Chapter 17

Nature, and how to study it

17.1 Readings and Homework

- Readings
  - Required: Aristotle, *Physics* II, 1-3, RAPG pp.702-709
  - Recommended:
    * Not in RAPG: *Metaphysics*, V, 4
    * In RAGP: *Metaphysics*, A.3; Parts of Animals I
    * Not in RAGP: *Posterior Analytics*, II.11; *Metaphysics* D.2; *Generation and Corruption* 335a28-336a12.
  - For further thinking about final causes in the sciences: Allen, Colin, "Teleological Notions in Biology", The Stanford Encyclopedia of Philosophy (Summer 2004 Edition), Edward N. Zalta (ed.).
    `http://plato.stanford.edu/entries/teleology-biology/`
- Study questions:
  1. How does Aristotle define a natural object? Contrast with an artifact.
  2. Explain in what sense a statue made of stone falling down on the ground is and/or is not a natural movement (until 193a)
  3. Explain the argument in favor of the thesis that "the nature and substance of a natural thing" is the matter (1.193a10-30).

4. Explain the argument in favor of the thesis that form is the nature and substance of natural thing (1.193a30-193b6)
5. How does a mathematician study an apple? How would the ancient materialists study an apple? How should the natural scientist study the apple, according to Aristotle? (book 2)
6. What are the four kind of causes that Aristotle distinguishes in book 3?

17.1.1 References for the course notes

For this course, I am using extensively the form and content of Professor Terrence Penner's course notes (Philosophy 430, Spring 1996)

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17.2 Natural objects and Artifacts

Aristotle defines what a natural object is. He starts with what he considers the most obvious examples:

- animals, trees and plants, that is, natural bodies,
- the simple bodies, that is, the four elements.

This kind of being has to be contrasted with artifacts: beds and cloaks.

The first characteristic of a natural object is that it "has within itself a principle of motion and stability in place, in growth and decay or in alteration" (192b15).

This principle is further called *a nature*:

> [...] a nature is a type of principle and cause of motion and stability within those things to which it primarily belongs in their own right and not coincidentally. (192b20-25)

Thus, a first, too crude (because it does not take into account the qualifications in the sentence quoted), way to characterize what a nature is for Aristotle is the following:

- *A natural object X is an object which has a nature within itself*

- *the nature of X is an internal principle, or cause, of rest or change in X.*

Suppose that I invite you for dinner, and that you bring along a bottle of wine. Consider now the two following questions:

(1) What did move you here?

(2) What did move the bottle here?

It seem all right to answer that:

(1') Nothing moved you, you did it yourself

(2') You moved the bottle

There seems to be a straightforward distinction between self-movers and things moved by other things. Thus, a first, crude characterization of natural objects and artifacts by Aristotle could be the following:

(D1) Natural objects are these things that have a nature: the cause of their moving is internal.

(D2) Artifacts are these things that do not have a nature, that is: the cause of their moving is external.

This is not quite accurate. If it was, then it would be quite easy to put Aristotle into trouble.

17.3 Pico's dog-shaped rock

17.3.1 The problem

On the one hand, it is clear from what we just said that a rock falling down to the ground is the natural movement of a natural object. A rock is primarily made of earth, and earth naturally goes straight to the center of the Earth. **A rock thus has a nature: the nature of earth.**

On the other hand, from the paradigmatic examples given by Aristotle at the beginning, we can infer that **a statue is not a natural object, thence does not have a nature.**

So we should have:

(E1) A rock has a nature, the nature of earth

(E2) A statue has not a nature

But how is this possible? Could not we reason about the statue, just as we did about the rock? The statue is made of rock (say), rock is mostly earth, so that the statue should have, just as the rock has, the nature of earth. If you throw the statue through the window, it will "naturally" fall!

