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Nachkommen mit den Vorfahren werden durch die Wärmeimpulse des Samens, zu denen noch schwächere Eigenimpulse der Katamenien kommen,<sup>34</sup> auf chemischem Wege auf das Material übertragen. Die zentrale Modellvorstellung ist dabei die der Verkochung (*tréyucis*), die durch die Wärme in unterschiedlicher Intensität bewirkt wird. Wie ein Bildhauer mit seinen Werkzeugen aus dem Material die Formen herausarbeitet, die er hervorbringen gedenkt, so arbeiten die Wärmeimpulse aus dem Material der Katamenien die Formen des Nachkommen heraus,<sup>35</sup> und zwar die Formen, die den Vorfahren entsprechen, weil die Wärmebewegungen genau wie der Same und die Katamenien, in denen sie enthalten sind, von diesen Vorfahren stammen. (Man kann mit einer gewissen Berechtigung sagen, Aristoteles habe die ursprünglich materiell gedachte Pangenesislehre auf seine recht unklaren Wärmebewegungen übertragen: Diese Bewegungen sind in den Eltern dieselben wie im Samen bzw. den Katamenien und später als Verdauungswärmebewegungen im neuen Nachkommen.) Die allgemeinste Form ist dabei die Spezies, zu der die Eltern gehören, denn es gilt die (auch empirisch verifizierbare) Regel, daß Tiere einer Spezies immer nur Nachkommen derselben Spezies zeugen. Die Fortpflanzung der Spezies ist der Zweck (*τέλος*) der Zeugung und die Form der Spezies ist bei Eltern und Nachkommen identisch. In diesem Sinne konnte Aristoteles am Beginn seiner Schrift sagen, daß die Formursache und die Zielsache bei der Zeugung der Tiere dasselbe sind.

Worauf es mir aber in erster Linie ankam, waren nicht die Details der beiden konkurrierenden Zeugungslehren, sondern die Methode, anhand derer Aristoteles zu seinen Ergebnissen gelangt. Er setzt sich mit Vorgängereinigungen auseinander, indem er sie als Lösungsversuche ernst nimmt und auf ihre logische und empirische Stichhaltigkeit hin befragt. Es ist kein historisches, antiquarisches oder kulturgeschichtliches Interesse, das ihn dazu treibt, den Dialog mit anderen Forschungsmeinungen im Medium der Schrift und des Buches aufzunehmen. Er schöpft vielmehr relativ vorurteilslos aus dem lebendigen Strom der Lösungsversuche der Gegenwart oder Vergangenheit, weil er damit sicherer sein kann, daß sein eigener Lösungsversuch der Wahrheit mehr entspricht als die anderen. Auch heute funktioniert Forschung nicht wesentlich anders, nur daß gerade im Bereich der Naturwissenschaften die ‚Halbwertszeit des Wissens‘ immer geringer wird und damit das Interesse an weiter zurückliegenden Lösungsansätzen dramatisch sinkt. Daß dies nicht immer berechtigt ist, kann gerade die frappierende Aktualität des aristotelischen Lösungsansatzes in der Zeugungslehre zeigen. Es sollte die zentrale Aufgabe von Wissenschaftshistorie, sei es in der Medizin oder in anderen Disziplinen sein, das Verständnis für diese Zusammenhänge lebendig zu halten.

34 Diese Eigenimpulse der Katamenien sind folgerichtig, weil die Katamenien genau wie der Same durch mehr oder weniger intensive Verkochung aus Blut entstanden sind. Mit ihnen kann Aristoteles die Vererbung von Eigenschaften der Mutter erklären, vgl. S. Föllinger, *Differenz und Gleichheit* (wie Anm. 14) 170ff.

35 Der Vorgang ist allerdings bei der Embryonalgenese viel komplexer, denn es muß nicht nur Über- schubmaterial abgearbeitet werden, sondern es müssen Gewebe und Organe von unterschiedlichster physikalischer und chemischer Beschaffenheit hergestellt und miteinander funktional verknüpft werden.

## The flood in Aristotle's *Meteorologica* (I. 14)\*

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Plato in his later dialogues (Timaeus, Critias, Laws), as is well known, sticks to the doctrine that each human civilisation (Egypt being the only exception) was destroyed many times due to various causes. The 'excess of fire' and the flood are the most significant and world-embracing, in a sense that they affect areas of certain types all over the world: conflagrations the highland areas, floods the lowlands. These two types of catastrophe are also the regular ones, although Plato fails to explain what sort of regularity underlies them. The floods destroy the advanced culture of the cities and move civilisation to the most primitive level, as only uneducated populations in mountains, shepherds and herdsmen, survive. This is the starting point of each new development, including Greek civilisation (Tim. 22 b-23 c; Criti. 109 d, 111 b, 112 a; Leg. 677 a, 702 a).<sup>1</sup>

The prevailing opinion of scholars was for a long time that the same or a very similar view was shared also by Aristotle and that the catastrophes and following development of civilisation played an important role in Aristotle's lost treatises, the *Protrepticus* and *On Philosophy* being the favourite candidates for assignment of the fragments or alleged fragments. In another, forthcoming paper,<sup>2</sup> I argue (relying in part on the work of some scholars) that we in fact do not possess reliable evidence for the presence of this doctrine in the lost treatises. Some texts traditionally regarded as Aristotle's fragments are in fact a late contamination of Aristotle's teaching in his preserved treatises with Plato's doctrines, as is certain for the alleged "Philoponus" fragment.<sup>3</sup> It is probable that Aristotle's doctrines reflected by such pieces were borrowed from the treatises of the Corpus Aristotelicum we still possess, not from the popular treatises lost for us. In other cases, as the passage from Iamblichus, *De Comm. Math.* Sc. 26. p. 83. 6-22 (usually regarded as *Protrepticus*, fr. 8 Ross) it is less certain, but the doctrine underlying it does not differ from what is known from Aristotle's preserved treatises.

