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NATURE AS CRAFTSMAN IN GREEK THOUGHT

BY FRIEDRICH SOLMSEN

The early Greek cosmogonies know nothing of a god who "created Heaven and Earth" or who "separated light from darkness." In Hesiod's epic on the origin of the gods, the *Theogony*, Earth, Heaven, Light, and Darkness are among the first entities that come into being but they are not in any way fashioned or created. In the *Theogony* to "come into being" (*gignesthai*) means to be born, and this meaning holds good even for many or most of the physical parts of the Cosmos. The Ocean, the rivers and wells, the Sun, the moon, and the stars spring from a union or "marriage" between a male and a female deity,¹ not differing in this respect from other gods and goddesses, such as Kronos, Rhea, Zeus, Hera, and their respective children. The pattern is not one of creation but of procreation. Inevitably even where this pattern prevails primeval entities like Earth and Heaven, Light and Darkness, find themselves in a peculiar position since parents are hardly yet available "in the beginning." Here there are instances of parthenogenesis—not only Heaven but also the Sea and the Mountains are born of Earth alone—and even of a genesis which cannot be understood as birth. Chaos (a yawning emptiness) and Earth simply "came into being."² When Earth "gives birth to Heaven equal to herself that he might cover her on every side,"³ it is tempting to discover a reflection of the "separation" motif familiar from the biblical creation story and other near-Eastern cosmogonies; but if traditions of the kind had in one way or another become known to Hesiod he has amalgamated them to his scheme of divine matings and births. In the *Theogony*, "Light" (*Aither*) is not separated from Darkness but born of the union of two powers of darkness, Night and Erebus, Night "having become pregnant after uniting in love with Erebus."⁴

Students of comparative mythology are probably right in distinguishing between a creational and a procreational pattern of cos-

¹ *Theog.* 132f., 337–370, 371–382.

² For the birth of Heaven, mountains, and sea, cf. *Theog.* 126–133. At v. 116 Earth comes into being *after* Chaos. Night and Erebus come to be *out of* Chaos (v. 123), yet as *chaos* is a neuter and presumably sexless as well as shapeless, parthenogenesis and sexual reproduction seem to be equally out of the question.

³ vv. 126f.

⁴ The discovery of a Hurrian *Theogony* has brought the question of Hesiod's indebtedness to near-Eastern traditions into focus; cf. H. G. Güterbock *Kumarbi, Mythen vom churritischen Kronos* (Zurich; New York, 1946) and (for a translation of the text) James B. Pritchard (ed.), *Ancient Near Eastern Texts relating to the Old Testament* (2nd ed., Princeton, 1955), 120.

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mogony.⁵ While many known cosmogonies are a mixture of these two types, Hesiod's work stands out as a remarkably pure example of the procreational approach (no qualification is needed for the special treatment of the first cosmic entities). In the scheme of the *Theogony* the Olympian gods are late-comers who appear long after the entire physical world has come into existence. They are still in time to create order but only a moral or social, not in any way a cosmic order.⁶ As regards man's place in this scheme of origins, it is true that the story of the Five Ages in the *Works and Days* introduces the gods as creators (literally "makers") of several successive generations; moreover both this poem and the *Theogony* include the tale of the fashioning by Hephaestus and other gods of a woman who in the *Theogony* at any rate is meant to be the ancestress of the female sex.⁷ These tales, which may look like concessions made to the alternative type of cosmogony, are not germane to Hesiod's basic conception of origins. They have been incorporated for specific purposes. Even so, it is noteworthy that instances of divine "making" or "fashioning" (*plattēin*) are found in the earliest Greek account.

Little as we know about the first Presocratic systems, it seems safe to say that their authors abandoned the scheme of pedigrees and the pattern of divine matings and births. Some phases of Hesiod's pedigrees have a transparent causal meaning; there can be no doubt what he "means" when he describes Strife (*Eris*) as mother of arguments, lies, fights, and murders, Dawn as that of the winds, or Zeus and Themis as parents of the Horai who "take care of mortal men, watching over their works" and whose names indicate Justice, Peace, and orderly community life.⁸ But this was not the way in which the early physicists would convey their ideas of causality. They introduced new patterns of thought which, as far as we can judge were again not technomorphic but rather sociomorphic (to use these convenient, if far from beautiful terms). Justice, which Hesiod and others had conceived as a stabilizing and regulative factor in human relations, was now found operating also in the physical Universe.⁹ Becoming was probably no longer understood in terms of birth. Moreover, contrary to the intention of the *Theogony*, every instance of Becoming had to

⁵ See Kurt von Fritz in *Hésiode et son influence (Entretiens sur l'antiquité classique, vol. 7, Geneva, 1962)* 7; Hans Schwabl, *Realencyclopädie für die klass. Altertumswissenschaft* s. v. "Weltschöpfung," p. 1435. Cf. also Harry A. Wolfson, *The Philosophy of the Church Fathers* (Cambridge, Mass., 1956), 288ff.

⁶ See my book, *Hesiod and Aeschylus* (Ithaca, N.Y., 1949), 34f., 64f.

⁷ See for the Five Ages *Works and Days* 106-173; for the fashioning of "the woman" esp. *Theog.* 571-593f. and *Works and Days* 59-71 (other lines in this section, including vv. 80-82 which contain the name Pandora, are under serious suspicion with regard to their authenticity). ⁸ *Theog.* 226ff., 378ff., 901ff.

⁹ See esp. Anaximander 12B1. (For references to the Presocratics, cf. H. Diels-W. Kranz, *Die Fragmente der Vorsokratiker*, 9th ed., Berlin, 1960.)

be balanced against one of Passing-away, and if there were entities, like Anaximander's Infinite, which would not pass away and to which the epic phrase "unaging and undying"¹⁰ was applicable, they could not have come into being either. Our limited information does not allow us to say with confidence that there were no instances of "fashioning." If we consider the changes or "turnings" (*tropai*) of Heraclitus' Fire¹¹ as typical of early Presocratic language, and suppose that Anaximander used the same or similar words for the metamorphoses of his Air, then this view of things is incompatible with the idea of a fashioning or manipulating divinity. This conclusion may be hypothetical, but as there is no trace of such a divinity in the evidence we may as well acquiesce in this opinion.

Against this background of Presocratic cosmology Parmenides' new departure in the second part of his poem becomes all the more startling. For while in the "Way of Truth" he repudiated all categories of physical thought, exposing their intrinsic illogicality, we find him in the "Way of Opinion" resorting to conceptions which the physicists in all probability had given up as inadequate and too primitive. When the powers of light and darkness which have broken apart must come together again to create entities partaking of both, Parmenides introduces the female *daimon* "who steers everything."¹² Her function is to produce mixtures of the opposite powers. In Greek poetry the verb "to mix" (*mignysthai*) is commonly used of sexual relations. Far from eschewing these connotations, Parmenides avails himself of them to define the operation of the *daimon*: "everywhere she presides over hateful birth and mating (*mixis*), sending the female to mate with the male and conversely again the male with the female." Not content with thus describing her activities, he makes Eros her first creation ("First of all gods she devised Eros"),¹³ restoring him, so to speak, to the place that he occupied in the Hesiodic *Theogony*. The very scanty remains that we have of the sequel do not allow us to discern how far Parmenides carried the motifs of mating and birth. He is not likely to have worked out complete pedigrees in the Hesiodic fashion. We know that he continued to deal with mixed entities, and the concepts of mating and birth are his way of introducing the idea of physical mixture. We should, of course, not forget that we find ourselves in the "unreal" world of Becoming and are listening to "opinions." Whether it also is relevant that Parmenides writes in the idiom and metre of Homer and Hesiod is less easy to say; for although the crucial fragments 12 and 13 use epic words they employ them freely and in new combinations.

¹⁰ Anaximander A15, B3. Cf. Werner Jaeger, *The Theology of the Early Greek Philosophers* (Oxford, 1947), 24ff., 32 and my "Anaximander's Infinite. Traces and Influences," *Archiv für Gesch. der Philosophie* 44 (1962) 110ff., esp. 114 n. 19.

¹¹ Heraclitus 22B31. ¹² Parmenides 28B12.3ff. ¹³ B13 (cf. Hesiod, *Theog.* 120ff.).

