶν ἐσχάτων· ταύτα δ’ ὄσπερ πέρικε μᾶλλον,
τὰ μὲν ὡς ἐπόμενα τὰ δ’ ὡς ἡγοῦμενα. ἐτὶ δὲ
κέκαμπται τὸν τρόπον τούτου καὶ διὰ τὸ πλήθος
τῶν σκελῶν· ἢττον γὰρ ἃν οὕτως ἐν τῇ πορείᾳ
ἐμπόδια τε αὐτὰ αὐτοῖς εἶν καὶ προσκόπτοι. ἦ
τε βλαστήσης αὐτῶν ἐστὶ διὰ τὸ τρωγλοδυτικά
534
such as the crocodile, the common and the spotted lizard, and land and water tortoises, all have their legs attached obliquely and stretched out upon the ground; and they bend them obliquely, since they are thus useful in enabling them to crawl easily into their holes and to sit upon and protect their eggs. Since their legs project, they are obliged to raise their whole body by drawing in their thighs and placing them underneath them; and in this process they cannot bend them otherwise than outwards.

XVI. It has already been said that bloodless animals which have legs are polypods, and none of them quadrupeds. Their legs, except the two extreme pairs, are necessarily attached obliquely and bend upwards and are themselves bowed somewhat backwards; and the reason for this is plain. For in all such animals the middle legs must both lead and follow. If, therefore, they were underneath them, they would have to bend both forwards and backwards—fowards because they lead, and backwards because they follow. But since they must do both these things, their legs are bowed and make their bends obliquely, except the extreme pairs, which are more in accordance with nature, since the first pair leads and the last pair follows. The number of legs is a further reason for their being bent in this way; for they would thus be less likely to get in each other’s way during movement and collide with one another. The reason that these animals are bow-legged is that they all, or most of

1 προστέλλουτα (cum Mich.) Jaeger: προστέλλουτα libri.
ARISTOTLE

713b

einai pantai h ta pleistata: ou gar oion te ypilalai einai ta zwna1 ton trpon ton ton.

Oi de karkinou twn polupodwn periattotata pefu-


casw: ouste gar eis to prosebhein poiountai twn porieian

plin w sper eirhtai prosteron, pollous te touj

ygoumenous exousi mouni twn zwn. ton ton to

aitiwn h sklerotis twn podwn, kai oti chrwntai

ou neusewis charion autois alla porieias: pezeounta

gar diateleswai. pantwn men ou twn polupodwn

eis to plagwion ai kampai, w sper kai twn tetrap-

podw onsa trugolidotika: twnuta de estin ouw

saora kai krokodeiloi kai ta polla twn w-

tokouwtwn. aitw de oti trugoludutei ta men

tois tokois, ta de kai tw bier panti.

XVII. Allla twn men allwn blaiouqai ta kwa

dia to malakai einai, twn de karaobon ontwon skler-

rodermon on podes eisiv esti tw neiv kai ou tou

badiwv chariv twn de karkinon h kampiv eis to

plagwion, kai ou belaiowtai wspere tois wotokoiv

twn tetrapodwn kai tois anaimos kai poluposi,

dia to skleroderma einai ta kula kai ostrakowde

onti ou neustiki kai trugoludity: prosw tyn gar

biw. kai stratogulos de tyn mofhiv, kai ouv

exwv ouropynwv wspere de karabos: prosw tyn

neuviv gar tois karaobon chrismov, de ou neuv-

stikos. kai oumion de tw opisthein to plagwion

exei mounos, dia to pollous exenw twn ygemovnas

1 ta zwnta om. SU.

* 712 b 20 f.

b Viz. two pairs of front legs.

c i.e. they walk both on dry land and in the sea.

d The whole of the section is obscure, and the text doubtful.

536
them, live in holes; for creatures that live thus cannot be tall.

Crabs are the most strangely constituted of all the polypods; for they do not progress forward (except in the sense already mentioned), and they alone among animals have several leading legs. The reason is the hardness of their feet and the fact that they use them not for swimming but for walking; for they always go along the ground. All the polypods bend their legs obliquely like the quadrupeds that live in holes; lizards, for instance, and crocodiles and most oviparous quadrupeds are of this nature. The reason is that they live in holes, some only during the breeding season, others throughout their lives.

XVII. Now the other polypods are bow-legged because they are soft-skinned, but the legs of the spiny lobster, which is hard-skinned, are used for swimming and not for walking. The bendings of crabs' legs are oblique but their legs are not bowed, as are those of viviparous quadrupeds and bloodless polypods, because their legs are hard-skinned and testaceous, the crab not being a swimming animal and living in holes, for it lives on the ground. Moreover, the crab is round in shape and does not possess a tail like the spiny lobster; for the latter's tail is useful for swimming, but the crab does not swim. And it is the only animal in which the side is like a hinder part, because its leading feet are numerous.

* There is no single word in English for this animal, the Latin locusta and the French langouste.

† And therefore are not bowed, as Mich. explains.