\* This paper was presented during the 16<sup>th</sup> annual meeting of the AKAN (Mainz, 11 June 2005) and slightly revised afterwards. I am grateful to the participants of the conference for a stimulating, friendly discussion of the paper. The warmest thanks are due to the Alexander von Humboldt-Stiftung for financial support of my participation in the conference and of my stay in Berlin in Summer 2004 and 2005, which made it possible for me to complete the study of Aristotle's doctrine of catastrophes, a part of which the following text represents. I owe special debt to Eleanor Dickey for correcting English of this paper.

1 Apart from other, unnamed catastrophes (Tim. 22 b-23 c; Leg. 677 a) pestilences are mentioned (Leg., loc. cit.).

2 See on this my "Aristotle on Catastrophes, the Pre-cataclysmic Wisdom and the Development of Civilisation" (forthcoming).

3 Philop. In Nicom. Isaagogen I. 1, formerly regarded as De philos. fr. 8 Ross; see against its ascription to Aristotle: W. Hease, "Ein vermeintliches Aristoteles-Fragment bei Johannes Philoponos", in H. Flashar, K. Gaiser (edd.), *Synusia: Festschrift für W. Schadewaldt* (Pfullingen 1965) 323-354.

But along with this caveat as regards some evidence, it is necessary to pay more attention to the evidence on catastrophes in the treatises of the *Corpus*. At the time of enthusiastic research on the Platonic stage of thought as represented by Aristotle's lost treatises, under the influence of Werner Jaeger, it was typical to see in certain passages of the treatises of the *Corpus* the remains of this stage and to use them as confirmation of such discoveries. A danger of this approach was unwarranted harmonisation of certain passages with real or alleged doctrines as contradicting these doctrines.<sup>4</sup> The doctrine of catastrophes is one example of this tendency to ignore important aspects of Aristotle's thought as we know it from the *Corpus* in favour of the mirage of the "early Aristotle"; the important passage on the flood in the *Meteorologica* was, on the one hand, declared to be a relic of Aristotle's earlier thought and an illogical insertion from Aristotle's *On Philosophy*, and, on the other hand, it was neglected as it concerns the real content of its doctrine. At the same time, neglect of this and some other pieces of the *Corpus* led some scholars to the opinion, which is in a sense an understandable reaction to extremes in the search for the 'lost Aristotle', that Aristotle did not at all assume the existence of catastrophes capable of destroying civilisations.

In what follows I will try to refute briefly this scepticism. But for the most part I have in view to concentrate here on meteorological aspects of Aristotle's doctrine of catastrophes. These aspects, being interesting by themselves, were not elucidated sufficiently in previous literature. Not surprisingly, one of the consequences of this uncertainty was the belief that Aristotle's doctrine of the floods was only a superfluous residuum of Plato's heritage, which played an important role in Aristotle's lost treatises but contradicted the main line of his mature thought as represented in the *Meteorologica*. As it has already been said, there are no sufficient reasons to suppose that the floods and the other catastrophes were discussed in detail in Aristotle's "exoteric" treatises preserved in fragments. I will try to prove, however, that periodic floods, albeit mentioned rarely in Aristotle's school treatises, nevertheless played an important explanatory role in his doctrine of reciprocal advancing and receding of the sea and the earth. The main piece relevant for our subject is *Meteorologica* I.14. Before discussion of the content of the chapter devoted on the whole to these global geological changes let us start with the piece of it that immediately concerns the flood.

Aristotle turns in this part to refutation of those who assert that these changes of surface of the earth (they mean specifically drying up) point to the process of the decay of the universe as a whole. Against this view Aristotle argues, first, that side by side with the earth encroaching on the sea in some places, one can observe, in other places, the contrary process of the sea encroaching on the dry earth (352 a 19-25); second (an appeal to more general premises), that these changes affect quantitatively too insignificant area and are of insignificant duration to affect the whole universe (352 a 25-a 29).<sup>5</sup> As an alternative to these doctrines he adduces his own explanation of these geo-

logical processes: the periodical floods result in the over-moistening in areas affected by them, which leads in turn to the process of gradual drying up. The latter process should be in due course interrupted by a new over-moistening (352 a 29-352 b 16, cf. II.3.356 b 31-357 a 3). It is important to notice just here that this doctrine can explain both processes which can be wrongly taken as symptoms of general decay of the universe, namely the encroaching of the sea and the drying up, and to represent them as only temporal and reciprocal. While representing this theory, the details of which I shall discuss further, Aristotle makes an important notice on the flood (352 a 28-352 b 3):

ἀλλὰ πάντων τούτων αἴτιον ἡκοληπρέπον ἔστι γίνεσθαι διὰ γρόνων εὐπαρέμων, οὖν ἐν ταῖς κατ' ἔνασιν ὥραις γειμῶν, οἷος περιόδου τινὸς μετέλη μέγας γειμῶν καὶ ὑπερβολῆς ὀμβρῶν. αἴτιον δὲ οὐκ αἰετὶ κατὰ τοὺς αὐτοὺς τόπους ἀλλ' ὅσπερ ὁ καλοῦμενος ἐπὶ δευκαλιόνοιο καταρσιμαῖος· καὶ γὰρ οἷος περὶ τὸν Ἑλληνικὸν ἐγένετο τόπον μέλαστρα, καὶ τούτου περὶ τὴν Ἑλλάδα τὴν ἀργεῖαν, αἴτιον δ' ἔστιν ἢ περὶ Δουδώνην καὶ τὸν Ἀχελῶϊον· οὗτος γὰρ ποταμὸς τὸ πᾶν μακροβέβηκεν· ὅκουν γὰρ οἱ Σελῶι ἐτραῖθα καὶ οἱ καλοῦμενοι τότε μὲν Ἴπυκοὶ νῦν δ' Ἑλλήνες.

Rather we should suppose that the cause of all these changes is that, just as there is a winter among the yearly seasons, so at fixed intervals in some great period of time there is a great winter and excess of rains. This does not happen every time in the regions of the same type,<sup>6</sup> but rather it is like the so-called flood of Deucalion, which took place largely in the Hellenic lands and particularly in old Hellas, that is in the country round Dodona and the Acheloius (for the latter has frequently changed its course). It can be seen also from the fact that here dwell the Selloi and the people then called Graikoi and now called Hellenes (tr. H. D. P. Lee with changes).