We have so far encountered few instances of the craftsmanship symbolism, but the developments discussed will help us to see its first occurrence in the right historical perspective. For Empedocles uses craftsmanship imagery for the same idea which Parmenides conveys by falling back (as it would seem) into the traditional epic symbolism of procreation. There are differences of philosophical meaning and context that must not be overlooked. The concept of mixture, as Empedocles uses it, is no longer relegated to the unreal world of Becoming. With him it belongs to the realm of truth (although his realm of truth owes much to Parmenides' "World of Opinion") and must in this realm replace the philosophically invalid concept of Becoming, which Parmenides himself in the "World of Opinion" was not debarred from using. There can be no emergence of new realities; the six eternal entities—or for our present purpose, the four physical elements—which have inherited the characteristics of Parmenidean Being must be preserved in the mixtures. To be more precise, they may become invisible in the product but must not lose their identity.¹⁴ It was one of Empedocles' brilliant insights that Parmenides' concept of mixture, properly defined and handled, allowed the preservation of the original ingredients. "Birth" (*tokos*), Parmenides' word, suggests *genesis* rather than mixture, and we may suspect that it could hardly have illustrated the ratios and other aspects of mixture which Empedocles was anxious to bring out.

In Empedocles too there is erotic and sexual imagery but we can see clearly to what point he carried it. The power responsible for the mixing of the elements is called in his poem Aphrodite, Philotes, Cypris, Harmonie, names definitely suggestive of sexual relations. Where Empedocles introduces his audience to the central rôle of this goddess in the physical world he makes emphatically clear that she is familiar to everybody from his personal experience.¹⁵ But although he could treat two of his physical elements as male and two as female and although he does speak of the elements as "coming together" or "uniting,"¹⁶ he does not, as far as we can tell from the preserved fragments, use the symbolism of "mating" to a degree comparable with Parmenides' description of the *daimon's* action. Nor does he refer to the mixtures or the products of the mixing as "births" or "offspring." As we have indicated, he resorts instead to images borrowed from the crafts and the craftsman.

All passages to be considered deal with the creation of biological forms by Cypris; e.g., "As at that time Cypris when she had drenched earth with water, busying herself about the forms(?) gave them(?)"

¹⁴ See esp. 31B27; cf. Arist., *de gen. et corr.* I.10, esp. 327b31–328a16; II.7, 334a26–b2.

¹⁵ See 31B17, 22–24.

¹⁶ See e.g. B17, 7; 20, 2; 21, 8; 22, 8, etc. It may be accidental that in B6 where Empedocles specifies his "four roots" he uses for them the names of two male and two female deities (Zeus, Hades; Hera, Nestis).

to swift fire to harden. . . ."¹⁷ Despite the uncertainties regarding an important word, we may take it that Cypris' concern is here, simply and generally, with the manifold "forms" of living beings. The thought and language of the fragment recall the fashioning of "the woman" (Pandora) by Hephaestus, which in Hesiod materializes through a drenching of earth in water, as well as some Homeric instances of his workmanship.¹⁸ Another fragment describes earth as "receiving in broad melting pots two portions of water and four of fire" while contributing two of her own; the result is "the white bones fitted together by the glue of Harmonie."¹⁹ The craft here alluded to may be that of a potter or smelter, whereas the operations of the first passage would rather make us think of a locksmith. Two other fragments present Aphrodite as fashioning the "tireless eyes."²⁰ The verb *pegnynai* in one of them suggests a carpenter's hammering; the "rivets" of the other would also seem to be borrowed from a carpenter's equipment, even if in Cypris' hands they have become "rivets of love" (γόμφοι κατάστοργοι). Finally there are two passages which, while not very specific about Cypris' procedure, refer to living beings or their parts as having received their characteristic complexion "in the hands of Cypris" (Κύπριδος ἐν παλάμῃσιν).²¹

It is not quite easy to assess the significance which these symbolisms had for Empedocles. There is nothing in his poems to suggest that the crafts were to his mind a model of purposeful or clearly articulated activity. Moreover it is not the technical illustrations as such that are new. Such illustrations may have figured in the earliest physical systems. If we trust the doxographic report, Anaximander likened the spheres of the heavenly bodies to chariot wheels and the opening through which these bodies are visible to the mouthpieces of a bellows.²² To this "traditional" form Empedocles seems close when he illustrates the mechanism of respiration by the operations performed with a waterlifter (*klepsydra*), or compares the structure of the eye and the movement of the visual ray with the construction of a lantern from which the fire "leaps forth to the outside."²³ Here the *tertium comparationis* lies in the structure or action of the finished

¹⁷ 31B73 (the reading "forms" [*eidea*] receives support from B71,3).

¹⁸ See esp. Hes., *Op.* 60f., Homer, *Iliad* 1, 600; 18, 421.

¹⁹ 31B96. If Empedocles really meant "glue" (which is not certain), this would be evidence that he did not expect his metaphors to be accepted literally; for an additional substance would disturb the ratio between the elements.

²⁰ 31B86f.

²¹ 31B 75,2; 95.

²² 12B21f. Diels-Kranz (see above Note). Cf. also e.g. Heraclitus in 22B59. More will be found in Kranz's paper, *Hermes* 74 (1938), 99ff.

²³ See 31B100 and 84 respectively (some other technical comparisons are indicated by 31A86.9 and B92). The painter simile 31B23 which recognizes a creative factor in their workmanship (cf. Fritz Wehrli, *Museum Helveticum*, 14 [1957], 43) can hardly be meant to illustrate Cypris' procedure.

product, not at all in the creative activity of its fashioner. For the passages discussed in our last paragraph the fashioner is essential, and he should be regarded as the novel feature. Yet on one occasion we find Empedocles crediting not the goddess Cypris but as humble an agent as fig-juice with the action of "binding and riveting" (i.e. curdling) milk,²⁴ and while we need not doubt that the fig-juice is meant to illustrate the modus of Cypris' operations, it still is noteworthy how generous Empedocles was in his use of craftsman similes. Bearing all these observations in mind, we shall think it unlikely that Empedocles was guided by a consciously held methodical principle.²⁵ Empedocles is a poet. Aristotle called him *metaphorikos*, probably in accordance with the distinction which he himself in his *Rhetoric* makes between metaphor and *eikon* ("image"), illustrating the former by examples in which the subjects compared are fused into one conception, whereas in the latter they are kept distinct.²⁶ This definition of metaphor fits our fragments and may even help to set them apart from the lantern and waterlifter simile. It would surely be unwise to separate the physicist and the poet in Empedocles "by the axe"; for what made him the father of comparative anatomy was after all the same uncanny feeling for "similarities" which earned him Aristotle's description as *metaphorikos*. What we wish to suggest is merely that (unlike Plato's and Aristotle's corresponding patterns) Empedocles' craftsmanship metaphors were not prompted by a philosophical theory or conviction. His imagination made him visualize Cypris' mixing in vivid and concrete pictures. Quite possibly he may have wished to bring out the effectiveness of Cypris' procedure or the durability of her works (it is worth mentioning that Aristotle, in the *Metaphysics*,²⁷ instances rivets and glue as means of achieving an elementary kind of unity), but the limited material does not allow us to be positive on this point.

Some samples of Cypris' craftsmanship were to be incorporated into later systems with whose teleological orientation they seemed to accord. This does not entitle us to read a teleological idea into Empedocles' own account of Cypris' procedure, for at most his teleology would be embryonic. One or two creations of Cypris are her "final" or "perfect" masterwork²⁸ but there is no trace in the fragments of a

²⁴ See 31B33. 31B34. "cementing barley meal by means of water" must have formed part of a simile, not of a "metaphor" in the sense presently to be defined.

²⁵ Note also that B98, although similar in content to B96, includes no craftsmanship motif comparable to the melting pots and the glue of Harmonie; instead, with perfectly different imagery, it refers to the "harbors of Cypris."

²⁶ Aristotle *fragm.* 2 of the dialogue "On poets"; cf. *Rhetoric* III.4, 1406b20ff. and *Poetics* 22, 1459a7f. Cf. Otto Regenbogen, *Kleine Schriften* (Munich, 1961), 198.

²⁷ *Metaph. Iota* 1, 1052a24; cf. *Phys.* V.3, 227a16f.