‡ Since the crab moves sidewise, one of its sides becomes as it were the back, but why it should be so for the reason given is obscure.
πόδας. τούτου δ' αύτιον ὅτι οὐ κάμπτει εἰς τὸ
πρόσθεν οὖδὲ βεβλαίσωται. τοῦ δὲ μὴ βεβλαι-
σῶσθαι τὸ αύτιον πρότερον εἰρηται, ἡ σκληρότης
καὶ τὸ ὀστρακώδες τοῦ δέρματος. ἀνάγκη δὴ
diὰ ταῦτα πᾶσι τε προηγεῖσθαι καὶ εἰς τὸ πλάγιον,
eἰς μὲν τὸ πλάγιον ὅτι εἰς τὸ πλάγιον ἡ κάμψις,
πᾶσι δ' ὅτι ἐνεπόδιζον ἂν οἱ ἁρμοῦντες πόδες
toῖς κινουμένοις. οἱ δὲ ψηττοειδεῖς τῶν ἱχθῶν,
ὡσπερ οἱ ἑτερόφθαλμοι βαδίζουσιν, οὕτω νέουσιν·
diéστραττα γὰρ αὐτῶν ἡ φύσις. οἱ δὲ στεγανό-
πόδες τῶν ὀρνίθων νέουσι τοῖς ποσίν, καὶ διὰ μὲν
tὸ τὸν ἁέρα δέχεσθαι καὶ ἀναπνεῖν δῖποδες ἐσὶ,
diὰ δὲ τὸ ἐν ψυμῷ τῶν βίων ἔχειν στεγανόπόδες·
ἀντὶ πτερυγίων γὰρ χρήσιμοι οἱ πόδες αὐτοῖς
τοιοῦτοι ὄντες. ἔχουσι δὲ τὰ σκέλη οὐχ ὡσπερ
οἱ ἄλλοι κατὰ μέσον, ἄλλ' ὅπως θευ μᾶλλον· ἐρ-
χυσκέλων γὰρ αὐτῶν ὄντων ὅπως θευ ὄντα πρὸς
τὴν νεῦσιν χρήσιμα. ἐρχυσκελεῖς δ' εἰςών οἱ
τοιοῦτοι διὰ τὸ ἀπὸ τοῦ μῆκος τῶν σκελῶν
ἀφελοῦσαν τὴν φύσιν προσθεῖναι εἰς τοὺς πόδας,
καὶ ἀντὶ τοῦ μῆκους πάχος ἀποδοῦναι τοῖς σκέλεσι
καὶ πλάτος τοῖς ποσίν· χρήσιμοι γὰρ πλατεῖς
ὄντες μᾶλλον ἡ μακρὸ πρὸς τὸ ἀποβιάζεσθαι τὸ
ψυμῷ, ὅταν νέουσιν.

ΧVIII. Εὐλόγως δὲ καὶ τὰ μὲν πτηνὰ πόδας
ἔχειν, οἱ δ' ἱχθύες ἄποδες· τοῖς μὲν γὰρ ὁ βίος ἐν
τῷ ἐηρῷ, μετέωρον δ' ἀεὶ μένειν ἄδυνατον, ὡστ' ἀνάγκη
πόδας ἔχειν· τοῖς δ' ἱχθύσιν ἐν τῷ ψυμῷ
ὁ βίος, καὶ τὸ ὑδρῷ δέχονται, οὐ τὸν ἁέρα. τὰ
μὲν οὖν πτερύγια χρήσιμα πρὸς τὸ νεῖν, οἱ δὲ
πόδες ἀχρηστοί. εἰ δ' ἀμφω εἰχον, ἀναμικτο ἡ
εἷς. ὀμοῖοι δ' ἔχουσιν οἱ ὀρνίθες τρόπον τυνᾶ
538
The reason is that it does not bend its legs forwards and is not bow-legged. Why it is not bow-legged has been already explained before, namely, because its skin is hard and testaceous. For this reason it must lead off with all its legs and obliquely—obliquely because its bendings are oblique, and with all its legs, because otherwise those which were at rest would impede those which were moving.

Flat-fish swim as one-eyed men walk; for their nature is distorted. Web-footed birds swim with their feet. They are bipeds, because they take in breath and respire; they are web-footed, because they live in the water, for their feet being of this kind are of service to them in place of fins. They do not have their legs, as the other birds do, in the centre of the body, but placed rather towards the back; for since they are short-legged, their legs being set back are useful for swimming. This class of bird is short-legged because nature has taken away from the length of their legs and added to their feet, and has given thickness instead of length to the legs and breadth to the feet; for, being broad, they are more useful than if they were long, in order to force away the water when they are swimming.

XVIII. It is for a good reason, too, that winged animals have feet, while fishes have none. The former live on dry land and cannot always remain up in the air, and so necessarily have feet; but fishes live in the water, and take in water and not air. Their fins, then, are useful for swimming, whereas feet would be useless. Also, if they had both feet and fins, they would be bloodless. Birds in a way

\[\pi\lambda\alpha\tau\epsilon\epsilon\ 2: \pi\alpha\chi\epsilon\epsilon\ \text{PSUY.}\]
tois ἰχθύσιν. tois ἵν ἄρα ὄρνισιν ἄνω αἱ πτερύγες
eis, tois de πτερύγια δύο ἐν τῷ πρανεῖ· καὶ τοῖς
μὲν ἐν τοῖς ὑπτίοις οἱ πόδες, τοῖς de ἐν τε τοῖς
ὑπτίοις καὶ ἐγγύς τῶν πρανῶν πτερύγια τοῖς
πλείστοις· καὶ οἱ μὲν ὄμορφους ἔχουσιν, οἱ δὲ
οὐραίοι.

XIX. Περὶ de τῶν ὀστρακοδέρμων ἀπορῆσειν
ἀν τις τίς ἡ κύνησις, καὶ εἰ μὴ ἔχουσι δεξιόν καὶ
ἀριστέρον, πόθεν κυνοῦται· φαίνονται de κυνού-
μενα. ἡ ωσπερ ἀνάπηρον deι τιθέναι πάν τὸ
toιοῦτον γένος, καὶ κυνεῖσθαι ὁμοίως οἶνον εἰ τις
ἀποκόψειε τῶν ὑποπόδων τὰ σκέλη, ἡ1 ὁσπερ
ἡ φώκη καὶ ἡ νυκτερίς· καὶ γάρ ταῦτα τετράποδα,
κακῶς δὲ ἐστίν. τὰ δὲ ὀστρακοδέρμα κυνεῖται μέν,
κυνεῖται de παρὰ φύσιν· οὐ γάρ ἐστι κυνητικά, ἀλλὰ
ὡς μὲν μόνιμα καὶ προσπέφυκότα κυνητικά, ὡς de
πορευτικὰ μόνιμα. ἔχουσι de φαύλως καὶ οἱ καρκίνοι
tὸ δεξία, ἐπεὶ ἔχουσι γε. δηλοῖ δὲ ἡ χελών· μεῖζων
γάρ καὶ ἰσχυροτέρα ἡ δεξιά, ὡς βουλομένων δι-
ωρίσθαι τῶν δεξιῶν καὶ τῶν ἀριστερῶν.