To make the case even worse, imagine that you are hiking in the Azores, and that you pass the dog shaped rock in Pico. Now imagine you find a way to take it back to your yard or dinning room as a statue. According to what we said, both the following propositions stand:

*(E3a) Your dog-rock-statue has a nature (by E1),

*(E3b) Your dog-rock-statue has not a nature (by E2),

which is obviously contradictory. **So it seems that Aristotle runs into contradiction as soon as we consider the fact that natural objects can be used as artifacts.** It is certainly not satisfactory to think that the dog-rock, in Pico, has a nature, but changes as soon as you took it back to your yard. **The way we use, or consider, or name things should not be a criteria for these things to be natural or not.**

17.3.2 The operator "qua"

The foregoing considerations should help us understand the qualification of the sentence I already quoted:

> [...] a nature is a type of principle and cause of motion and stability within those things to which it primarily belongs in their own right and not coincidentally. (192b20-25)

So, not only is a nature an internal principle or cause of motion, but also it should not cause motion coincidentally. Aristotle gives himself an explanation for this notion of non-coincidental cause: a doctor can be the cause of the cause of his being healthy. She can prescribe to herself to take some treatment to heal. But this is mere co-incidence that the person being healed and the healer are one and the same individual. So we have:

- a phenomena: a person was healed by herself (Let say she is called Maiwen)

  in which we have to distinguish:

- the object of the action: the patient

- the subject, the cause, of the action: a doctor, that is, the person who "has the medical science"

The possessor of the medical science is a non-coincidental cause of his patients being healed. Thus, here is how we can understand our case:

- Maiwen, *qua* doctor, caused Maiwen being healed;
- Maiwen, *qua* patient, was healed by Maiwen;
- Maiwen, *qua* patient, caused Maiwen being healed *only coincidentally*

Let us try to apply this distinction to the dog rock statue:
(E3a) Your dog-rock-statue, *qua* rock, has a nature,
(E3b) Your dog-rock-statue, *qua* statue, has not a nature,

So natural objects and artifacts are distinguished by whether they possess a nature, that is an internal, non-coincidental cause of natural movement or not. Now, what about the statue falling down? It is not the statue, as statue, that fell down, but a rock, or the statue as a rock.

17.3.3 What is the nature of a "this" in itself?

If we stop here, it seems that your dog-rock-statue has a nature or not, depending on how you consider it, or worse, on how you call it. In this case, all there are are things-as-described-in-this-way or things-as described-in-that-way. There is not anything "in itself".

Some consider that Aristotle cannot stop here because he wants to talk about this-es. Now, what is your dog-rock-statue as a this? What is it, in itself, when I am pointing to it, and do not chose any name for it? It seems that if Aristotle wants to say that the world consists of this-es, the this-es should be characterizable in themselves independently of how we call them.

We know that the statue as rock has a nature. We know that the statue as a statue does not have a nature. But has this (pointing at the dog-rock-statue) a nature? Don't we want to say that the nature of the dog-rock-statue in itself is the nature of the rock? The question is thus whether the dog-rock-statue has a nature *qua* itself.

In other word, the question is whether there is a privileged description of the dog-rock-statue, a proper description which would reveal it as a nature. Professor Penner thinks there is such descriptions, and these descriptions are precisely what the physicist and the biologist are looking for.

- Everything is something *qua* itself.

- "The nature of a thing is a principle of being-moved or being-at-rest in that thing *qua* itself" (Penner p.75)
- This is what the scientist has to find
- This is also why there will be things that remain identical through change

Now, what are these privileged descriptions? What is the nature of the dog-rock-statue of Pico?

We have seen that one candidate for being the nature of anything is **matter**. Aristotle comes in the *Physics* to talk about matter when he is looking for the underlying subject of essential change, where the unshaped becomes shaped. In this kind of change, it seems that the idea of a primary subject leads us to a notion of primary substance which does not correspond to the substances of the *Categories*, the individual substances. Considering essential change, it seemed that matter is the ultimate primary subject remaining the same through change. Aristotle is going to argue against this appearance though.

17.4 Is the matter of something its nature?

The argument for matter being the nature of things: let's bury a bed, and see what grows out of it. The thought experiment suggests that the nature of a wooden bed is wood. Just in the same way, if you drop your dog-rock-statue out of the window, it will fall down, straight to the center of the Earth. This suggests again that the nature of the dog-rock-statue is rock, its matter. The natures of the wooden bed and of the dog-rock-statue are the principle of movement of the bed and the dog-rock-statue by themselves. Let alone, independently of us sleeping on the bed, or giving support so that the statue stands up, what do they have as natural movement?