²⁸ *Scil.* the *Sphairos* (31B27, 28) and, in the realm of biology, blood and flesh (B98), both of which contain the elements as mixed in about equal portions.

conscious or purposeful planning on her part. In fact the absence of forethought and wisdom makes her the least intellectual of all Pre-socratic deities (with the possible exception of her rival-partner in Empedocles' scheme, Strife).²⁹ Since Empedocles asserts that "everything" has "consciousness and a portion of insight"³⁰ we would go too far were we to deny these qualities to the goddess. Still her craftsmanship, as we find it in the fragments, is entirely of the "manual" kind. True to her character, she seems to act on impulse.

The intellectual element which is so difficult to find in Empedocles' Cypris reappears with a vengeance in Anaxagoras' deity. *Nous* is pure mind or pure intellect, debarred from all direct contact with the material which he is said to "set in order" (*diakosmein*).³¹ In the history of the craftsmanship motif *Nous* can have no place. It would be all the more important to know whether Diogenes of Apollonia or another physicist writing under the impact of Anaxagoras showed in detail how the "working" of the divine Mind may be traced in many specific items relating to the structure of our body and to the organization of human life. The proofs of divine providence (*pronoia*) which we read in Xenophon's *Memorabilia* (I, 4 and IV, 3) are of this type. They focus on the deity's special care for man, finding evidence for it in the thoughtful design of some of our organs. In this context God is spoken of as a "craftsman" (*demiourgos*) and the results of his workmanship as an "artful device" (*technema*). More specifically he is said to have covered our eyes with the eyelids as with doors which are opened or closed, to have planted the hair on the eyelids to function as a strainer (and to protect the eyes from the winds), and to have "battlemented" the region above the eyes by means of the eyebrows. Slightly later the alimentary tract is referred to as "channels" (*ὄχεροι*).³² Since it is difficult to perceive the outlines of a physical

²⁹ By contrast, the deity whom Empedocles proclaims in the *Purifications* is thoroughly spiritual. Fragment 134 endows him with intellectual qualities comparable to the *gnome*, *nous* and *sophie* of Xenophanes' and Heraclitus' god.

³⁰ 31B110, 10 ("consciousness" and "insight" are perhaps the nearest approximations to *phronesis* and *noma*).

³¹ 59B12. Charles H. Kahn, *Anaximander and the Origins of Greek Cosmology* (New York, 1960), 163ff., questions the accepted chronology which puts Empedocles prior to Anaxagoras.

³² Xenophon *Memorabilia* I, 4, 6.—Aristophanes, *Thesmophor.* 19 (the ear as a funnel) is another passage which has repeatedly been cited in this connection.

³³ Willy Theiler's discussion (*Zur Geschichte der teleologischen Naturbetrachtung bis auf Aristoteles* [Zurich, 1925], 13ff.) remains important, no matter how one feels about the attributions to Diogenes. For a skeptical view see Gregory Vlastos, *The Philosophical Quarterly* 2(1952), 115 n. 84. I find it difficult to imagine the arguments of Xenophon's chapter as a sequel to Diogenes 61B3 or 4. And as sixty or more years may lie between Diogenes and Xenophon the former's ideas, if present, would have become subject to every degree of dilution for edificatory and other purposes.

system behind these arguments for Providence it remains doubtful whether they go back to a physicist like Diogenes³³ or whether they are the résumé of perhaps less highbrow treatises whose author or authors we are in no position to identify. The idea that all of our organs and endowments are admirably adapted to their function pervades the account more palpably than the conception of divine craftsmanship. But when all this has been said it remains embarrassing that we cannot be more definite about the source of Xenophon's arguments.

The Demiurge of Plato's *Timaeus* is a conception much too original to be explained as a synthesis of earlier thinkers' ideas. Plato's choice of this symbolism is best understood in the light of what he himself elsewhere says about the pattern of a craftsman's operation. However, before we address ourselves to this task, we may note that the range of activities given to the Demiurge is large enough to embrace some manifestations of Anaxagoras' *Nous* as well as the manipulations of Empedocles' Cypris, while somewhere between these extremes there are even contacts with the popularized (?) concept of a provident deity for which Xenophon is our witness.³⁴ The Demiurge resembles Anaxagoras' *Nous* in that he too is a mind and that he too sets everything in order. At least one statement by which Anaxagoras describes the "ordering" (*diakosmein*) initiated by his *Nous* is applicable to Plato's divine architect (if this statement is only a part of a sentence, we should remember how much Anaxagoras is able to pack into a few words): "Mind also devised this orderly revolution in which now the stars, the Sun and the moon revolve."³⁵ In fact the *diakosmein* of the Demiurge is most conspicuous in the region of the celestial revolutions, although it is by no means confined to it. Here no Necessity and no secondary causes had to be taken into account.

However, Plato, as is well known, missed in Anaxagoras indications as to the specific reasons and purposes of the divine *Nous*.³⁶ What Anaxagoras omitted he himself supplies in rich measure. Wherever the god—and his helpers—comes into operation and wherever there is room for a purpose cause, Plato informs us regarding the specific ends pursued by his creator-god. Very frequently this information is given in the form of a *logismos*, a train of reasoning said to have taken place in the divine Mind.

Taking thought he found that, among things by nature visible, no work that is without intelligence will ever be better than one that has intelligence . . . and moreover that intelligence cannot be present in anything apart from soul. In virtue of this reasoning, when he framed the universe, he fashioned

³⁴ *Tim.* 45d7f. (the eyelids as "protection"—not as "door"—of the eyes, a thought which Plato incorporates but which he does not pause to elaborate).

³⁵ Anaxagoras 59B12; For *diakosmein* see *Tim.* 37d5 (53a7, 69c7, 75c7). Due to the advances made in his own life time by the astronomers, Plato is in a position to assign "orderly revolutions" also to the planets. ³⁶ Plato, *Phaedo* 97b–99d.

reason within soul and soul within body, to the end that the work he accomplished might be by nature as beautiful and perfect as possible.³⁷

Invariably the god and his helpers are guided by the "good"; the *logismos* reasons out how in a given instance and under given conditions the good may be as fully as possible realized. Instructive as it might be, we shall here forego a closer analysis of these divine reasonings. The one additional example presently to be quoted will serve the dual purpose of showing that Plato's gods, while fashioning man, are motivated by ends higher than his physical preservation—this distinguishes them from the provident god of Xenophon—and of presenting the gods in a situation of choice between two possible courses of actions, either of which would have realized something "good"; "The limiting conditions of Necessity allow in no wise dense bone and much flesh to go together with keenly responsive sensation."

If it were otherwise, the head would have received such physical equipment "and the human race, bearing a head fortified with flesh and sinew, would have enjoyed a life twice as many times as long as now, healthier and freer from pain. But as it was, the craftsmen who brought us into being reckoned whether they should make a long-lived but inferior race or one with a shorter life but nobler, and agreed that everyone must on every account prefer the shorter and better life to the longer and worse. Hence they covered the head with thin bone but not with flesh. . . . Accordingly the head . . . is all the more sensitive and intelligent, but much weaker."³⁸

The decision between a long unglorious life and a short life dedicated to the realization of human excellence was for the Greeks a familiar motif, which had found its noblest and most authoritative treatment in Achilles' choice between these alternatives. In the *Apology* Socrates quotes this Homeric *exemplum* as sanctioning his own decision in a comparable situation.³⁹ If the gods in the act of creating man showed the same preference which heroes and men are so often presented as adopting, we should regard their decision as a "prototype" and as the divine endorsement, given once for all, of man's moral destiny.

When we turn from the craftsman's reasoning processes to their execution we find so great a variety of manual activities that it would be tedious to list all of them. Many of the verbs employed by Plato suggest a carpenter's or builder's work. The god "frames" (*tektainein*)

³⁷ *Tim.* 30b (here and elsewhere F. M. Cornford's translation has been used, with occasional modifications). The following is the rationale for the creation of the Sun (39b): "And in order that there might be a conspicuous measure for the relative speed and slowness with which they (*scil.* the celestial spheres) moved in their eight revolutions, the god kindled a light in the second orbit from the Earth—what we now call the Sun—in order that he might fill the whole heaven with his shining and that all living things for whom it was meet might possess number. . . ." See also e.g. 72c2ff., 74a7ff., 76d7ff. (more briefly, 45a3f., d7f.). ³⁸ *Tim.* 75a7ff.