Τὰ μὲν οὖν περὶ τῶν μορίων, τῶν τ᾽ ἄλλων καὶ
tῶν περὶ τὴν πορείαν τῶν ζώων καὶ περὶ πᾶσαν
tὴν κατὰ τόπον μεταβολὴν, τοῦτον ἔχει τὸν τρόπον
tοῦτων de διωρισμένων ἔχομενον ἐστὶ θεωρῆσαι
περὶ ψυχῆς.

1 ἢ addidi.

* i.e. a second pair of fins.
* See H.A. 527 b 35 ff., where land-snails, sea-snails, oysters and sea-urchins are given as examples.
* See H.A. 498 a 31, P.A. 697 b 1 ff.
* These words can only refer to the De anima, which from its citation in the De generatione animalium, De partibus animalium, etc., must be regarded as an earlier work. This

540
resemble fishes. For birds have their wings in the upper part of their bodies, fishes have two fins in their fore-part; birds have feet on their under-part, most fishes have fins in their under-part and near their front fins; also, birds have a tail, fishes a tail-fin.

XIX. A question may be raised as to what is the movement of testaceans, and where their movement begins if they have no right and left; for they obviously do move. Must all this class be regarded as maimed and as moving in the same way as an animal with feet if one were to cut off its legs, or as analogous to the seal and bat, which are quadrupeds but malformed? Now the testaceans move, but move in a way contrary to nature. They are not really mobile; but if you regard them as sedentary and attached by growth, you find that they are capable of movement; if you regard them as progressing, you find that they are sedentary.

Crabs show only a feeble differentiation of right and left, but they do show it. It can be seen in the claw; for the right claw is bigger and stronger, as though the left and right wished to be differentiated.

So much for our discussion of the parts of animals and particularly those which have to do with progression and all change from place to place. Now that these points have been settled, our next task is to consider soul.

has led some critics (e.g. Brandis) to reject the whole of this paragraph as a later addition. Such a paragraph, however, is a characteristic conclusion in Aristotle, and should not be rejected as a whole. It is quite possible that the words περὶ ψυχής are corrupt, and indeed the word ψυχής has been supplied by a later hand in Z, whereas the first hand had left a blank and had written ζωή (sic) in the margin, which would be a reference to the latter part of the group of treatises known as the Parva Naturalia.
# INDEX TO PARTS OF ANIMALS

The Index is to be regarded as supplementary to the Summary on pages 12-18. Further references will sometimes be found in the notes on Terminology, pages 24-39.

The numbers 3 to 50 refer to the pages of the Introduction.

The numbers 39a to 97b (standing for 639a to 697b) refer to the pages and columns of the Berlin edition which are printed at the top of each page of the Greek text. The lines are referred to in units of five lines; thus

\[ 40a1 = 640a1-640a4 \]
\[ 40b5 = 640b5-640b9. \]

Such references include footnotes to the translation.

*\( \text{f, ff} = \text{following section or sections.} \)*

Under any heading, each entry is separated from the preceding by a dash ( / ), unless it has the same page number.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>abdomen (abdominal cavities)</td>
<td>50a10</td>
</tr>
<tr>
<td>abomosum</td>
<td>74b15 / 76a10</td>
</tr>
<tr>
<td>abscess</td>
<td>67b5</td>
</tr>
<tr>
<td>&quot;abscession&quot;</td>
<td>39 / 90a5</td>
</tr>
<tr>
<td>Acalephae</td>
<td>81a35</td>
</tr>
<tr>
<td>Aesop</td>
<td>63a35</td>
</tr>
<tr>
<td>allantois</td>
<td>93b25</td>
</tr>
<tr>
<td>Amia</td>
<td>76b20</td>
</tr>
<tr>
<td>analogy, difference by 44b10</td>
<td>/ 45b5</td>
</tr>
<tr>
<td>Anaxagoras</td>
<td>40b5 / 45a35 / 77a5 / 87a5</td>
</tr>
<tr>
<td>animal</td>
<td>53b20 / 66a35</td>
</tr>
<tr>
<td>antelope</td>
<td>63a10</td>
</tr>
<tr>
<td>ants</td>
<td>50b25 / 78b15 / 83a5</td>
</tr>
<tr>
<td>Aorta</td>
<td>52b25 / 66b25 / 67b15ff / 71b15 / 77a5 / 78a1</td>
</tr>
<tr>
<td>ape</td>
<td>89b30</td>
</tr>
<tr>
<td>appendage</td>
<td>70a30</td>
</tr>
<tr>
<td>Aquinas, St Thomas</td>
<td>42</td>
</tr>
<tr>
<td>Arcadia</td>
<td>73a15</td>
</tr>
<tr>
<td>Aristotle, &quot;lantern&quot;</td>
<td>of 80a5</td>
</tr>
<tr>
<td>art</td>
<td>39b15 / 40a25</td>
</tr>
<tr>
<td>Ascidian</td>
<td>80a5 / 81a10, 25f</td>
</tr>
<tr>
<td>ass</td>
<td>67a20 / 88b20</td>
</tr>
<tr>
<td>&quot;Indian&quot;</td>
<td>ass 63a15</td>
</tr>
<tr>
<td>Astaci</td>
<td>83b25 ff</td>
</tr>
<tr>
<td>attributes, &quot;essential&quot; (or &quot;inseparable&quot;)</td>
<td>43a25 / 45b1</td>
</tr>
<tr>
<td>auditory passages</td>
<td>57a15</td>
</tr>
<tr>
<td>backbone</td>
<td>51b30 / 52a10 / 54b10</td>
</tr>
</tbody>
</table>