The traditional story of the flood of Deucalion, which was treated by Plato as the catastrophe which destroyed all civilisation (Leg. 677 a 4; Tim. 22 a), is thus re-interpreted by Aristotle as the memory of a flood that affected Greece only, and particularly only a part of Greece, namely the area around Dodona and the Acheloius. The generalising character of Aristotle's argument (he adduces Deucalion's flood only as an example) favours suggestion, that he, contrary to Plato's doctrine of world-broad cata-

small changes of brief duration like these: for the mass and the size of the earth are of course nothing compared to that of the universe". By implication it would mean that these processes are significant enough to bring the earth to its end, but not the whole universe. But Aristotle rather wants to say that they are insignificant even for the earth, *a fortiori* then for the whole universe.

6 The sentence αἴτιον δὲ οὐκ αἰετὶ κατὰ τοὺς αὐτοὺς τόπους as it is usually understood, e.g. by Lee (Aristotle, *Meteorologica* with an Engl. Transl. by H. D. P. Lee [Cambridge, Mass./London 1952]: this does not always happen in the same region of the earth) is illogical: Aristotle denies that the flood takes place every time in the same region, but adduces immediately not examples of catastrophes that occurred in various places, but the limited character of one of them. Probably it has the sense "not happen every time in the regions of the same type". If this is plausible, it can be viewed as polemic against Plato, who assumed that the floods that have the earth-embracing character always affect areas of the same kind, i.e. the lowland regions near rivers. The local character of Deucalion's flood, which is in fact the only one for which Aristotle claims to possess evidence, would be then an important counterexample for Plato's theory. Note that this statement does not necessarily have the meaning that apart from the floods that affect areas of the same type there are some, as Deucalion's flood, that have a local character. Take οὐκ ἀνεγὰρ αἰετὶ together with κατὰ τοὺς αὐτοὺς τόπους: Aristotle on this interpretation will reject the possibility that the floods affect every time all areas of the same type, and imply that they have always only a local and limited character.

4 It should be noted that I am not a champion of today's prevailing neglect or rejection of any development of Aristotle's thought, which seems to me another wrong extremity.

5 "But we must not suppose that the cause of this is the process of the birth and decay of the universe; for it is absurd to undermine the whole (i.e. to suppose that it is undermined) because of

trophes, in principle admits only limited ones.<sup>7</sup> Pointing at this modification, Renate Zoeffel argued that such limited catastrophes do not serve, according to Aristotle, as the factor that destroys civilisations.<sup>8</sup> However, she, as well as the other scholars, failed to notice that Aristotle's arguments concerning localisation of the flood in the adduced passage from the *Meteorologica* strongly suggests quite the contrary: namely, that Deucalion's flood was a starting point of the Greek civilisation, and that a primitive civilisation was destroyed by this catastrophe.<sup>9</sup> First, Aristotle calls this area 'primitive Greece' (ἡ Ἐλλάς ἡ ἀρχαία), implying obviously that it was the most ancient territory occupied by the Greeks. Second, his statement that in this area lived Sellioi and "those, who at that time (sc. during the flood) were called Graikoi and today are called Hellenes", is presumably reference to the most remote phenomena of Greek history which tradition ascribes to the places around Dodona and the Acheloiis. The Σέλλοι, the priests of the Dodonian Zeus, with their primitive mode of life, as represented in Homer (Il. 16. 234-235), are evidently taken, in a Thucydidean manner, as a relic of the remotest past of Greek civilisation preserved in tradition (already in Aristotle's time these priests did not exist).<sup>10</sup>

7 This inference was rightly drawn from this passage in various times by various scholars. However, its significance for the estimation of evidence for Aristotle's theory, which contradicts this limited character, was neglected by the most of them, see further on "Censorinus' fragment". It is necessary to stress, to avoid the usual misunderstanding, that Aristotle's catastrophes are limited not only in the sense that they do not affect the whole universe and do not destroy the total mankind (this is true also for catastrophes Plato represents in the Timaeus, the Critias and the Laws, contrary to the cosmic catastrophe in the Statesman), but in the sense that they did not affect the whole earth and do not occur in various areas simultaneously, in contrast to Plato's catastrophes in the first three dialogues just mentioned.

8 R. Zoeffel, *Historia und Geschichte bei Aristoteles*, Abh. der Akademie der Wiss. Heidelberg, philos.-hist. Kl. 1975, 2 (Heidelberg 1975), 58. She argues that floods, which have periodical character and thus are associated by scholars with Aristotle's "Kreislauftheorie", are not mentioned as one of the factors destroying the whole peoples, such as wars, pestilences and famines, Meteor. I.14.351 b 8-22 (p. 59 f.). But Aristotle adduces here specifically the causes of disappearance of the *memory* of the beginning of the gradual and slow process of drying up, and it would be illogical to suppose that one of them could be a flood which in fact interrupts this process.

9 It is symptomatic that the passage that allows a glance at Aristotle's theory of catastrophes on the whole was either neglected or not used appropriately, whereas scholars paid far more attention to the real or only alleged Aristotelian fragments concerning floods, which are far less informative, as was rightly noticed by I. Düring, *Aristoteles* (Heidelberg 1966) 396 n. 334. Zoeffel (n. 8) 46f., 59 adduces this passage as evidence for Aristotle's view of catastrophes as periodical, but not destroying the 'whole peoples', in contrast to catastrophes mentioned at Meteor. I.14.351 b 8, which are destroying, but not periodical (see the preceding note), thus failing to notice the real significance of the former passage.