³⁹ See *Apol.* 28b–d where Plato refers to Homer, *Il.* 18, 94ff. (78–126; cf. 9. 410–416). See also Soph., *Aias* 457–480, *Antig.* 450–470, Eurip., *Iph. Aul.*, 1374–1401a1.

the Cosmos with the World-soul in it, and his helpers resort to the same technical process when constructing the human "frame."⁴⁰ He "turns" (*torneuein*, according to the dictionary, "work with a lathe or chisel") the Cosmos round and spherical, an operation likewise at a later juncture repeated by his helpers when they form the human skull.⁴¹ "The gods 'build between head and breast the neck as an isthmus and boundary.'" Similarly, if more elaborately "they build a partition (*scil.* the diaphragm) across the hollow of the trunk, as if marking off the men's apartment from the women's and set the midriff as a fence between them."⁴² In both instances they are visualized as housebuilders. The actions of splitting, bending, and joining which figure in the construction of the world-soul and its circles may seem more suggestive of a locksmith's work.⁴³ To make a firm compound of the four elements, the gods use "a multitude of rivets"—the same device which Cypris had seen fit to employ.⁴⁴ In another phase of the divine workmanship conduits comparable to the irrigation system of a garden are constructed throughout our body for the purpose of "water-supply"; these conduits or channels are the blood vessels, and the "water supply" is Plato's way of referring to the distribution of food to every part of the body (that the blood vessels are the vehicle of this process was a recent discovery).⁴⁵ The same section also describes a complicated dual network woven by the gods and stretched out through a large part of our body. Some details of the construction are difficult to understand⁴⁶ but they do not affect the basic idea that the network provides the mechanism of respiration. Finally there are many instances of "modelling" (*plattein*) and "mixing."⁴⁷ These operations account for most of our bones and tissues. The Demiurge is in this context once actually referred to as "modeller in wax" (*kero-plastes*),⁴⁸ and it is in this section that his procedures most closely

⁴⁰ 30b5, 33b1, cf. 45b3; 70e3. cf. here throughout Theiler, *op. cit.* 75f.

⁴¹ 33b5; 69c6; 73e7 (cf. 44d3ff.).

⁴² See 69e2, 6; see also c8.

⁴³ See esp. 35b7, c1, d2. Note that these operations are performed on non-physical or non-material objects.

⁴⁴ 43a3; cf. above (Theiler, 76). For the god(s) as "fastening," see 45b4, 69e4, 73c3, 74b5, as "felting" 45b8, as "stuffing" 74a5, e2, as "winding" 73a3.

⁴⁵ 77c6–79a4; note especially 77c8, d6, e7, and 79a2f. where the food is pumped into the veins "as water from a spring into funnels"; cf. 80d1ff., 81a1. On the underlying physiology, see my "Tissues and the Soul," *Philos. Rev.* 59 (1950), 452ff.

⁴⁶ Cf. Cornford's illuminating commentary, *Plato's Cosmology* (London, 1937), 305ff. ⁴⁷ See section 73c1–74e1. For the mixing of the ingredients of the World soul (35af.), cf. my comment above, Note 43.

⁴⁸ 74c6. It is amusing to observe how many of the technical activities that Plato associates with the Demiurge and his helpers—turning, digging, cementing, rivetting, molding, etc.—recur in the inscriptions which embody the financial account for the work done by various craftsmen on the Erechtheum (*Inscriptiones Graecae* I, 2nd ed., 373f.). For "modellers in wax," see *ibid.*, 373.98, 374.255.

resemble those of Empedocles' Cypris. A sentence which calls for a comparison with her workmanship may illustrate this type of divine "fashioning." To create the bones, the god "having sifted out earth that was pure and smooth, kneaded it and soaked it with marrow; then he plunged it into fire, next dipped it in water, and again in fire and once more in water; by thus shifting it several times from one to the other he made it insoluble by either."⁴⁹

Cypris too may have had the intention to make her products "insoluble" when she "gave (them) to swift fire to harden,"⁵⁰ yet there is nowhere in Empedocles a statement or conception of her intentions, whereas in Plato everything that the craftsman does serves a clearly defined purpose, taking its place in his comprehensive plan of cosmic *taxis* (order). However, in the sections where Necessity dominates and where the conditions determined by this secondary cause are set forth the Craftsman disappears from sight.⁵¹ He returns in due course to use "causes of this kind as subservient, while he himself fashions (more literally, 'frames') the good in everything that comes into being."⁵² A closer analysis of the *Timaeus* would have to indicate still other sections of this work in which Plato drops the craftsmanship motif, preferring a different pattern of presentation. The absence of the Demiurge does not invariably imply that teleology has faded out of the picture.⁵³

In spite of such variations, the Demiurge and his technical operations must bring out a significant facet of the physical world. The workmanship of Cypris is confined to living beings,⁵⁴ the "artful devices" of Xenophon's divine providence to man's anatomy. Why does Plato employ the symbolism of a divine architect, a creator of the world and man, a figure which in some ways resembles the god of non-Hellenic cosmogonies and creation myths? Neither these myths as such nor the fact that the Hebrew-Christian tradition found it possible to restate the events of *Genesis* in concepts ultimately derived from the *Timaeus*⁵⁵ can give us the answer (for the Hebrew-

⁴⁹ 73e.

⁵⁰ See above, note 17.

⁵¹ See esp. the sections dealing with the varieties and mixtures of the four elements (58c-61c) and the mechanism of sense-perceptions (61c-68d). ⁵² 68e4ff.

⁵³ The account of nutrition, growth, decline and death (80d-813), while including no reference to the craftsmen, is closely connected with their provisions as described in 77d-79a so that the motifs may be presumed to carry over.

⁵⁴ That the relevant fragments deal with only these might be considered an accident. But it is by no means certain that Empedocles' poem included the creation of the Heaven and other parts of the physical world by Cypris.

⁵⁵ In the absence of a pertinent study, reference may be made to F. E. Robbins, *The Hexaemeral Literature* (Diss., Chicago, 1912) and Willy Theiler in *Reallexikon für Antike und Christentum* s. v. "Demiurg" 703ff. See also Karl Gronau, *Posidonius und die jüdisch-christliche Genesisexegese* (Leipzig; Berlin, 1914); Carl Schneider, *Geistesgeschichte des Antiken Christentums* (Munich, 1954) 1.424ff.

Christian exegesis amalgamated elements foreign to the original meaning of *Genesis*). The Demiurge, whose very name is "craftsman" and who is a creator only *qua* craftsman, cannot be understood apart from Plato's conception of the crafts and their representatives. For the rest, we must take our stand on Plato's own repeated affirmation that he is telling a likely tale, or offering "accounts no less likely than any other."⁵⁶ Plato considers the realm of *genesis* as opaque to human reason; but precisely because the truth cannot be known⁵⁷ and because the myth is under these circumstances the most appropriate "form" (*schema*), Plato felt free to use a symbolism which must convey something essential about the physical world and its participation in the "good."

Other Platonic dialogues include descriptions of a craftsman's typical operation. Some of these passages bring out aspects that the *Timaeus* uses to advantage; their testimony is valuable regardless whether or not the physical world and the divine master craftsman are in the offing. In the *Gorgias* Socrates affirms: "The craftsmen having their eye on their task do not select and apply to it at random what they apply; rather they see to it that their work comes to have a definite form (*eidos*). For instance, painters, housebuilders, shipwrights, and all other craftsmen whomever you wish to choose, place all things in some order (*εἰς τάξιν τινά*) and compel one part to suit another and to harmonize with it until the whole thing as they fashion it has order and beautiful organization (*τεταγμένον καὶ κεκοσμημένον*)."⁵⁸ Order (*taxis*) and beautiful organization (*kosmos*) are the conditions which the Demiurge in the *Timaeus* imposes on his material. In a well-known passage of the *Republic* the maker of a bed and a table, called *demiourgos* and obviously a carpenter, is said to look at the Forms, while he is engaged in his work.⁵⁹ Finally, in the *Laws* Plato insists that "every skilled craftsman (*ἐντεχνος δημιουργός*) does all things for the sake of the whole, directing his efforts to the common best and executing the part for the sake of the whole."⁶⁰ The relevance of the last passage may not be immediately obvious, since it could be argued that in the *Timaeus* man is important in his own right and not, or not only "for the sake of the whole." It may be all to the good if the passage of the *Laws* brings this problem into sharper focus. Whatever its solution—which we do not here attempt to find—it is evident

⁵⁶ 29cf., 48d.

⁵⁷ 29bff.