543
backward-grazing oxen
59a15
Bacon, Francis 58b15
barn-door fowls 57b25
bat 97b1 ff
Batos 95b25 / 96a25 / 97a5
beak 59b1 ff /
   62a30 ff / 92b15 / 93a10 f
bear 58b1
beautiful, the 45a25
bee 48a5 / 50b25 / 61a20 /
   78b10 ff / 82b10 / 83a5, 30
beetle, see dung-beetle
belly 55a1
bending 54b5 / 83b1, 30 /
   87b25 f / 89a10 / 93b1
Bergson 3
bile 49b30. See also gall
birds 42b10 / 57b5, 15 /
   59b1 ff / 60a25 / 74b15 ff /
   76a30 / 91a20 / 92b1 ff /
   97b20
bison 63a10
bivalves 79b15 ff
Black Sea 82a25
bladder 70b25 ff / 71b15, 25 /
   76a25
“blend” 31 / 37 / 38 / 39 /
   50b25 / 52b25, 35 / 69a10 /
   73b30 / 86a10
blinking 57a35, b15 f / 91a20
blood 4 / 45b5 / 47b1 (current of), 30 ff / 49a15, b20 /
   50a30 ff / 51a10 / 56b1 /
   66b25 f / 67b15 ff / 78a5
blood-vessels 47b5 / 50a25 f /
   52b30 / 54b1 / 65b10 f, 25 /
   66b25 / 67b15 ff
   Great Blood-vessel 52b25 /
   66b25 / 67b15 ff / 71b1 /
   78a1
blooded animals 22 / 42b10 / 544
INDEX TO PARTS OF ANIMALS

Cephalopods 23 / 54a10 / 78a25 ff, b25 ff / 84b5 ff
Cercidas 73a15
Cestreas 75a10 / 96a5
Cetacea 69a5 / 97a15 ff
Chalcis in Euboea 77a1
chamaeleon 92a20
chance 40a30 / 41b20 / 45a20
ciliary motion 84b20
classification 18 / 20 / 42b5 ff / 43b10 ff
claws 62b1 / 83b30 f / 84a15, 30
cloven hoof 74a25 / and passim
cockchafer 82b15
“colliquescence ” 38 / 77a10
colon 75b5, 15
common functions to body and soul 9 / 43a35
components in isolation 45a35
“composition” 4 / 46a10 ff
composition of Aristotle’s works 10
“concoction” 31 / 34 / 50a5 / 51a20, b25 / 52a5 / 68b5 / 70a20, 25 / 72a1 / 75a10 f / 77b25 f
connate pneuma 59b15 / 69a1
controlling part 73b10 / 81b15 ff / 82b1, 25 / 86a15
Cook, A. B. 73a15
cooling 56a20 / 62a15 / 68b35 ff / 92a20 / 96b20
copulation 89a5, 25
Cordylus 95b25
couvre-feu 54a5
 crab 79a30 / 91b15
Crex 95a20
crocodile 60b25 f / 90b20 / 91a15, b5 ff
crop 74b20 ff / 78b30 f
crow 62b5
Crustacea 23 / 54a1 / 57b30 / 78a25 ff / 83b25 ff
cuttlefish 54a20. See also Sepia
Cuvier 44 / 84b15
Cyproi 60b35
Darwin 4 / 7
deer 50b15 / 63a10, b10 / 64a1 / 67a20 / 77a30 / 88b25
deformed animals 57a20 / 60b25 / 84b1 / 95b1
Democritus 40b30 f / 42a25 / 65a30
derivation of words 62b20 / 72b30
diaphragm 70a5 / 72b10 ff
dichotomy 18 / 42b5 ff
differentiae 42b20 ff
disadvantageous parts 48a15 / 59a15 / 63a5 / 64a5 / 94a15
Dissections 50a30 / 66a5 / 68b30
divers 59a5
divine things 44b25 ff / 56a5
“division of labour ” 83a20 / 91b20
dog 74a1 / 75a25 / 88a5, b1
Indian dog 43b5
dog-teeth 61b10
dolphin 55a15 / 69a5 / 77a35 / 96b25 / 97a15
duality of the body 56b30 / 63a20 / 67b30 / 69b10 ff
dung 75b30
dung-beetle 82b25
dwarf-like 86b1 ff / 89b25 / 95a5
dynamis 29 / 30-32 / 40a20 / 46a10, b15 ff / 47b5 / 55b10
ears 57a10 ff
earth 51a25
ARISTOTLE

earthly matter 63b25 ff etc.
editions of Aristotle’s *De partibus* 44-45
Edwards, Milne 83a20
eel 96a1, b20
eggs 65a35 / 84a20 / 92a15
“Elements” 30 / 42a20 / 46a10, b5 / 47a10 / 48b10
elephant 58b30 ff / 61a25 / 63a1 / 82b30 / 88b5, 15 / 92b15
embryo 51b20 / 55a1 / 65b1 / 66a20 / 71b5 / 76a15
Empedocles 40a20, b5 / 42a15 / 48a30
Emys 71a30
epiglottis 64b20 ff
epipetron 81a20
equivalents, law of organic 55a25
“excess and defect” (“the more and less”) 19 / 44a20, b15 / 49a30 / 55a30 / 61b30 ff / 84a30 / 92b5
excrement 63a15. See residue
excretory organs 89a5 ff
eye and eyelid 57a25 ff / 91a20
eyebrows 58b10 ff
eyelashes 58a10 ff