10 H. Strohm, *Aristoteles, Meteorologie. Über die Welt, Übersetzung und Kommentar*, Berlin 1970, 166f. thought that both reference to changes of the Acheloiis stream (he compared with Thuc. 2. 102-5-6, where the myth of Alcmeon implies the pristine character of observations upon the sitting activity of Acheloiis) and to the pristine character of the sanctuary of Dodona, are purported to stress the extraordinary longevity of the local tradition, which, however, in spite of this longevity, could not be ancient enough to reach the time of Deucalion's flood. This cannot be right, for Aristotle does not point to a lack of tradition concerning the flood. On the contrary, he

It is less clear what made Aristotle believe that the Greeks lived around Dodona at the time when they were still called 'Graikoi', not 'Hellenes'.<sup>11</sup> What is certain is that Aristotle found some indications in tradition that the Greeks dwelled in Epirus in the age before the birth of Hellen, their eponym (whom tradition related to Thessaly). It is henceforth again an argument in favour of localisation of the flood here from the remotest events of the Greek past as related to this area. Both arguments cannot be, in my view, explained otherwise than that the flood was for Aristotle the event which the earliest stage of Greek civilisation was linked, or, to put it otherwise, that the flood was for him the cause of destroying the previous civilisation. This passage, in my view, definitely proves that although Aristotle (unlike Plato) admitted only local catastrophes, he nevertheless assumed that such catastrophes, the flood among them, could destroy some civilisations and thus clear a way for a new development.<sup>12</sup>

Now let us turn to the physical aspects of Aristotle's doctrine. That Aristotle connects the most considerable flood that Greek tradition knows with the Acheloiis, the most famous of Greek rivers, possessing the mighty stream, needs no justification. But what does the reference to the multiply changes of Acheloiis' stream mean?<sup>13</sup> It is, I think, an attempt to infer occurrence of floods in this area from the mythological tradition (which is rationalised here) that the previous course of the Acheloiis was changed by Heracles: changes in a stream bed are often a consequence of inundations, and Aristotle might have known relevant examples.<sup>14</sup> He could also have in view the drying up of the rivers, the process which according to him inevitably follows

uses indirect indications in the tradition to localise the catastrophes. Also the silting activity of the Acheloiis does not imply changes of its stream (see further).

11 I have in view to discuss this subject on another occasion.

12 The reasoning in Met. A 8. 1074 a 38-b 4 suggests also (see the forthcoming paper cited in n. 2) that the cause of disappearance of the advanced philosophical knowledge of his predecessors was for Aristotle the destruction of previous civilisations, not the degradation of knowledge. Another passage, Meteor. I.14.351 b 8-22 (see n. 8), shows that Aristotle admits also other catastrophic factors, as wars, diseases, famines, some of which certainly have as a consequence the disappearance of some civilisations. The interesting detail is that such catastrophes that have only occasional character occur during the more global process of drying up of the area, which in long run necessitates disappearance of population from these places.

13 F. Solmsen, *Aristotle's System of the Physical World* (Ithaca/New York 1960) 434 n. 169 and Strohm (n. 10) 166f. wrongly supposed that Aristotle has here in view the well known alluvial activity of the Acheloiis at the Echinades.

14 The interesting parallel to Aristotle's reasoning here is a scholion to Iliad 21. 194 (V 166 Erbse), which also connects 'the pristine Hellas' (ἡ Ἐλλάς ἡ ἀρχαία) with the area of the Acheloiis and Dodona. According to the scholion, Acheloiis in the past flew from Dodona, the area of the "pristine Hellas", through Aetolia into the Ambracian gulf until Heracles turned the course of the river. This looks like misunderstanding of Aristotle's thought, since he certainly treated Dodona as the place where the survivors were saved after the flood, rather than as the centre of the catastrophe. Diod. IV. 35 adduces an allegorised version of the myth of Heracles' breaking of the horn of Amalthea, which belonged to the bull Acheloiis, and presenting it as a gift to Aetolians. According to this allegorical explanation, Heracles turned Acheloiis' stream to make it flow through Aetolia. This or a similar tradition on changes of the low stream of the Acheloiis seems to underlie Aristotle's remark.

temporary excess of water in the rivers due to rains and their flooding (Meteor. I.14.352 b 10-16, see further).

Hence, the passage of the Meteorologica proves that limited catastrophes could in Aristotle's view be the cause of destruction of whole civilisations in some area, as was certainly the case in his view with the civilisation that preceded the contemporary Greek one. It does not follow, of course, necessarily from this passage that Aristotle excluded occurrence of some catastrophes or specifically of some floods of a universal character. However, there are strong reasons to suppose that he in fact admitted only the local catastrophes. First, he interprets Deucalion's flood, which had according to Plato a global character, as having taken place in Greece only and, moreover, as having affected only a part of it. Second, if my interpretation of this passage is on the right lines, Aristotle rejects here the doctrine, which again belongs to Plato, that the floods affect *all* areas of the same type, which means that he rejects their earth-embracing character (see above).

The flood is for Aristotle a recurrent event with regularity of some sort, γήπεραι δὲ γρόνων εἰλημμένων, as he says. At Phys. IV.13.222 a 20-27 Aristotle adduces the flood as an example of a distant future event, which cannot be called a 'now event' in the sense that this expression is applied to events close to a speaker. The passage confirms that Aristotle believed in recurrent floods, as is seen also from the Meteorologica, and that he regarded their occurrence as in a sense predestined. It does not, however, point to a fixed number of years between the floods. This is rather excluded by the character of the doctrine Aristotle holds. The regularity Aristotle supposes is a more vague balance between evaporation and precipitation. At Meteor. II.13.355 a 26-28 Aristotle points to the existence of such a balance in a general form: all the evaporated water will fall again with rains, if not in exact correspondence in every year and at each place, yet in a certain period, and, not taking each area, but the earth as the whole.