⁵⁸ *Gorgias* 503e. E. R. Doods (*Plato, Gorgias*, Oxford, 1959 *ad loc.*) aptly compares *Phaedrus* 264c and 268 d4.

⁵⁹ *Rep.* X, 596b. Note that Socrates describes this approach as familiar ("we are in the habit of saying . . ."); cf. *Crat.* 389b.

⁶⁰ *Legg.* 10, 903c5ff. *Polit.* 308c may illustrate the selective procedure of the crafts. Passages in the *Republic* (VI, 507c, VII, 530a) and in other dialogues (*Soph.* 265c5ff., 266b, *Polit.* 273a and *passim*) indicate how much Plato is in the habit of thinking in terms of a divine craftsman (and what different forms this idea takes).

from the three passages quoted to what aspects of the physical world Plato, by employing the craftsman symbolism, gave the desired measure of relief. To the concepts of order and intrinsic harmony emphasized by the other passages the *Laws* add that of the good, which in the *Timaeus* is closely associated with *taxis*. Anaxagoras, as Plato's criticism in the *Phaedo* stresses, had failed to show how thanks to the action of the *Nous* the good is realized throughout the Cosmos. Plato had expected him to indicate the "common best" (τὸ κοινῇ βέλτιστον) for the conditions and phenomena of the physical world.⁶¹ The craftsman, as again the *Laws* show, is able to produce this "common best" which gives the physical world (and any account about it) its meaning. But at this point it must be said once more that the realization of "the good" (*agathon*) in the world of Becoming is a subject so elusive and so little accessible to the ways of human reason that it can be treated only in the form of a myth and without any claim to "truth." For truth, knowledge, and perhaps also for the direct manifestation of the Good, Plato would look elsewhere.

The craftsman who, coming from the outside, introduces into the physical world order and as much "good" as it can accept, is an appropriate symbol because Plato would not credit nature (*physis*) itself with the capacity to produce anything valuable. Quite unlike Aristotle, Plato has no confidence in *physis*; nothing good—no order, form, or meaningful structure—could ever emerge from its crude and erratic ways⁶² (although he refuses to commit himself definitely on his own account, we may take it that an approach crediting nature itself with inherent rationality or teleology would be for him "less likely"). Form and direction have to come *ab extra*. The passages adduced show that Plato has confidence in the crafts. He has retained and developed Socrates' belief that the craftsman knows what he is doing; by and large Plato thinks of him as proceeding consistently toward a pre-established end. Since in the *Timaeus* the craftsman *ex hypothesi* is "the best of causes" and the world "the best of things that have come into being,"⁶³ it is immaterial that many reflections which guide the divine architect in his work of creation would be far too sublime for the average craftsman.

The continuity between Plato's and Aristotle's teleology is clear beyond the possibility of doubt and the necessity of arguments. The

⁶¹ *Phaedo* 97bff. (98blff. suggests that the "good" or "best" for each individual item and the "common best" coincide).

⁶² For *physis* without the god see *Tim.* 52d2–53b7; *Soph.* 265b7ff.

⁶³ *Tim.* 29a5. I refrain from discussing the relation between the Demiurge and the World-Soul. The craftsman passages in other dialogues, if given due weight, should discourage Platonic scholars from identifying these two concepts. Both of them, it is true, impart spiritual qualities to the physical world but it does the interpretation of the *Timaeus* no good if relationships other than those indicated by Plato are constructed between them.

general agreement of their conceptual scheme would prove it (both contrast purposive cause to "what comes about by necessity"), but it could be no less cogently shown by items of detail, including craftsmanship motifs that they have in common. In the *de partibus animalium*, as in the *Timaeus*, the diaphragm is considered a partition wall (or "fence") set up between the nobler and the less noble half of the trunk.⁶⁴ Here as there the blood vessels correspond to irrigation channels which carry the water (i.e. the food) in every direction, and here as there the belly is likened to a manger, although Aristotle has dropped the idea, which was out of line with his psychology, that the appetitive soul here receives its feeding.⁶⁵ In other instances Aristotle's dissent goes farther, making it necessary for him to abandon or to modify the craftsmanship motif. The "modelling" of our tissues fits his scheme too, but as he develops the comparison, bringing "nature" even closer to the modeller's ways, he arrives at conclusions which are the opposite of Plato's. "Modellers who set out to mould an animal of clay or some other plastic substance begin first of all with a hard and solid core and mould their figure round it. Nature has done its fashioning (*demiourgein*) in the same way. . . ." ⁶⁶ This means that the entire bony structure has been created for the sake of the flesh which it supports, an idea entirely in keeping with Aristotle's conviction that the flesh is essential to the nature of sentient beings.⁶⁷ In the *Timaeus* the relationship is the reverse; here the flesh is laid around the bony structure because the latter, being essential but of brittle composition, needs protection.⁶⁸ For us agreement and disagreement with the *Timaeus* are equally indicative of Aristotle's debt to Plato and to research, whether of the Academy

⁶⁴ *de part.an.* III. 10, 672b9-24 (esp. 19ff.); cf. *Tim.* 70a1f. In Thucydides I, 133 *diaphragma* is used in its original meaning (= "fence"). The word owes its modern currency to the passage in the *Timaeus*, where it is incidental in the house-builder symbolism. Galen, *de locis affectis* V. 4 (VIII, 327ff Kühn) informs us that after Plato (and, he implies, under his influence) the physicians adopted the word *diaphragma*, giving up the term *phrenes* which was unsatisfactory because it suggested "thought" and had in the past been applied to various organs supposed to be the seat of thought. On *phrenes* cf. R. B. Onians, *The Origins of European Thought* (Cambridge, 1952), 23-40.

⁶⁵ 9 *de part. anim.* III. 5, 668a14: bloodvessels "may be compared to water courses (*hydragogiai*) in the gardens which from one well branch off into many and always more channels to carry supply in every direction." Aristotle reinforces this extended analogy by another involving the procedures of an architect (a17ff.) but the water courses are clearly a more serviceable illustration. For Plato see above, p. 482. The "manger": *Tim.* 70e2f., *de part.* II. 3, 650a18ff.

⁶⁶ *de part. anim.* II. 9, 654b29ff. (A. L. Peck's translation); cf. 8.653b32ff. Aristotle however observes that in the case of crustacea, turtles, etc. the hard substance lies "outside" the flesh (653b38ff.). In Empedocles the same creatures owe this disposition of the "dense" and "loose" parts to "the hands of Cypris." Aristotle attributes it to *physis*.

⁶⁷ See the beginning of *de part. anim.* II.8 (653b 19-37).

⁶⁸ *Tim.* 74a7-d2.

or of physicians and biologists in whose work the Academy took a profound interest. However, important as the evidence for the continuity is, it should not divert our attention from the new departures embodied in the underlying theory. For in contrast with Plato, Aristotle has a definite, full-fledged theory regarding the parallel operation of nature and craft (*techne*).

For Aristotle the physical world is not the subject of a myth or a "likely tale." Knowing of no reason why nature should be opaque to human intelligence he is convinced that the truth can be found—a conviction which of course does not exclude reservations or uncertainty about details—and that scientific methods lead to valid results concerning the ways in which nature "works." The last point entails a further break with Plato. Aristotle has full confidence in nature. By its own devices and through its own resources *physis* is able to produce the best.⁶⁹ And since it no longer needs external help to achieve its purposes, the craftsmanship which in the *Timaeus* supervened from the outside is now an immanent characteristic of nature's own operations.

The Second Book of the *Physics* and the First Book of *de partibus animalium* include the most outspoken affirmations about the parallel direction of nature and craft. In the *Physics* Aristotle, having stated that "nature is in the class of purpose causes" (literally "for the sake of something" causes)⁷⁰ and having defended this proposition against the alternative mechanistic approach, declares: "Wherever there is an end, the former and successive steps are for the sake of this end. Hence as in action so in nature, and as in nature so it is in every action, if nothing interferes. Now action is for the sake of an end. Therefore nature too is for the sake of an end."⁷¹ Although "action" (*prattein*) does not necessarily or exclusively denote technical operation—it could, for instance, refer to moral action⁷²—Aristotle in the subsequent arguments restricts the meaning of the concept to this sphere. Without supporting his thesis by additional reasoning but letting it rest entirely on the parallel orientation toward the "end," he insists on a complete correspondence: "If a house were one of the things made by nature it would come into being in the same way as it now does by art; and if the products of nature came into being not only by nature but also by craft they would come into being in the

⁶⁹ For evidence from Aristotle's cosmology see my *Aristotle's System of the Physical World* (Ithaca, N. Y., 1960), 112, 272.