Fabricius 43
fat 51a20 ff / 72a1
fear 50b25 / 67a15 f / 79a25 / 82b25 / 92a20
feathers 92b10
fibres 50b10, 30
fin 85b15 / 93b25 ff
Final Cause 21 / 39b15 ff / 46b25
fire 49a20 / 50a5 ff / 52b5
fishes 42b10 / 58a1 / 60b10 ff, 546

35f / 62a5 f / 66b10 / 75a1 ff / 76a25, b20 / 95b1 ff
fishing-frog 95b10 / 96a25
fishing-rod 93a20
flea 83a30
flesh 47a20 / 51b5 / 53b15 ff / 60a5 f / 68a25 ff
fly 61a20 / 78b15 / 82b10 / 83a30
fluid and solid 32 / 46a15
flux 52b30
fontanel, anterior 53a35
foot 82a35 ff / 85a10 ff / 90a25 ff
foreskin 57b1
form (and matter) 9 / 11 / 25 / 40a15, b20 / 41a15
formation (process of) 27 / 40a10 ff / 46a25
funnel 79a1
gadflies 61a20
gall and gall-bladder 5 / 76b15 ff
gazelle 50b15 / 63a10, b25
gills 59b15 / 96b1 ff / 97a15f
gladius 54a20
goat 73b30 / 74b5 / 76b35 f / 88b25
Goethe 84b15
good, the 39b20 / 59b30 / 70b20
“good life” 56a5
“goodness” (arete) 42a30
goosefish 95b10 / 96a25
grasshopper 82a15 f
grease 51a25
Great Blood-vessel, see under blood-vessels
Grosseteste, Richard 41
gut 74a10 / 75a30 f

haematoporphyria 68b5
INDEX TO PARTS OF ANIMALS

haemorrhage 68b15
hair 58a15 ff
hand 87a5 ff, b1 ff / 90a30
hare 67a20 / 69b30 / 76a15
Harun-al-Rashid 40
Harvey, William 43 / 44
hawk 70b1
head 56a10 ff / 58b1 / 86a5 ff
hearing 56b10
heart 47a25 / 53b5 / 54b10 / 56a25 / 65a10, b10 ff / 70a20 f / 73b10 / 77b1 / 78b1 / 86a15 / 96b15
heat 53b5 / 96b15 / and passim
hepatopancreas, see mecon
Heracleitus 45a15
Heracleotic crabs 84a10
Herodotus 59a15
Hippocrates 30 / 31 / 37 / 40b15 / 48a1 / 50b20 / 85b5 / 86b25
Histo ria Animalium 46a5 / 50a30 / 60b1 / 74b15 / 80a1 / 84b5 / 89a15 / 96b15
Holothuria 81a15
Homer 73a15
hoof 90a5 ff
horned animals 73b30
horns 62b20 ff
horse 63a1 / 66b15 / 88b20, 30
hot, the 50a5 ff
hot and cold 41b15 / 46a15 / 48a20 ff
hucklebone 51a30 / 54b20 / 90a10 ff
hyaena 67a20

"idly" ("Nature does nothing idly") 61b20 / 91b1 / 94a15 / 95b15

immortality 37
"Indian ass" 63a15 f
ink 79a1 ff / 81b25
Insects 23 / 54a25 / 57b35 / 59b15 / 78b10 / 82a1 ff
instruments, instrumental parts 30 / 45b15, 25 / 46b25 / 47a1 ff, b20 / 87a5 ff
intelligence 48a1 / 50b20 / 72a30 / 86a25 f / 87a5
intermediate creatures 23 / 69a10 / 81a10, b10 / 89b30 / 97a15 ff
"internal finality" 3
intestines 50a15 / 74a10 ff / 73b1 ff / 76b10
irrigation 68a10 f
ischium 95a1 ff
jaws 91a25 ff
jejunum 75b25 ff
joints 54b15. See also bending

Kerkidas 73a15
Kestreus 75a10 / 96a5
kidney 70a15, b20 / 71a25 ff
kite 70b1
Knides 81a35
Ktesias 63a15

"lantern of Aristotle" 80a5
lard 51a20 ff, b25 / 72a5
layrnx 64a15 ff
laughter 73a1 ff
Lee, H. D. P. 10
Leonardo da Vinci 65b5
leopard 67a20 / 88a5
Lesbos 80b1
life 55b35 / 78b1
limpet 79b25 / 80a20
lion 51b35 / 55a10 / 58a30 / 86a20 / 88a5, b1 / 89a30

547
lips 59b20
liver 66a25 ff / 69b25 ff /
   73b15 ff / 77a15, 35 f, b35
lizard 76a25 / 91a5 ff
"lizards" (σαρπαί, plaited
tubes) 85b5
lobster 84a30
locust 83a30
logos 26 f / 39b15 / 40a30 / 
   42a20 / 46b1 / 49b25 / 
   78a35 / 95b15
Lophius piscatorius 95b10
lumen 71b1
lung 64a20 f / 65a15 / 68b30 ff
lynx 89a30
Maia 84a10
mammae 88a15 ff
Man 44a1 / 45b25 / 53a25 ff /
   56a5 / 58a15, b1 / 59b30 / 
   60a10 ff / 61b5 / 62b15 /
   66b5 / 69a20, b5 / 71b1 / 
   73a5, 25 / 76b30 / 86a25 ff /
   88b30 / 89b5 ff / 90a25 / 
   95a5
marrow 51b20 ff
marten 67a20
matter and form 9 / 35 / 36
mecon 79b10 / 80a20
melanin 34
Melolontha 82b15
membrane 73b1 ff / 77b15, 35 / 
   82b15 / 83b20 / 91a20
mesentery 50a25 / 76b10 / 
   77b35 ff
Methydrion 73a15
metre 60a5
mice 67a20 / 76b30
Michael Scot 40 ff / 46-47
migrants 94a5
milk 76a10 f / 88b1
moderation 52b15
Moerbeke, William of 42
   548
moon, full 80a30
mouth 50a10 ff / 62a15 ff
   96b20 ff
Murex 61a20
mussel 79b25 / 83b15
mytis 79a5 / 81b20 ff
nails 87b20 / 90b5
Natural science 39a10 / 40a
   "Natural Selection" 4
Nature 39b15 / 41a25, b10 ff, 
   42a15 / and passim
Naxos 77a1
Necessity 21 / 39b20 ff / 
   42a1 ff, 30 ff / 45b30 / 
   46b25 / 51a15 / 63b20 / 
   70a30, b20 / 72b30 / 77a15, 
   b20 / 78a1 / 79a25 / 82b25 / 
   85b15 / 92a1 / 94b5
neck 64a10 / 86a5 ff / 92b20 ff
Nerites 79b20
nictitating membrane 57a30
   "non-uniform" parts 28-30 / 
   46a20, b5, 30 / 47a25 / 
   55b25 ff
nostrils 58b25 ff
nutriment ("ultimate")
   50a30 / 51a15 / 78a5, 15
nutrition 47a25 / 50a35
octopus 52b25 / 54a20 / 
   78b25 / 79a5 ff / 85a5, 15 ff
oesophagus 50a15 / 64a15 ff / 
   74a10, b20 / 86a20 / 
   91a1
omasum 74b15 / 76a10 f
omentum 76b10 / 77b15
operculum 79b15
opposites, division by 43a30
orifice 81a25
Oryx 63a20
os sepiae 54a20
Ostreae 80b20
INDEX TO PARTS OF ANIMALS