It is further highly improbable that the Great Winter, as Aristotle baptised this period of rains, has something to do with the astronomic Great Year, i.e. with the great cosmic period representing the least common multiple for the periods of revolutions, <sup>14</sup> of the sun, the moon and five planets as the scholars believed almost unanimously.<sup>15</sup> Aristotle, first, while holding the view, that the balance between evaporation and precipitation is regulated by sun's annual revolutions (I.9.346 b 35-347 a 8),

<sup>15</sup> This belief was shared not only by the scholars who ascribed to Aristotle the notion of the earth-embracing floods and who thought that such catastrophes were linked with cosmic periods also in Plato (as was typical, e.g., for E. Bigone, L'Aristotele perduto e la formazione filosofica di Epicuro [Florence 1973] II, 129 f.), but also by those who rightly saw that Aristotle admitted only floods and these ones of local character only. One exception is C. Natali, "La teoria aristotelica delle catastrofi: Metodi di razionalizzazione di un mito", RPhC 105 (1977) 403-24, at 417 n. 4, who briefly rejects the connection between the flood and planetary constellations in Aristotle as supposed by Olympiodorus. The contamination of two doctrines and their further identification with the Stoic doctrine of the Great Year goes back to Aristotle's commentators, see Alex. Aphr., in Meteor. p. 62. 15 Hayduck [CAG III. 2], who paraphrases Meteor. I.14.352 a 30-31 περιόδου τῶν πλανήτων as κατὰ περιόδους τῶν ἄστρων, and especially Olympiodorus who interprets as implying periodical floods and conflagrations of the whole universe during certain conjunctions of planets, exactly as in Censorinus' passage (in Meteor. p. 111. 30-112. 9 Stüwe [CAG XII. 2]).

certainly sees no causal links between this balance and circulation of other planets. Second, the conjunction of the seven cosmic bodies in a certain point of the Zodiac as was imagined by the later doctrines of the Great Year should have affected the whole of the earth, not a limited area of it as it follows from Aristotle's doctrine of the flood in the Meteorologica.

There is, however, evidence that ascribes to Aristotle a view contradicting his doctrine of limited catastrophes in the Meteorologica. Censorinus (De die nat. 18.11 = fr. 25 Rose = *Prorr.* fr. 19 Walzer; Ross) adduces as the Aristotelian the notion of the astronomic "Greatest Year". In this period the seven cosmic bodies starting from their conjunction under the certain sign of the Zodiac will return after a certain number of revolutions to the same position:

*Est praeterea annus, quem Aristoteles maximum potius quam magnum appellat, quem solis et lunae vagarumque quingue stellarum orbes conficiunt, cum ad idem signum, ubi quondam simul fuerunt, una referentur, cuius anni hiems summa est cataclysmos, quem nostri diluvionem vocant, aestas est ecpyrosis, quod est mundi incendium, nam his alternis temporibus mundus tum exignescere tum exaquescere videtur.*

There is also the year which Aristotle calls the 'Greatest' not the 'Great' one, which is accomplished by the revolutions of the sun, the moon and five planets, when they conjoint in the same sign, in which they had once been all together. The completed winter of this year is the κρηκλυσις, which is 'diluvio' in our language, and the summer of it is the ἐκπύρωσις, i.e. 'incendium'. For during this alternating periods the universe now conflagrates, now is affected by inundation.

Apart from Censorinus' direct statement that the flood and the conflagration he describes are of world-embracing character, it is clear that the astronomically caused catastrophes should be universal, contrary to those of the floods, which affect only limited area of the earth according to Aristotle's doctrine in the Meteorologica, and which, of course, in their turn can be neither affected by nor simply coincide with conjunctions of heavenly bodies. If Censorinus' evidence were reliable, we should have supposed that in some of his lost treatises Aristotle held a view on the flood considerably different from the one we know from his preserved treatise. But Censorinus' evidence is too much garbled by anachronisms to allow such a hypothesis.<sup>16</sup> In Plato the astronomic "Great Year" (Tim. 39 d) was not connected with world catastrophes either; the latter are influenced according to him by deviations of planets (Tim. 22 c-d). There is no evidence that Aristotle admitted such a connection in any period of his work. The earliest known doctrine according to which periodical conflagrations and floods of universal character occur under the definite conjunction of planets is one that belongs to Babylonian Berossos, i.e. the beginning of the third century BC, if this evidence refers to genuine Berossos.<sup>17</sup> According to this astrological doctrine, the conflagration

<sup>16</sup> Most scholars suspected either Censorinus' information on the Great Summer (for only Great Winter is mentioned in the Meteorologica) or the descriptions of both Great Summer and Great Winter, due to the Stoic appearance of their representation as universal catastrophes. Nobody, however, has yet noticed that the notion of planetary constellations as the cause of these catastrophes contradicts Aristotle's theory.

<sup>17</sup> Sen. N. Q. III.29.1 = Berossos fr. 37 Schnabel (=FGHHist 680 F 21); F. Jacoby treated this piece as Pseudo-Berossean, see also J. Mansfeld, "Providence and the Destruction of the Universe in

occurs during conjunctions in the constellation of Cancer, the flood in Capricorn. The doctrine of periodic conflagrations and floods became popular among the Stoics, at least the later ones.<sup>18</sup> Hence there are reasons to assume that Censorinus contaminates Aristotle's doctrine of periodical local floods, as we know it from the *Meteorologica*, with the later, predominantly Stoic doctrine of periodical universal floods and conflagrations influenced by conjunctions of planets, instead of taking as Aristotelian fragment a passage of Censorinus that evidently contradicts Aristotle's view in the *Meteorologica*.<sup>19</sup>

It is time to discuss Aristotle's general theory of changes of the sea shore at the very beginning of the *Meteor.* I.14 (351 a 19-27):

The same parts of the earth are not always moist or dry, but change their character according to the appearance or failure of rivers.<sup>20</sup> So also mainland and sea change places and one area does not remain earth, another sea, for all time, but sea replaces what was once dry land, and where there is now sea there is at another time land. This process must, however, be supposed to take place according to a certain order and periodicity (tr. H.D.P. Lee with changes).

Early Stoic Thought", in: M. J. Vermaseren (ed.), *Studies in Hellenistic Religion* (Leiden 1979) 129-88, at 146 n. 52, but Tony Long regards it as belonging in fact to Berossos (A. A. Long, "Astrology: Arguments pro and contra", in J. Barnes et al. (ed.), *Science and Speculation: Studies in Hellenistic Theory and Practice* [Cambridge/Paris 1982] 165-92, at p. 166f.).