⁷⁰ Arist., *Phys.* II. 8, 198b10ff. Hans Meyer, *Natur und Kunst bei Aristoteles* (Paderborn, 1919), offers admirable philosophical interpretations and integrations; the historical conclusions of the last chapter (pp. 111ff.) are less cogent.

⁷¹ *Ibid.*, 199a8ff.

⁷² For the paradigmatic function of the crafts in Aristotle's ethics see Richard Walzer, *Magna Moralia und Aristotelische Ethik* (Berlin, 1929), 31ff.

same way as by nature.”⁷³ This is an entirely new concept of nature, and since it has been fathered (or godfathered) by craft it is not astonishing that Aristotle, looking from the vantage point of this concept at the crafts, persuades himself that craft follows the pattern of nature. Like Democritus and others before himself, although with different intent, he declares that the crafts “imitate” nature.⁷⁴ Still another doctrine, likewise entailed by the parallelism, is enunciated at the end of this section: “In the productions of craft and in those of nature the relation between the later and the earlier stages is analogous” (ὁμοίως ἔχει).⁷⁵

The teleological direction of natural processes does not for Aristotle imply deliberation or a conscious “seeking” and “inquiring” (ζητεῖν).⁷⁶ There are no such mental acts even when the swallow builds its nest or when the spider weaves its net. However, Aristotle uses these items and also the manipulations of the ants—manipulations wrongly held to spring from intelligence—as proofs of the operation of the purpose cause and, working downward in the scale of beings, assumes the same cause when “the plants grow leaves for the sake (i.e. for the protection) of the fruits and send their roots down, not up, for the sake of nourishment.” The absence of deliberation cannot militate against the assumption of purpose in nature; for “even craft does not deliberate”⁷⁷ (Aristotle here probably thinks of the craftsman as acting automatically and by instinct).

In the Introduction to *de partibus animalium* essentially the same theory is set forth, except that being slanted toward the biological investigations which it precedes it is more definitely “methodological.” “Becoming is for the sake of being.” Biological growth and development must be understood (and explained) with reference to the result, the finished product. Once more the building of a house serves as model. “Such and such things happen in the process of house building because the form (*eidos*, *scil.* of the house) is such and such.” This approach is better than to say that the house is of such and such kind due to the manner in which it has come into being.⁷⁸ In another section of the First Book Aristotle, arguing that in biological studies the purpose cause should have primacy—for this cause “is the rational ground” (*logos*) and the rational “principle” (*arche*)—supports this axiom by referring to two craftsmen, the physician and again the housebuilder.⁷⁹ Both have set before themselves the end of their professional action and both state the rational grounds and reasons of each step they take with reference to this end. In the case of the

⁷³ *Phys.* II.8, 199a12ff.; see also 199b28ff.

⁷⁴ More precisely, they partly complete, partly imitate nature (*ibid.*, a15ff.; cf. Democritus 68B154). ⁷⁵ *Ibid.* 18ff. ⁷⁶ *Ibid.*, 20–30 and 199b26ff. ⁷⁷ 199b28.

⁷⁸ *de part. anim.* I.1, 640a10ff., esp. 16–19.

⁷⁹ *Ibid.* 639b12ff., esp. 15–19.

builder the end is of course again the completed house. When concluding this argument, Aristotle adds: "Yet purpose and beauty are in an even higher degree present in the works of nature than in those of craft."⁸⁰ From still another section of this Book we may report the thought that a carpenter when asked to account for his procedure might mention his tools, axe and auger, but would, since this is not a sufficient answer, also indicate why he made his strokes.⁸¹ The "why" is again the purpose, i.e. the "shape" or "form" which is to emerge in the end. To understand this observation correctly we may bear in mind that nature too employs "tools" or "instruments" (*organa*). The vital spirit (*pneuma*), for instance, is in Book V of *de generatione animalium* called "an instrument useful for many purposes" (*polychreston organon*) and compared with the hammer and anvil employed by a smith.⁸² Clearly the biologist would give an inadequate account if he were content with stating what instruments nature uses (although Aristotle's precursors have in his opinion done no more than this); he must also point out what ends nature pursues with the help of these "instruments." The methodological importance of each of these observations will be obvious.⁸³

The two treatises *de partibus animalium* and *de generatione animalium* include a good number of instances in which nature acts like a modeller, a painter, a cook, a carpenter, a housebuilder, or a channelbuilder. Some such instances have already been presented and it will here suffice to add one more from each treatise. In the process of reproduction, as Aristotle analyzes it, the male parent contributes "form," not matter, the *sperma* being in no sense a physical part of the fetation, "just as from the carpenter nothing passes into the timber, his material, and no physical part of the art of carpentry is present in the product; what is due to the carpenter is the shape and form. . . ." ⁸⁴ Wishing to understand the viscera below the diaphragm in their relation to other organs, Aristotle compares them to "bonds"; they are, "as it were, anchor lines thrown out to the body, e.g. from the great blood vessel to the liver and to the spleen"; so that "like rivets they fasten (the blood vessel) to the body." ⁸⁵ For good meas-

⁸⁰ *Ibid.* 19ff.

⁸¹ *Ibid.* 641a6-14.

⁸² *de gen. anim.* V.8,789b6-13. On purposes associated with the *pneuma* see my recent article "Greek Philosophy and the discovery of the nerves," *Museum Helveticum* 18 (1961), 150ff.; esp. 174ff.

⁸³ For an implementation of the last point see e.g. *de gen. anim.* II.6,743a5-27 and especially 37ff.

⁸⁴ *de gen. anim.* I.22,730b9-15 (the analogy extends beyond the items here selected; see b5-32). For other carpenter analogies, see *ibid.* I.18,723b28ff., II.6,743a25-27.

⁸⁵ *de part. anim.* III. 7, 670a8-17. See further *de gen. anim.* I.22,730b27. and 29f. ("nature [here] resembles a modeller rather than a carpenter"); I.18,725a24-27; II.6,743b18-25 (nature as painter), II.6,743a29-34; IV.7,776a1-8 (nature as

ure reference may still be made to an instance in which nature seems to part company with the crafts, but the craftsman in question is not a very reputable practitioner of his profession; nature does well not to follow his example, and yet Aristotle, partly by force of habit and partly for the humorous effect, works out the analogy. "Whenever it is possible to employ two organs for two functions, without their getting into each other's way, nature is not in the habit to act like the coppersmith who in the interest of cheapness produces a spit-and-lampstand combination" (*obeliskolychnion*).⁸⁶

As a rule, the technical activities are presented in the form of a comparison. Unlike the Demiurge and his helpers who build, frame and mould, Aristotle's *physis* does not actually build or engage in carpenter's work but acts *like* a carpenter, modeller, smith, etc.⁸⁷ Thus after Empedocles' delight in metaphors and Plato's use of a consistent symbolism we find in Aristotle the method of resorting to analogies. He uses them wherever he feels that they illustrate, confirm, or justify his conception of nature's *modus operandi*. Each analogy is complete in itself; there is no thought of integrating them in a pattern or conception comparable to the Platonic Demiurge. Moreover nature's working or purpose can be, and very often is, explained without recourse to such analogies.⁸⁸ Does this mean that the same thinker who in his theory is the first to give craftsmanship a recognized standing shows in his practice that the motif has passed the peak of its usefulness and vitality? Superficially this opinion may have a certain persuasiveness. A point in its favor is that while the Platonic craftsman fashions both Cosmos and man, Aristotle's craftsmanlike *physis* is restricted to the realm of biological entities. For, his Cosmos being eternal, Aristotle would see no advantage—not even of an expository or pedagogical kind⁸⁹—in approaching it from the genetic point of view, and with this point of view the craftsmanship motif too has lost its applicability. Evidently the motif is most useful where the relation between Being and Becoming is a problem of vital importance. In Aristotle's physiology and theory of reproduction this relationship continues to be crucial, the eternity of the species notwith-

cook; cf. also I.20,729a12–14); *de part. anim.* II.16,659a8ff.; 15,658b14–18 (observations probably indebted to the doctrine in Xenophon, *Memor.* I.4).

⁸⁶ *de part. anim.* IV.6,683a22–25. As a rule Aristotle is quite prepared to allow nature such *petites économies*.