ostrich 58a10 / 95a15 / 97b10 ff
"ova" 80a10 ff, b1 ff
ox 66b15 / 71b5 / 88b25 etc.
oyster 80b5, 20 / 81b10

Parthenides 48a25
Parnassus 81a20
parrot-fish 62a5 / 75a1
"part" 28-30 / 51b25 / 64a5 / 90a5/
passages 50a15 / 56b15 / 71b1, 10 ff / 78a10
"pen" of Calamary 54a20
penis 89a20 f
"perfect" animals 55b30 / 66a25 / 82a30
philosophers, early 40b5 / 41a5 ff / 47a10
"philosophical treatises" 42a5
phlegm 53a1 / 77b5
pigeon 70b1
plants 50a20 / 55b30 / 78a10 / 81a15 ff / 82b30 / 83b15 / 86b30
Plato 30 / 42b5 / 45a35 / 51b20 / 69a15 / 76b25
pneuma, connate 59b15 / 69a1
"potentiality" 42a1 / 47a5 / 49b1ff / 67b20 / 68a30
"pounce" (of cuttlefish) 54a20
privative terms, privation 42b20 ff / 49a15
proboscis 78b10 / 79a5 / 85a30, b10
Protagoras 42a25
purpose 45a20 / 51a15 / 63b20 / 70b20 / 77a15 / 78a15 / 92a1

Purpura 61a20 / 79b15 f
Pyrrha, strait of 80b1
Pythagoreans 70b20

rain 53a1
razor-fishes 83b15
"realization" 35 ff
relative size of parts 65b5
rennet 76a5 ff
residue 29 / 32-34 / 47b25 / 50a20 / 70b25 / 71a5 / 74a15 / 75b10 ff / 76a30 / 77a10 f, 25 / 81a30
respiration 5 / 42a30 / 62a15 / 64b1 / 65a15
reticulum 74b15 / 76a5
Rhine 97a5
rhinoceros 63a15
ribs 55a1
Risus Sardonicus 73a10
rot 72a30 ff
rumen 74b15
rumination, ruminants 74b5 / 75a1 f

St-Hilaire, J.Barthélémy-44/45
St-Hilaire, G. 84b15
saw-teeth 61b15 / 62a5
scales 91a15
scallops 79b25 / 80b20 / 83b15
Scarus 62a5 / 75a1
scorpion 88a10
sea-anemone 81a35
sea-cucumber 81a15
sea-lung 81a15
sea-nettle 81a35
sea-sickness 64b10
sea-snail 78b20 / 79b5
sea-squirt 81a10
sea-urchin 79b25 f / 80a1ff, 30, b1 ff / 83b10

549
ARISTOTLE

seal 57a20 / 71b5 / 76b25 / 97b1 f
seed 41b25 / 89a5 f
Selachia 4 / 55a20, 25, 35 / 76b1 / 95b5 / 96b1 ff / 97a5
self-defence 55b5 / 62b25 etc.
semen 51b10, 20 / 89a5 f
sensation 47a1 ff / 48a1 / 50b25 / 51a10, b1 / 53b20 / 56a1, 15 / 66a35 / 72b30 / 81a15 ff
sense, "general" 86a30
sense-organs 47a5 / 56b25
senses 56a25 ff / 86a10
Sepia 54a20 / 78b25 / 79a5 ff / 85a10 ff
septum 81a30
serpents 60b5 / 76a25, b20 / 90b15 ff / 91b25 ff / 96a5 / 97a10
serum 51a15 / 53a1
Shakespeare 33 / 34
sheep 71b5 / 72a25 ff / 73b30 / 76b35 f
sheep-rot 72a30 ff
sinews 66b10 / 96b5
Siphae 96a5
sleep 53a10
smell 59b15
Smyraena 96a5
snake 91a15
Socrates 42a25
solid and fluid 47a20, b10 / 48b1 / 49b10 ff
solidification 49a30 / 51a10
Soul 9 / 34-37 / 38 / 41a15 ff / 50b25 / 52b5 f / 67b20 / 72b15 / 76b25 / 78b1 / 86b25 / 92a20
sounds 60a1 f
speech 59b30 ff / 60a20 / 61b15 / 64b1 / 73a20
spider-crab 84a10