Following that path, we end up with the following metaphysical view: there are ultimate bits of matter, and everything is but diverse arrangements of these bits of ultimate matter.

Aristotle concludes in saying that:

> This, then, is one way we speak of a nature: as the primary matter that is a subject for each thing that has within itself a principle of motion and change.(193a30)

In the *Metaphysics*, Aristotle will explain (not entirely clearly) in what sense he accepts and rejects matter as the nature and substance. For now, we understand that such a conception is at odds with the metaphysics of the categories. Aristotle does not stop here though. In the text, Aristotle in fact reinterpret the argument of the buried bed growing tree in favor of the thesis that the form is the nature and substance of things.

17.5 Is the form of something its nature?

1. Analogy between artifacts and natural objects:

   - the rock is not called a statue (an artifact) when it is only potentially, and not actually a statue.

   - the cells, blood or bones are not called a tiger (a natural object) when it is only potentially, and not actually, a tiger.

   Thus, there is a sense in which the form is the nature and substance of something. And, Aristotle adds:

   > Indeed, the form is the nature more than the matter is.(193b5-10)

2. Back to the wooden bed

   Aristotle turns the bed argument against the thesis it was intended to support, that is, that matter is the ultimate nature and substance.

   The claim is that what the bed argument really shows is that "nature, as applied to coming to be, is really a road towards nature". Let us try to explain:

   - The wooden bed is a road to wood

   - a man is a road to a man

   - a cub is a road to a tiger

   Granted, a cub is made of flesh and bones. But this is not what makes it what it is. What makes it what it is is not what it is growing *from*, but what it is growing *into*. Now, a cub is growing into a tiger, so that the nature and substance of a cub is to be a tiger. **Thus, the nature and substance of a individual substance is what it is "growing into".**

17.5.1 Did Aristotle find his third route?

Remember that Aristotle wanted to find a third route between the Presocratics' materialism (all that exists is matter) and Plato's idealism (what really exists are forms, while the sensibles are mere shadows of these forms). Did he manage to do so?

This is not pure platonism because Aristotle makes it clear that "the form is not separable except in account". The form of the tiger is thus not separable from the this-tiger except verbally.

But Aristotle is not materialist either, since the matter, being only potentially and not actually the individual substance considered, does not constitute its nature and substance.

17.6 The study of nature

17.6.1 Natures vs. other aspect of beings

- Mathematical objects:

  Remember that to give an account for the possibility of mathematics is crucial if Aristotle wants to succeed over Plato's arguments for the existence of the forms. Aristotle claims that:

  - Mathematicians and students of nature have the same objects of study: bodies (terrestrial and celestial).

  - but they differ in how they look at these bodies

  Mathematicians study natural bodies, but not *qua* natural bodies. Rather, they consider the limits of the bodies: surfaces and lines. They *abstract* these lines and surfaces from their being the limits of natural bodies. **Abstraction is here a form of separation, but only in thought**. Abstraction in this sense is possible for mathematical objects (lines, surfaces, or numbers).

- As to abstracting the natures from natural object says Aristotle, is not even possible.

  There is no way we can speak of a snub nose without considering the snub nose as a natural body, including its matter.

So, the form of the tiger is not separable from the tiger, *not even conceptually*?? Natural bodies, studied as natural bodies, cannot be studies independently of their form. This is a stronger claim than the claim that the form of the tiger is not ontologically separable from the tiger, a claim we already talked about.

- SO: Aristotle here makes a distinction between

  1. mathematical objects (curves and surfaces), which:

  - are not separable ontologically

  - but are separable in thought

  and

  2. Natures, which

  - are not separable ontologically

  - are not separable in thought

  Natures do not have a form that can be conceived independently of their matter.

17.6.2 Biology: the study of natures

- Study of nature: Physics vs. Biology

  With this in mind, we can turn to the object of study of the student of nature, that is, the biologist and the physicist.