⁸⁷ "Nature as cook" may be a special case; for inasmuch as nature produces much by means of the "innate heat" it does actually cook.

⁸⁸ The "partition" or "fence" motif used by Aristotle (see above, n. 64) seems vestigial when compared with *Timaeus* 69e6ff. Elsewhere technical comparisons are kept at a minimum (e.g. *de part. anim.* II.8,654a7).

⁸⁹ For an exception see *de caelo* II.14,297a12ff. However, neither this passage nor *de caelo* II.9,291a24ff. and II.9,291b12ff., where we are close to the "biological" concept of *physis*, include a reference to the crafts.

standing. Thus the paradigmatic function of the crafts is again confined to the area in which Empedocles had originally used them.

Still it would be rash to say that Aristotle's practice shows the technical motif in a state of decline and perhaps even on the way out.⁹⁰ It does not matter too much how many propositions Aristotle, even in biology, may establish without resorting to an analogy. The very significant use made of it in the methodological Introduction to *de partibus animalium*, and the almost equally significant use in connection with a fundamental theory of generation,⁹¹ should have more weight in the balance. Combined with the even more fundamental disquisition in *Physics* II, they show how integral a part of his teleology the craftsmanship motif must have been. In truth teleology and the craftsman ideology are inseparable ingredients of the concept of nature to which Aristotle during his years in the Academy had become accustomed and which he had fully made his own. What is new in his own outlook is that he has "internalized" the teleological motif. As we have said, purpose and the good are no longer introduced *ab extra*; it is nature itself which works in the purposeful ways and methods of a craftsman—or "like" a craftsman.

If Aristotle was in the habit of visualizing nature as paralleling the operations of the crafts, we are justified in asking whether any of his characteristic tenets may not owe their origin to this habit. The question, once asked, need not be confined to his biology; it is equally pertinent to some of his major physical and metaphysical doctrines. For some doctrines that involve the parallel are, on the face of things, more persuasive in their bearing on the crafts than in their, perhaps secondary, application to nature—and yet it is the application to nature which finally counts. We should readily grant, when looking at an unshaped piece of wood and at the same time at a bed fashioned out of such wood, that the former "has nothing in common with craft . . . and is not (a work of) craft." But is it equally clear, if we compare bone or flesh with the material, whatever it may be, from which they have originated, that only the product is "by nature" or, as Aristotle, with a barely perceptible toning down of his confidence asserts, that the finished product is "in a higher degree nature

⁹⁰ There are no craftsman analogies in Theophrastus' *de causis plantarum*, which is the botanical counterpart of Aristotle's *de partibus animalium*. A reading of *de causis plantarum* gives the impression that *physis* when left to its own devices is still extraordinarily resourceful but somehow less imaginative and enterprising than when it has the inspiring example of the crafts.

⁹¹ See above pp. 488 and 489. For discrepancies between nature and the crafts see *de gen. anim.* II. 1, 735a3–5; *Metaph. Zeta* 7. Klaus Oehler in *Einsichten Gerhard Krüger zum 60. Geburtstag* (Frankfurt, 1962), 279ff. presents correct observations on this subject but forms his conclusions regarding the place of the crafts in Aristotle's scheme too readily on the basis of these discrepancies. Meyer's judgment (see Note 70) seems fairer and better.

(*physis*)"?⁹² In such and similar cases we must of course admit that the actual "discovery" of the tenets eludes us and that it need not have been achieved by way of the arguments presented in the treatises. And what is true of the tenets holds good, by and large, also of the concepts which Aristotle brings along to his investigations. Concepts like *ergon* ("work," used in the sense of "function"), *dynamis*, and *energeia*, may each of them be connected with the pattern of the crafts, but as their terminological status evidently antedates the composition of the treatises, speculations about their origin are precarious.⁹³ The word *organon* ("instrument"), of which we have spoken, is used by Plato of the sense organs in a manner which makes it gratuitous to think of the craftsman symbolism.⁹⁴ There remains one far from unimportant concept for which the evidence seems to converge, pointing in rather conclusive fashion to an origin in the context of our motif.

The original and normal meaning of the word *hyle* which Aristotle uses for "matter" is "wood" or "timber." That no Greek author before him—with the possible exception of Plato in one or two passages presently to be discussed—ever employs the word in the sense of "matter" is entirely natural; for none had arrived at a concept of matter. This is not the place to set forth how indispensable the term and concept proved to be in Aristotle's own scheme, and has been ever since. What interests us, in the perspective of our topic, is that when Aristotle needed a word to represent (or symbolize) the raw and unshaped condition of a thing which has not yet received its form he chose one that denoted such a condition in the crafts. More specifically he turned to the carpenter. For wood or timber is what the carpenter accepts as his material to fashion it into a bed or a table. Aristotle himself uses this relation between the carpenter's timber and his finished product repeatedly to bring out the corresponding relation between raw matter and a formed or fully developed entity in nature.⁹⁵ That his word for the carpenter's material is not always

⁹² *Phys.* II.1, 193a31–b3, b6f. The thesis of *Metaph. Zeta* 8f. that neither matter nor Form comes into being but only their compound, is more easily proved with the help of a technical illustration (the bronze sphere); had Aristotle resorted to his physical stock example that "man begets man" it would have been a hard saying that the material and the Form (in the begetting father!) do not come into being. And it seems to me that even for the distinction between a passive and an active intellect the analogy of the craft is the decisive argument (*de anima* III.5, 430a10–15).

⁹³ On *dynamis* and *energeia* see Jaeger, *Aristotle* (Engl. paperback ed. Oxford, 1962), 384. The terms are found in the *Protrepticus* (fragm. 14) which belongs to Aristotle's Academic period.

⁹⁴ See e.g. *Rep.* VI.508b, *Theaet.* 185c, *Tim.* 45af.

⁹⁵ Some pertinent Aristotelian passages are *de anima* II.4, 416b1f.; *de gen. anim.* I.18, 723b30; 22, 730b4–15; *de part. an.* I.1, 640a23–29; *Metaph. Lambda* 6, 1071–

hyle but often another word for wood, *xylon*, need not disturb us any more than that he also for purposes of exemplification likes to use the relation between bronze and a finished statue.⁹⁶ One word had after all to be chosen to serve as a generic term and if timber does not seem to us an inevitable choice, it still happens to be the choice which Aristotle made, no matter whether we account for it by Aristotle's own use of the carpenter as his favorite example of a craftsman or prefer to think of the carpenter as particularly important and conspicuous among the craftsmen in a Greek community (since both explanations have a good foundation in facts, it would hardly be wise to rely exclusively on one of them). Aristotle himself declares as plainly as we could wish: "All things that come into being either by nature or by craft have *hyle*."⁹⁷ Since timber or wood is never in Aristotle's or any other Greek system envisaged as the substratum of physical formations, there is nothing on the side of *physis* that could explain Aristotle's use of the word *hyle*. We must perforce turn to the other realm in which "all things that come into being have *hyle*." Here, as we have already begun to see, *hyle* really has the place which Aristotle assigns to it also in nature and the only hypothesis needed to explain his usage is that he generalized, taking carpentry as his starting point. In this instance the habit of thinking of nature as proceeding like a craft seems indeed to have proved fruitful. It furnished Aristotle with a concept essential for both his theory of Being and of nature.

In his preserved treatises Aristotle never bothers to justify his use of *hyle* in its generalized meaning. He assumes it to be understood and familiar. To think that like other items of his terminology it had become fixed before he began to expound his system is probably correct but it leaves us with the question whether Aristotle himself and on his own accord coined the term or whether it reflects some kind of agreement and understanding in his environment. This environment would of course be the Academy; for we have seen that Plato and Aristotle share the basic outlook from which the craftsman symbolism sprang, and if Plato himself did not need a concept of matter for his

b29f. An entire book (V) of Theophrastus *Historia plantarum* deals with the carpenter's use of *hyle*. For evidence from earlier Greek literature see my "Aristotle's word for 'matter'" in *Didascaliae, Studies in honor of Anselm M. Albareda* (New York, 1961), 405ff.

⁹⁶ E.g. *Metaph.* Delta 2, 1013b7. 4. 1014b26-32; Zeta 7, 1033a3. 8 *passim*.