spiral shells 79b10
spit-and-lampstand 83a25
spleen 66a25 / 69b25 ff / 70a30 ff, b30
sponge 81a10 f
spontaneous production 40a30
spurs 94a10
starfish 81b5 f
sterility 51b10
sting 61a15, 25 / 82a10, b30 ff
stomach 74a5 ff / 80b25 ff / 89b35
stone 67b1
substratum 49a15 f
suckers 85b10
suct 51a20 ff, b25 / 72a5
sutures 53a35 / 58b1 / 67a5
sweat 68b1
swine 63a5 / 88b1, 10 etc.
symmetria 52b35 / 86a10
systoich'ia, 70b20
tail 58a30 / 84a1 / 89b1 ff / 95b5 f
talons 94a15
taste 56b35 / 60a20 / 61a5 / 90b25 ff
Taylor, Prof. A. E. 20
teeth 55b5 / 61a30 ff / 78b15 / 80b25
teleology 3 / 48a15 / 59a15 / 63a10 / 94a20
tentacles 85b1 f
Testacea 23 / 54a1 / 78b10, 20 / 79b1 ff / 83b1 ff
testicles 95a25 / 97a10
text and manuscripts of De partibus 45 ff
theoretical sciences 40a
Thompson, Prof. D'Arcy 10 / 19 / 20 / 44a20
Tipha 96a5
INDEX TO PARTS OF ANIMALS

tissues 4
toad 73b30
Toledo 40/41
tongue 59b35 ff / 78b5 ff / 90b20 ff
torpedo-fish 95b5 / 96a25 f
turtle 54a5 / 71a15 f / 73b30 / 76a30 / 91a15
touch 47 / 53b20 / 56a35
Transformations, theory of 19 / 20
translations of Aristotle's works 39-43 / 44-45
transmigration 36
troglohytes 69b5 / 84a5
Trygon 95b5, 25
tube-feet 81a5
turtle 54a5
tusks 55b10

umbilical cord 93b25
umbilicus 93b20
"uniform" parts 28-30 / 40b20 / 46a20, b5, 30 / 47a25, b10
upright posture 53a30 / 56a10 / 58a20 / 62b20 / 69b5 / 86a25 ff / 87a5 / 89b10 ff / 90a25 / 95a1 ff
ureters 71b15

vaporization 52b35 / 72b15
variations in "parts" 47b25 ff / 73b10 ff
ventilation 53b1
vermiform appendix 75a15
vertebrae 51b30 / 54b15 / 86a20
Vertebrates and Invertebrates 45b10
viper 76b1 f
viscera 47a30 / 65a25 ff / 73b10 ff
Vivipara 55a5, b10 / 62b20 / 73b15 / 74a25 / 85b35 ff

wasp 83a5
whale 69a5 / 97a15 ff
whelk 79b15 f / 83b10
windpipe 64a35 ff / 86a15
wing (of birds) 93b1 ff
wing (of insects) 82b5 ff
wolf 86a20 / 88a5
woodpecker 62b5
wryneck 95a20

xanthopterine 34

Zeus hoplosmios 73a15
zoological works of Aristotle 8

551
INDEX TO MOVEMENT AND PROGRESSION OF ANIMALS

Note: 98a–99b = 698a–699b
00a–14b = 700a–714b.

The matter contained in lines 1-5, 5-10 etc. is treated as a section, and each section is referred to by the number of its first line: e.g. 98a1 refers to anything contained in page 698a lines 1-4, and 13b10 to anything contained in page 713b lines 10-14.

action, the result of the practical syllogism 01a22 ff
active \( \text{passive} 02b10 / 05a20\)
alteration, causes of 01b15
animals passim
appetite 00b10
arms, movement of, in running 05a15
athletes, use of weights in jumping by 05a15
Atlas, the fable of 99a25, b1

back \( \text{front, of animals} 05a25, b10\)
bat 14b10
bees 10a10
beetles 10a10
bending, as a means of motion 07b5 / 08b20 ff / 09b1; concave and convex \( \text{ib. 10;} \) of legs in walking by man 11a25 ff, by quadrupeds \( \text{ib. b10, by birds 12b20}\)
bipeds 04a10, 15 / 06a25, b1 ff / 10b5 / 12b30
birds 09b20; are bipeds 06a25; standing position of 10b15 ff; compared with fishes 14a20 ff; birds with talons the swiftest flyers 10a25; web-footed birds, 14a5
bloodless animals, progression of 12b20 ff; structure of \( \text{ib. 30;} \) can have more than four feet 08a15; can live though divided in parts 07a30
boat, illustration from a 98b20
bones 01b5
Boreas 98b25
MOVEMENT & PROGRESSION OF ANIMALS

bronze, horses in 10b20
caterpillars, 03b25 / 09a30
children, their difficulty in walking 10b10
cockchafer 10a10
conger-eels 08a1
crabs 12b10 / 14b15; curious structure of 13b10 ff
crawling 09a5, 25
crocodile 13a15, b15
cupids, pictures of winged Hal
De anima, referred to 00b5 / 14b20
De partibus animalium, referred to 98a1
desire, as a cause of motion 00b15 / 01a1 / 03a5; absent in involuntary movements 03b10
diagonal movement of the legs 04b1 / 12a20, b5
dimensions of animals 04b15 / 05a25

earth, immobility of the 99a30, b5 ff
earthworms 05b25
eels 08a1 ff / 09b10
elbow 12a10; elbow-joint 98b1 / 02a25
elephant 09a10 / 12a10
feet, even number of, in all animals 04a15 / 08a20 ff
fiery element 03a20
fire, movement of 99b25 / 00a10
fishes 09b30 / 13b5; compared with birds 14a20 ff
flat-fish 09b10 / 14a5
flying 98a5, b15 / 09b5
“foot,” defined 06a30
footless animals 04a10 / 05b20 / 06b1; movement of 07b5 / 09a25
fore-arm 98b1 / 02a25
fowls, domestic 10a5
geometrical illustrations 98a10 / 02b25 / 03b25

good, the, as a cause of movement 00b25; real (apparent good, ib.
hand 02a30 ff
heart 03a10 / 03b5, 20
heavens, movement of the 99a10
heron 10a10
hips 98b5 / 09a10 / 11a5; of birds 10b20, of man ib.
Historia animalium, referred to 04b10
Homer, quoted (Od. viii. 20-22) 99b35
hopping 03b30
horses, of bronze 10b20, in religious processions 12a30
“impossible,” meaning of 99b15
imagination 00b10 / 01b15 / 02a15 / 03b10 ff
inferior (superior parts 04b20 / 05a25 / 06b1 ff / 07a5
insects 09b30 / 10a5 ff / 13a1
intellect 00b10
joints 98a15 / 02a20 / 03a10 / 05a15; of elbow 98b1
jumping 05a5, 15 / 08a20 / 09b5