  Just as any science, the natural sciences take the beings, the natural objects, as objects of study. Also they differ from other sciences (mathematics or metaphysics) in so far as they study these beings in a specific way.

  From what has just been said, it is clear that the natural scientist cannot focus on the form only. He would lose its object completely, and turn to mathematics or something else.

  Should the natural sciences consider the natural beings just in so far as they are constituted of matter? This is the idea of the presocratic physicists. But Aristotle does not take physics to be the model of science.

For Aristotle, it is biology and not physics which is the paradigm of natural science. Physics is to follow the method of biology.

- Study of natures: matter vs. form

  Further, Aristotle proposes to understand how the biologist has to study natural bodies with the same analogy as in the previous chapter: the analogy with craft and artifacts.

  - The doctor cannot make bodies healthy if he does not know both the matter of bodies and their form, that is, in what their being healthy consists. Medical science thus consists in knowing both the form and the matter of healthy bodies.

  - The builder of a house cannot build houses if he does not know both the characteristics of the bricks and wood the house is made of, and the characteristics of the form of a house. Building science thus consists in knowing both the form and the matter of a bricks-and-wood-assembled-in-a-house.

  If the analogy stands between science of nature and craft, then science of nature is a study of both the form and matter of natural bodies.

- Why does the analogy stand?

  - Aristotle helps us to understand in talking about "ends" and about "what it is for"

  - thus **biology is teleological** (be careful: teleological (related to ends) is not the same word as theological (related to God))

  - but don't misunderstand the analogy: not external causes

  - rather, natures are themselves an end

  - for instance, the tiger is the end of the tiger

  - and if you want to study the cub as a biologist, you have to study the matter of the tiger, and its form, both "enough to know what something is for"

  That is to say that you have to understand the matter and the form of the cub, so that you can give an account of it having for end to be a tiger, of this "this" having the nature and substance of a tiger.

  This is going to be clearer after we study the four causes.

17.7 The four causes

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17.7.1 The problem of translation: what is an *aition*

[...]

We will begin with the question, What is it that Aristotle says there are four of? The Greek word is *aition* (plural *aitia*); sometimes it takes a feminine form, *aitia* (plural *aitiai*). And what is an *aition*? Part of Aristotles point is that there is no one answer to this question. **An *aition* is just whatever one can cite in answer to a why? question**. And what we give in answering a why? question is an **explanation**. So an *aition* is best thought of as an explanation or an explanatory factor.

This is a good start, but it is still not totally clear what an *aition* is. For Aristotle thinks that you can ask what the *aitia* of this table are, and its not clear what sense, if any, it makes to ask for an explanation of the table. So we had better look at some texts to try to sort this out.

[...]

17.7.2 The Doctrine of four causes

The traditional picture and terminology (not all Aristotles terminology):

1. Material cause: that out of which a thing comes to be, and which persists, e.g., bronze, silver, and the genus of these (= metal?).

2. Formal cause: the statement of essence, the account of what-it-is- to-be, and the parts of the account.

3. Efficient cause: the primary source of change, e.g., the man who gives advice, the father (of the child).

4. Final cause: the end (telos), that for the sake of which a thing is done, e.g., health (is the cause of exercise).

Aristotle's doctrine is that ***aition* is ambiguous**. As he puts it, *aition* is said in many ways. That is, when one says that x is the *aition* of y, it isn't clear what is meant until one specifies what sense of *aition* is intended:

1. x is what y is [made] out of.

2. x is what it is to be y.

3. x is what produces y.

4. x is what y is for.

This makes it hard for us to get clear on what Aristotle was up to, since neither cause nor explanation is ambiguous in the way Aristotle claims aition is. There is no English translation of *aition* that is ambiguous in the way (Aristotle claims) *aition* is. But if we shift from the noun cause to the verb makes we may get somewhere. Aristotle's point may be put this way: **if we ask what makes something so-and-so?** we can give four very different sorts of answer - each appropriate to a different sense of makes. Consider the following sentences:

1. he table is made of wood.