18 Mansfeld (n. 17) 147 n. 52 notes that the Stoic doctrine of alternating floods and conflagrations is of late character: he adduces Sen. N. Q. III. 27-30; Cons. Marc. 26. 6; Comm. Luc. p. 252 Usener (SVF II. 608); Orig. C. Cels. IV. 64 (=SVF II. 1174) (cf. also Dio Chrys. 36. 47-49). It differs from the doctrine of Cleanthus (the only safe evidence on views of the earlier Stoa on floods, SVF I. 497), according to which the flood immediately follows the total conflagration and serves as a prelude to the new cosmogony (D. E. Hahn, *The Origins of Stoic Cosmology* [Ohio State University Press 1977] 186; A. A. Long, "The Stoics on World-conflagration and Everlasting Recurrence", in R. Epp [ed.], *Spindell Conference 1984: Recovering the Stoics = Southern Journal of Philosophy suppl.*, vol. XXIII [1985], 33 n. 35). For our purposes it is important only that the doctrine Censorinus attributes to Aristotle was well known in Censorinus' time as the Stoic one.

19 Effe's attempt (B. Effe, *Studien zur Kosmologie und Theologie der Aristotelischen Schrift "Über die Philosophie"*, *Zetemata* 50 [Munich 1970] 62 f., 66f.) to save for Aristotle's On Philosophy the doctrine of the *cosmic* Greatest Year and of the *limited* flood relying on Censorinus is thus implausible. It is also unfounded as far as it concerns Censorinus' evidence: *pace* Effe, who tried to prove that Censorinus has in view local floods, the latter represents flood and conflagration as equally embracing the whole of the earth. As for the Stoic *flavour*, both 'exignescere' and 'exaquescere' in Censorinus are exact translations of Stoic technical *ἐκρηγοῦσθαι* and *ἐξυγρῦσθαι* (for the latter, rarer one, see Cleanthus, SVF I. 497). Even the expression "the Greatest Year" was used by the Stoics; see Arius Didymus, SVF II. 599 (cf. Mansfeld [n. 17] 145 n. 49, who is rightly sceptical of the possibility of something genuinely Aristotelian in Censorinus' evidence). J. L. Ideler (ed.), *Aristotelis Meteorologicorum libri IV* (Leipzig 1834) I. 484, thought that the only source of Censorinus' Aristotelian doctrine was the *Meteorologica*. One cannot be sure, but we certainly have no reason to conclude that the doctrine of Aristotle to which the narrative of Censorinus ultimately goes back differed from the one known from the *Meteorologica*.

20 Aristotle implies here, as the following sentence suggests, the fluctuations of borders between water and dry land, not the relative drying up and moistening of the same areas, as is the case in the seemingly identical sentence below at 351 a 35-b 5, for the former changes only are a consequence of origin and disappearance of rivers, whereas the latter ones are, on the contrary, the cause of these processes, cf. the resuming of the formulation 351 a 19-21 below at 352 b 16-20.

As I have said in the beginning, it was argued repeatedly that the notion of the flood, used also by Aristotle to explain the same great geological changes, was superfluous in frames of the theory developed by him in this part of ch. 14 and represented only a sort of abundant "Academic" (i.e. Platonic) heritage. The main foundation for this belief was the reasoning which immediately follows the passage adduced above and which looks like an alternative to the doctrine of the floods (351 a 26-36):

ἀρχὴ δὲ τοῦτον καὶ ἄλλον ὅτι καὶ τῆς γῆς τὰ ἐντός, ὅσπερ τὰ σόματα τῶν φυχῶν καὶ ζῴων, ἀκμῆν ἔχει καὶ γῆρας, πάλιν ἐκείνοισιν μὲν οὐ κατὰ μέτρον ταῦτα συμβαίνει πρόχρον, ἀλλ' αἴμα πᾶν ἀκμῆσειν καὶ φθίβειν ἀνογκάζον· τῆ δὲ γῆ τοῦτο γίνεσθαι κατὰ μέτρος διὰ τὴν ἐπιπέδην. ταῦτα μὲν οὖν ἀδύναται καὶ φθίβει διὰ τὸν ἥλιον καὶ τὴν περιφορὰν, διὰ δὲ ταῦτα καὶ τὴν δύναμιν τὰ μέρη τῆς γῆς λαμβάνει διασφραῖσσαι, ὅσπερ μέγρη τὴν ἐπιπέδου δύναται διαμείβειν, εἴτα ἤπιπνίσεσθαι καὶ γηραιότερα πάλιν ἔτιροισι δὲ τόσοι φθοροῦνται καὶ ἐνδοβοῦ γίνεσθαι κατὰ μέτρος.

This process (i.e. the encroaching and receding of the sea) must be supposed to take place in a certain order and cyclically. Its originating cause is that the interior part of the earth, like the bodies of plants and animals, has its maturity and age. Only whereas the parts of plants and animals are not affected separately but the whole creature must grow to maturity and decay at the same time, the parts of the earth are affected separately, the cause of the process being cold and heat. The interior parts of the earth thus undergo processes of growth and decay owing to the sun's course, and because of these processes the various parts of the earth acquire different capacity to contain moisture, so that they remain moist up to a certain point and then dry up and become old again, while others come to life and become moist in their turn (tr. H.D.P. Lee with considerable changes).