553
knee 98b1
lampreys 08a1
leeches 09a30
left ) ( right 05a25, b15 ff; left and right sides of the body, similar 02b10; weights carried on left shoulder 05b30; why men step off with the left foot 06a5
legs, the 98b5 / 10b10; position of, in movement 09b15 ff; of man, bent in convex direction 04a15, of birds, in a concave direction ib. 20; four ways of bending the legs 12a1; transference of weight from one leg to another 11a10; of polypods 13b25 ff; necessary to birds 09b20; used to direct flight 10a15
lizards 13b15
lobster 13b20 ff

man, the only erect animal 10b10; right-handed 06a20; why a biped 04a15; why not winged 11a1; his action in walking 07b15; bends his legs in a convex direction 04a15
marionettes, illustration from 01b1
Metaphysics, referred to 00b5
mice 98b15
molluses 06a30
moon 99b15
motion, movement, of the universe 98b10, of the heavens 99a10, b10, of animate things 00b10, of inanimate things 00b10, of the soul 00b1, of red-blooded footless animals 07b5; various kinds of movement 98a5 / 05a1 ff; cause of movement 00b15 ff; where situated 02a20, b5 ff; points at which movement takes place 04a10 / 07a15 ff, b5 ff / 09b20; movement begins on the right side 05b30 / 06b15; movement implies something at rest outside 99b30 / 02a25; movement of one part necessitates rest of another part 98a15, b1 ff / 00a5; movement by bending 08b20 ff / 09b1 / 11a5; voluntary ) ( involuntary movement 03b5; diagonal movement of the legs 04b1 / 12a20, b5; movement in jumping, running, and walking 05a5 ff
mover, the prime 00b5, moves without being itself moved 98a5 / 00b30, is eternal 00b30
mullet 08a1

nature, creates nothing without a purpose 04b15 / 08a10, creates nothing unnatural 11a5
nutrition, of plants 06b5, of plants and animals compared 05b5
opposite parts of the body move simultaneously 02b10
oviparous quadrupeds 04b1 / 13a15

passive (active 02a10 / 03a20
peacock 10a5, 20

Physics, reference to (258b49) 98a10
plants, nutrition of 06b5, lack movement ib., compared with animals 05b5, superior and inferior parts of 05a25, b1 ff

points at which movement takes place 04a10 / 07a15 ff, b5 ff / 09b20
poles, the 99a20 ff
polypods 04a10 / 06a30, b5 / 08b1 / 12b10 / 13a25, b15
porphyrio (a bird) 10a10
procession, religious 12a30
purple-fish 06a15
purpose 00b10 / 01a5, in nature 04b15 / 08a10

quadrupeds 04a10 ff / 06a30 / 07b15; bending of the legs of quadrupeds in walking 11b10; oviparous quadrupeds 04b1

ray (fish) 09b15
red-blooded animals 11a5, move at four points 04a10 / 07a15, b5 / 09b20, cannot live if divided into parts 07a25

resistance of earth, air or sea necessary to movement 98b15
rest (motion 98b5

right ) ( left 05a25, b1 / 06b25 / 07a5; movement originates on the right side 05b30 / 06b15; right side superior to left 06a20, b10; right limbs used in defence 06a5
roots of plants 05b5
rudder, slight movement of, changes direction of boat 01b25

scolopendrac 07a30 / 08b5
seal 14b10
sensation 01a35, cause of alteration 01b15; origin of sensation situated in the centre of the body 02b20
sense-perception, in animals 05b10; objects of 98a10
sexual organs 03b5, 20
shin 98b1
shoulder 98b1 / 09a10 / 11a5 / 12a10
sinews 01b5
Siphae 08a5
snakes 05b25 / 09a25, movement of 07b20 ff, why footless 08a5 ff
soul, movement of the 90b1, central position of 03a35, as origin of movement 02b1 ff / 03a1
spine 02b20
spirit, innate, in animals 03a10 ff
stromboid testaceans 06a10, b1
superior ( inferior parts 04b20 / 05a25 / 06b1 ff / 07a5
swimming 98a5, b15 / 09b5
syllogism, the practical 01a10 ff

555
tail, used as a rudder 10a1
talons, birds with, the swiftest
flyers 10a25
testaceans 06a10, b1 / 14b5
thighs 12a15, of birds 12b30
Tityos 98b25
tortoise 13a15
toy-carriage, illustration from
01b1
trumpet-shell 06a15

universe, movement of the
98b10

tortoise 13a15
viviparous quadrupeds 04a20
voluntary )( involuntary
movement 03b5

walking 05a5
wasp 10a10
water-fowl 10a10
web-footed birds 14a5
weights, used by athletes
when jumping 05a15,
carried on left shoulder
05b30
wings 05b20 / 06a25 / 09b5, 30; of birds, necessary for
walking 09b20, and for
standing 10b30, serve as
front legs 12b20; of cupids,
useless 11a1; of insects
10a15; grow obliquely
13a5
wrestling-school 09b10
wrist 02b1
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