2. Having four legs and a flat top makes this a table.

3. A carpenter makes a table.

4. Having a surface suitable for eating or writing makes this a table.

Aristotelian versions of (1) - (4):
1a. Wood is an *aition* of a table.
2a. Having four legs and a flat top is an *aition* of a table.
3a. A carpenter is an *aition* of a table.
4a. Having a surface suitable for eating or writing is an *aition* of a table.
These sentences can be disambiguated by specifying the relevant sense of *aition* in each case:
1b. Wood is what the table is made out of.
2b. Having four legs and a flat top is what it is to be a table.
3b. A carpenter is what produces a table.
4b. Eating on and writing on is what a table is for.

17.7.3 Matter and Form vs. Principles of motion

9. **Matter and form** are two of the four causes, or explanatory factors. They are used to analyze the world **statically** - they tell us how it is at a given moment. But **they do not tell us how it came to be that way**. For that we need to look at things dynamically - we need to look at causes that explain why matter has come to be formed in the way that it has. **Change consists in matter taking on (or losing) form. Efficient and final causes are used to explain why change occurs.**

In Metaphysics III, Aristotle notes that those who thought that only the matter was cause were constraint to reject the possibility of change, for they could not give an account of it.

10. **This is easiest to see in the case of an artifact**, like a statue or a table. The table has come into existence because the carpenter put the form of the table (which he had in his mind) into the wood of which the table is composed. The carpenter has done this for the purpose of creating something he can write on or eat on. (Or, more likely, that he can sell to someone who wants it for that purpose.) This is a teleological explanation of there being a table.

11. **But what about natural objects?** Aristotle (notoriously) held that the four causes could be found in nature, as well. That is, that there is a final cause of a tree, just as there is a final cause of a table. Here he is commonly thought to have made a huge mistake. **How can there be final causes in nature, when final causes are purposes, what a thing is for?** In the case of an artifact, the final cause is the end or goal that the artisan had in mind in making the thing. But what is the final cause of a dog, or a horse, or an oak tree?

1. What they are used for? E.g., pets, pulling plows, serving as building materials, etc. To suppose so would be to suppose Aristotle guilty of reading human purposes and plans into nature. But this is not what he has in mind.

2. Perhaps he thinks of nature as being like art, except that the artisan is God? God is the efficient cause of natural objects, and Gods purposes are the final causes of the natural objects that he creates.

No. In both (a) and (b), the final cause is external to the object. (Both the artisan and God are external to their artifacts; they impose form

on matter from the outside.) But the final causes of natural objects are internal to those objects.

17.7.4 Final causes in nature: some of the details of Aristotle's account

- **The final cause of a natural object - a plant or an animal - is not a purpose, plan, or intention.** Rather, *it is whatever lies at the end of the regular series of developmental changes that typical specimens of a given species undergo.* The final cause need not be a purpose that someone has in mind. I.e., where F is a biological kind: the *telos* of an F is what embryonic, immature, or developing Fs are all tending to grow into. **The *telos* of a developing tiger is to be a tiger.**

- **Aristotle opposes final causes in nature to chance or randomness.** So the fact that there is regularity in nature - as Aristotle says, things in nature happen always or for the most part - suggests to him that biological individuals run true to form. So this end, which developing individuals regularly achieve, is what they are aiming at. **Thus, for a natural object, the final cause is typically identified with the formal cause.** The final cause of a developing plant or animal is the form it will ultimately achieve, the form into which it grows and develops.

  References: Physics 198a25, 199a31, De Anima 415b10, Generation of Animals 715a4ff.

- This helps to explain why form, mover, and *telos* often coincide, as Aristotle says (198a25). I.e., why **one and the same thing can serve as three of the causes** - formal, efficient, and final.

  The *telos* of a (developing) tiger is just (to be) a tiger (i.e. to be an animal with the characteristics specified in the definition of a tiger). Thus, the final cause (telos) and formal cause (essence) amount to the same thing. And Aristotle also says that a source of natural change (efficient cause) is a thing's form, or what it is, for that is its end and what it is for (198b3). Hence, one and the same thing serves as formal, final, and efficient cause.