To resume, Aristotle asserts here that the temporal victories of sea and dry land over each other are caused by fluctuations in the levels of rivers that drain into the sea, and these levels depend in their turn on the "flourishing" and "decay" of the areas from which these rivers flow. The latter processes are the consequence of increase and decrease of the cold and the heat, which are caused by the sun's annual course.<sup>21</sup>

F. Solmsen supposed that Aristotle's theory of the periods of the youth and old age of certain areas, caused by the annual revolutions of the sun, would have been sufficient to explain changes of the boundaries between the sea and the earth and thus to dispense with the 'mythological' notion of the floods. Periodical flourishing and decay of some areas, according to Solmsen, influence the level of rivers that flow from these areas, and these changes in turn influence the sea, causing it to encroach on the earth or

21 ταῦτα μὲν οὖν αἰθέρα καὶ φθίβει διὰ τὸν ἥλιον καὶ τὴν περιφορὰν. ταῦτα is understood usually (after Ideler [n. 18] I. 477) as referring to cold and heat. According to such understanding Aristotle assumes a direct causal link between annual periods of cold and warm and the capacity of various areas to hold moisture (see translations of Webster [The Works of Aristotle Translated into English: *Meteorologica* translated by E. W. Webster [Oxford 1925] and Lee [n. 6]). But αἰθέρα καὶ φθίβει normally is applied to living beings, and it is natural to take it as applied metaphorically to the interior parts of the earth, similar to ἀκμῆν ἔχει καὶ γῆρας in the previous sentence. If it is right, than the following phrase means: the interior parts of the earth (ταῦτα μὲν) flourish and decay due to sun's revolutions, and in accordance with these processes (διὰ δὲ ταῦτα) the different areas become more or less capable of holding water. According to this interpretation Aristotle certainly assumes the dependence of flourishing and decay on the sun's annual revolutions and on the respective increase and decay of heat and cold, but does not assume the dependence of the capacity to contain water on these seasonal changes. The latter capacity varies in accordance with processes of flourishing and decay.

to recede.<sup>22</sup> Solmsen, however, admitted that, alternatively to his suggestion, the flourishing of the areas might have implied an initial excess inundation,<sup>23</sup> which was a right guess, as I shall argue. B. Effe in his detailed study of the fragments of Aristotle's *On Philosophy* argued already more decisively that the doctrine of the flood in ch. 14 of the *Meteorologica* contradicted the doctrine of the earth changes in the beginning of the same chapter and that the former represented an already superseded stage of Aristotle's theory. According to Effe, the process of flourishing and following decay of an area from which rivers flow, or in other words the development from abundance of moisture to shortage of it, was in Aristotle's view sufficiently explained by the general rhythm caused by the sun's annual revolutions.<sup>24</sup> Effe supposed on this ground that the piece on the flood which, as he argued, interrupted the narrative in the *Meteorologica* and violated its logic was an insertion from Aristotle's earlier 'exoteric' treatise *On Philosophy*.<sup>25</sup> A.-H. Chroust in his paper on Aristotle's doctrine of the flood followed closely Effe's suggestions.<sup>26</sup> However, in contrast to this view, Aristotle twice, once in the same chapter and again in the second book of the *Meteorologica*, affirms explicitly that there is a direct causal link between the excess of rain or, in other words, the flood and the changes of the sea's borders (I.14.352 a 29-b 17; II.3.356 b 31-357 a 3). In order to check whether his reasoning on the ages of areas in fact contradicts this statement, it is necessary once again to follow the causal links Aristotle assumes in this reasoning.

The immediate cause of changes of boundaries between dry earth and sea are, according to Aristotle, the appearance and disappearance of rivers (351 a 19-25, cf. b 2-8, 353 a 19-22). The effect of these changes of rivers upon the sea is explained in the other passage, which concludes this section (I.14.351 a 36-b 8). Interpretation of this passage entails some difficulties, but its general sense is clear: the abundant rivers by siltng push off the sea from the shore in one place and make it encroach on the earth in another. With the diminishing of the water levels of the rivers at the first place due

22 Solmsen (n. 13) 436 f.

23 See Solmsen (n. 13) 437: "The reviving or rejuvenescing so essential for the biological theory may after all involve a tacit assumption of the floods."

24 Effe (n. 19) 53-58. As Solmsen before him, Effe referred to Aristotle's doctrine of the sun's annual revolutions in ecliptic as the reason of subinary *genesis* and *phthora* as underlying the reasoning in the *Meteorologica* (GC II.10, esp. 336 b 10-27), but stressed correctly that the periods of the growth and decay determined by the sun's motions are incomparably longer than a year (p. 53 n. 217). He did not attempt, however, to explain what sort of influence the annual movement of the sun has on 'flourishing' and 'decay' of various areas.

25 Effe (n. 19) 57. One of the 'proofs' was the presence of defence of the incorruptibility of the universe and assumption of partial catastrophes, such as floods, in [Ocellus Lucanus], *De Univ. Nat.* 38-42, the pieces of which on other, but equally insufficient grounds were assigned by Effe to the *On Philosophy*.

26 A.-H. Chroust, 'The 'Great Deluge' in Aristotle's *On Philosophy*', AC 42 (1973), 113-22, at p. 118. *Meteorologica*, 351 b 8-352 b 16 constitutes a sort of 'out-of-place insertion', which actually breaks up the main arguments about or accounts of the rise and fall of rivers and the concomitant changes in the shorelines of the sea'. He also believed that the relevant part of "Ocellus" goes back to the *On Philosophy*.

to drying up of the area of their springs, which results finally in complete disappearance of the rivers from a given area, the sea encroaches back at the place of the former siltng and consequently recedes from the shore at the place of the former encroaching on the mainland. One may suppose that the appearance of the springs of the rivers in another area mentioned by Aristotle means the beginning of the same process which would effect another part of the sea shore.<sup>27</sup>

This reciprocal increase and diminishing of masses of the earth and the sea are said to take part "in a certain order and cyclically" (351 a 25-26).<sup>28</sup> But what causes the rise, decay and finally the disappearance of rivers, the processes which in turn influence advance and receding of the sea? The immediate cause is the drying up of the area, where the springs of the rivers are located, and the moistening of other areas where the rivers begin to flow instead (351 a 36-b 5). These processes of drying up and moistening are treated as the ages of the interior parts of the earth in various areas, which attain flourishing (*ἀκμύζων*), i.e. get wet, and then become old (351 a 36-b 2), i.e. dry up.