⁹⁷ *Metaph.* Zeta 7, 1032a20. For *hyle* in the crafts see also e.g. *Metaph.* Delta 2, 1013b6-9; 18 (1014a12) etc. That some crafts produce their *hyle* (*Phys.* II.2, 194a33) is an exceptional statement, which we are probably entitled to disregard; see *contra Metaph.* Zeta 8, 1033a28f., b3-5. More important is *Phys.* I.7, 191a7ff. where Aristotle defines the substratum (= *hyle*) as "knowable by analogy," i.e. by the analogy of the crafts.

doctrine of Forms or for his teleology,⁹⁸ it would yet be conceivable that other members of his school—not necessarily only Aristotle—felt the need for such a concept and began to look for an appropriate word. To put it somewhat schematically, they may have asked: As the finished product of the craftsman relates to his raw material (*hyle*), so the finished work of nature (or of the Demiurge) relates to what?⁹⁹ And since their language offered no word for the last term of the proportion, the best that they could do was to adopt the corresponding one from the other side of the equation. An Academic background for Aristotle's term is in fact suggested by a passage of the *Philebus*.¹⁰⁰ Significantly the passage forms part of an argument that Becoming is for the sake of Being, a thesis which, as we know, Aristotle accepted without reservations and which he too likes to support by references to the craftsman's procedure.¹⁰¹ Plato's argument too includes the crafts. The question: is becoming for the sake of being or being for that of becoming? has hardly yet been formulated when the interlocutor asks whether this means "that shipbuilding goes on for the sake of ships rather than that ships are for the sake of shipbuilding and so on" (We need not hesitate to infer that Plato means his argument to hold good for technical as well as for natural genesis). The answer is: "While it is with a view to something coming into being that anyone provides himself with medicine, or tools of any kind, or any sort of material, the becoming always takes place with a view to the being of this or that . . ." ¹⁰²

The word here rendered by "material" is *hyle*, and while a commentator of the *Philebus* has every right to wonder whether the word "shipbuilding" in the question has prompted the word "timber" in the answer, our comment would be that the answer is in any case quite generalized and that the passage gives us all that we need for our hypothesis, to wit the craft (shipbuilding, i.e. carpentry) for which timber is actually the material, the generalized or metaphorical use of the word itself, and the philosophical context in which such generalized use would be most likely to develop. As Hackforth rightly observes: "This generalizing use in the fourth century would be a natural supposition to account for its technical sense in Aristotle." ¹⁰³ The term is here *in statu nascendi*.

⁹⁸ It is hardly necessary to say that the "Receptacle" of the *Timaeus* (49aff.) is not "matter" and only in a very restricted sense an alternative to "matter." At *Tim.* 69a6 Plato likens the types of causation previously analyzed and now to be used to the *hyle* lying ready for the carpenter's use.

⁹⁹ See the passage quoted above (n. 75) from *Phys.* II.8, 199a18ff. regarding "the analogous relation" in craft and in nature between "earlier and later stages."

¹⁰⁰ Plato, *Philebus*, 54b.

¹⁰¹ See above, n. 78.

¹⁰² 54c1. I am using the translation of R. Hackforth in his *Plato's Examination of Pleasure* (Cambridge, 1945).

In *Metaphysics Zeta* where Aristotle scrutinizes the process of *genesis* in the crafts he distinguishes two phases. The first of them is *noesis*, an intellectual process of analysis, which starts by imagining the desired object as finished and works its way back, reasoning out the preliminary stages and coming last to that stage which in the production must be the first.¹⁰⁴ Here the second phase, *poiesis* or production, takes over, to traverse the same road again in the opposite direction. Nature cannot go through the phase of intellectual analysis. Aristotle has not endowed it with a mind or consciousness, nor does he ever in his biological treatises present *physis* as performing a reasoning process comparable to those of the Platonic Demiurge. Short of this, however, it operates in ways so ingenious and, we must admit, so intelligent and pursues its "ends" so consistently that we often find it difficult to see the difference between its procedure and those of a conscious agent. These difficulties inherent in Aristotle's teleology are well known. They remain, but become less puzzling if we bear in mind that Aristotle has inherited the craftsmanship scheme from the Academy and that in the sober, scientific medium of his treatises there was no place for symbols or mythical figures. A statement like the following: "nature by constructing the diaphragm to be as it were a partition wall and a fence has divided off the nobler parts from the less noble ones; for the upper is the better. . ." would be considerably more convincing if instead of "nature" we read "the Demiurge," remembering that the idea and its phrasing, including the imagery, are derived from the *Timaeus*.¹⁰⁵ Yet the Demiurge would be a more appropriate agent also in instances where Aristotle had no such Platonic precedent, e.g. in the propositions: "Nature, like a sensible human being, always assigns an organ to an animal that can use it . . . she always does the best she can in the circumstances" (which accounts for the fact that man is endowed with hands).¹⁰⁶

We do not know whether the Stoics were aware of this problematic aspect of Aristotle's teleology and craftsmanlike nature. For them purpose in nature is again what it had been in Plato's *Timaeus*, something deliberately pursued by a conscious divine agent. In the history of teleology Aristotle's *physis*, which works toward its ends without being an intellect or having intellectual characteristics, may be regarded as an episode between two systems in which purposeful operation is, as we should expect, associated with intelligence and supreme knowledge.

¹⁰³ Hackforth (*ibid.*), 110n.1. It should, however, not be supposed that there is evidence for such use outside the Academy. ¹⁰⁴ *Metaph. Zeta* 7, esp. 1032a32–62.

¹⁰⁵ *de part. anim.* III.9,672a19ff., Pl., *Tim.* 69e5ff.

¹⁰⁶ *de part. anim.* IV.10,687a10ff. 16f.

In the Stoic system the deity is immanent, not as Aristotle's Prime Mover transcendent or, as Plato's Demiurge extrinsic and symbolic. When defining nature as "craftsman-like" or indeed as "a craftsman" and describing it as "proceeding methodically to the work of generation"¹⁰⁷ the Stoics obviate the difficulties inherent in Aristotle's conception by identifying nature with the divine forethought (*pronoia*). Zeno, Cleanthes, Chrysippus, and even Posidonius are said to be at one on the proposition that it is the *logos* (*scil.* immanent divine reason) which works upon matter and fashions matter into everything.¹⁰⁸ The word for "fashioning" is again *demiourgein* which Aristotle had used of nature and which seems to be a *Leitfossil* of our story. Although the identification of the *logos* with a particular physical element does not concern us here, it is pertinent to quote a doctrine of Zeno, since it bears on the manual aspect of craftsmanship: "What in the processes of our crafts is done by our hand is done with far more skilful craftsmanship by nature, that is to say by the craftsmanlike fire which is the teacher of the other crafts."¹⁰⁹ This being established, it was hardly necessary for the *logos*, when engaged in its creative work, to follow the methods of a particular craft. Special analogies and parallels may not have mattered for the Stoics. Rather, what did matter was that nature as defined by them could be trusted (again in Zeno's words) "to have forethought and plan all that is useful and advantageous."¹¹⁰

For their concepts of fire and *logos*, and even for the identity of both, the Stoics doubtless owe some debt to Heraclitus, although we should not underrate the influence of more recent philosophical and scientific thought upon both of these concepts.¹¹¹ The doctrine that the Fire-*logos* proceeds in the manner of a craftsman could not be found in Heraclitus. Here the Stoics are evidently in the debt of their immediate philosophical predecessors, Plato and Aristotle.¹¹²

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¹⁰⁷ *Fragmenta Stoicorum Veterum* collegit Joh. ab Arnim (Leipzig, 1904-5) 1, 171f., II. 774.

¹⁰⁸ *Ibid.* I.85 (Diog. Laert. VII, 134).

¹⁰⁹ *Ibid.* I. 171 (=Cicero, *de natura deor.* II, 57) The Stoic *physis* operates from the inside. In fact the Stoics seem to have pointed out that while the crafts "shape" the outside of their work, nature gives its products both inside and outside form (*ibid.* II, 1044).

¹¹⁰ *Ibid.*, I. 172.

¹¹¹ See "Cleanthes or Posidonius? The basis of Stoic physics" (*Mededelingen Nederlandse Akad.*, n.r. 24, 1961, 9).

¹¹² The substance of this paper has been read to the Interdepartmental Seminar on Interpretation at Columbia University and to the Colloquium on Ancient Philosophy at Princeton University. On both occasions the discussion opened new perspectives from which the paper has benefitted. I have also derived much help from my colleague and friend Professor Julius Weinberg.