Claims like "a tiger is for the sake of a tiger" or "an apple tree is for the sake of an apple tree" sound vacuous. But the identification of formal with final causes is not vacuous. It is to say, about a developing entity, that **there is something internal to it which will have the result that the outcome of the sequence of changes it is undergoing** - if it runs true to form - will be another entity of the same kind - a tiger, or an apple tree.

- So form and *telos* coincide. What about the efficient cause? The internal factor which accounts for this cubs growing up to be a tiger (a) has causal efficacy, and (b) was itself contributed by a tiger (i.e. the cubs father).

  This can be more easily grasped if we realize that **for Aristotle questions about causes in nature are raised about universals**. Hence, the answers to these questions will also be given in terms of universals. The questions that ask for formal, final, and efficient causes, respectively, are:

  1. What kind of thing do these flesh-and-bones constitute?
  2. What has this (seed, embryo, cub) all along been developing into?
  3. What produces a tiger?

  The answer to all three questions is the same: a tiger. It is in this sense that these three causes coincide.

- Aristotles account of **animal reproduction** makes use of just these points (cf. GA I.21, II.9 and Metaph. Z.7-9):

  1. T**he basic idea (as in all change) is that matter takes on form**. The form is contributed by the male parent (which actually does have the form), the matter by the female parent. This matter has the potentiality to be informed by precisely that form.

  2. **The embryonic substance has the form potentially**, and can be called by the same name as what produces it. (E.g., the embryonic tiger can be called a tiger, for that is what it is, potentially at least.) [But there are exceptions: the embryonic mule cannot be called by the name of its male parent, for that is a horse (1034b3).]

3. **The form does not come into existence. Rather, it must exist beforehand, and get imposed on appropriate matter.** In the case of the production of artifacts, the pre-existing form may exist merely potentially. (E.g., the artist has in mind the form he will impose on the clay. Nothing has to have the form in actuality.)

4. But in the case of natural generation, the pre-existing form must exist in actuality: there must exist beforehand another actual substance which produces it, e.g. an animal must exist beforehand if an animal is produced (1034b17).

6. **So the final cause of a natural substance is its form**. But what is the form of such a substance like? Is form merely shape, as the word suggests? No. For natural objects - living things - form is more complex. It has to do with function.

17.7.5 Final causes and functions

- We can approach this point by beginning with the case of bodily organs. For example, the final cause of an eye is its function, namely, sight. That is what an eye is for. And this function, according to Aristotle, is part of the formal cause of the thing, as well. Its function tells us what it is. What it is to be an eye is to be an organ of sight. **To say what a bodily organ is is to say what it does - what function it performs.** And the function will be one which serves the purpose of preserving the organism or enabling it to survive and flourish in its environment.

- Since typical, non-defective, specimens of a biological species do survive and flourish, Aristotle takes it that **the function of a kind of animal is to do what animals of that kind typically do,** and as a result of doing which they survive, flourish, and reproduce. Cf. Charlton (*Aristotle's Physics*, p. 102):

> [...] the widest or most general kind of thing which all non-defective members of a class can do, which differentiates them from other members of the next higher genus, is their function.

- **To say that there are ends (tel) in nature is not to say that nature has a purpose**. Aristotle is not seeking some one answer to a question like What is the purpose of nature? Rather, he is seeking a single kind of explanation of the characteristics and behavior of natural objects. That is, plants and animals develop and reproduce in regular ways, the processes involved (even where not consciously aimed at or deliberated about) are all toward certain ends.

- There is much that can be said in opposition to such a view. But at least it is not ridiculous, as is sometimes supposed. In so far as functional explanation still figures in biology, there is a residue of Aristotelian teleology in biology. And it has yet to be shown that biology can get along without teleological notions. The notions of function, and what something is for, are still employed in describing at least some of nature.

End of Marc Cohen's course Notes

For further thinking about final causes in the sciences: Allen, Colin, "Teleological Notions in Biology", The Stanford Encyclopedia of Philosophy (Summer 2004 Edition), Edward N. Zalta (ed.).

`http://plato.stanford.edu/entries/teleology-biology/`