In order to see what sort of influence of the sun on these processes Aristotle has in view and whether this influence was for him sufficient to make assumption of the floods superfluous, let us look closer at the relevant part of the GC II. 10. In this chapter the cycles of growth and decay on the earth are subordinated to the annual movement of the sun in the ecliptic, i.e. in the orbit inclined in the angle to the earth.<sup>29</sup> In the course of this movement the sun is now closer, now further from the surface of each area of the Earth, thus influencing its warming and cooling respectively (GC II.10.336 b 2-10). It is important to stress that Aristotle in this treatise unequivocally ascribes the growth of living beings to the sun's approaching to a given area, and their decay to sun's moving off in summer (336 b 6-8; 17 f.). This annual movement of the sun, according to Aristotle, is the cause not only of seasonal growth and decay of organisms, but also of large periods of growth and decay of any living being which can have various duration. The quantitative difference between these cycles in various plants and animals is also somehow determined by the annual movement of the sun (336 b 10-15). Aristotle probably thinks that the annual revolution of the sun forms a minimal period

27 In general I follow the interpretation of Webster (n. 21), see note ad loc. and Lee (n. 6) 108 f. note a).

28 Solmsen (n. 13) 423, represents mistakenly the floods as effecting diminishing of the earth in Aristotle's view, and as opposite in its effects to the siltng as increasing it (they "undo the patient work of the rivers and for a time tip the balance between land and sea in the opposite direction"). In fact, on the contrary, the rivers over-abundant with water (what is caused ultimately by the local flood, as we shall see) effect siltng and make the sea to recede at this place, what effects increase of dry land, and gradual drying up of these rivers (due to evaporation of the moist at the area of their springs) diminishes siltng and thus allows the sea to regain its position. At another place (436 n. 177) Solmsen rightly infers from the Meteor. I.14.351 a 36-b 8 that the process of siltng is interrupted by drying up of the rivers and following returning of the sea, but here he fails to recognise the flood as the starting point of these processes (see above on his hypothesis of "superfluous" doctrine of the flood).

29 Effe (n. 19) 53 with note 217, and Natali (n. 15) 416, rightly stress that Aristotle has in view the influence of annual revolutions on extraordinarily long processes of earth changes, but do not elucidate the character of this influence.



of growth and decay. A definite number of annual cycles in the life of each organism would in its turn depend on specific features of living organisms.

One of the difficulties which this doctrine involves is as follows: why does this movement bring out mainly growth in the first part of the life and mainly decay in the final part of it?<sup>30</sup> Presumably, as both processes are continuous due to the sun's regular movement, Aristotle thinks that in the first part of the life the periods of growth outweigh the effects of periods of decay, while in the last part the effects of the periods of decay is stronger than of the periods of growth. The ultimate reason should hence be the processes in organisms themselves.

Now let us return to Aristotle's reasoning in the beginning of *Meteorologica* I.14 on flourishing and decay of various areas. As I have already said, Aristotle maintains here a direct connection between the annual revolutions of the sun and the periods of flourishing and successive decay of various areas of the earth. But he obviously does not believe that the annual increase and decrease of cold and heat immediately bring about the flourishing or decay of areas on which the level of water in the rivers depends. Of course, the periods of overwhelming wet and dry are the same as winter and summer respectively according to him. Nevertheless, periods of moistening and drying up, which affect changes of the rivers' beds and, consequently, of the boundaries of the earth and the sea, should be of far more considerable length and intensity than seasonal fluctuations.<sup>31</sup> The latter are certainly of decisive character for the rivers that dry up in summer and then begin to flow again in winter (see below), but these certainly have no significant and long time effect on the level of the sea.

We may accordingly suppose that, as is the case in the GC, the revolutions of the sun are for Aristotle the ultimate effective cause of these processes, but that what matters is not seasonal changes but the effect of the sun over the course of many annual periods. It is also reasonable to think that this effect varies in accordance with the matter affected, i.e. in the case of the earth, in accordance with features of a relevant area. Presumably, on the analogy of Aristotle's reasoning in the GC, over a long period of time the annual approach of the sun will result in increasing flourishing of certain areas, whereas in the following period this approach will be already not sufficient to counterbalance the contrary effects of the sun's moving away.

Aristotle does not explain the processes of flourishing and decay of areas as a whole, but he explicitly identifies them according to his subject, changes of the water

30 G. J. F. Williams (tr., comm.) *Aristotle's De generatione et corruptione* (Oxford 1982) 190 f., points out this well: "if ten springs and ten summers bring an animal or a tree to maturity, and then ten autumns and winters bring about its decay, why do not the autumns and winters of the first part of its life have a corrupting effect and why do not the last ten springs and summers regenerate it?" Cf. H. H. Joachim (ed., comm.) *Aristotle, On Coming-to-be and Passing-Away* (Oxford 1922) 261.

31 Solmsen (n. 13) 436 n. 179, points out the difficulty: the sun according to Aristotle gives the area not only warmth but also cold. This would not have been a real difficulty, if Aristotle had in view the seasonal changes, cf. Strohm (n. 10) 163. But as Solmsen himself recognises, Aristotle needs here an explanation of long-time changes of moistening, and the year movement of the sun taken by itself certainly cannot explain them.

level of rivers, with relative moistening and drying up (351 a 32-35). Scholars usually notice that contrary to the doctrine of the GC (according to which the approach of the sun effects the process of generation, and its moving off the decay of living beings) in the *Meteorologica* Aristotle tends to connect the approach of the sun with the drying up and decay of a given area, and its moving off with the area's refreshment.<sup>32</sup> They rely on Aristotle's statement that the flourishing and decay of areas depends on cold and heat, factors that are in turn determined by the sun's movement in the ecliptic (351 a 28-32).<sup>33</sup> But this, I am afraid, is wrong reasoning based on the analogy of annual fluctuations of moist and dry which in fact depend directly on fluctuations of temperature.<sup>34</sup> The real picture seems to be far more complex. We do not know exactly what the flourishing of the interior parts of the earth means for Aristotle, but the reasoning in the GC suggests that he could think of it in biological terms. Accordingly, although it is certain that the annual revolutions of the sun in the course of many years effect the development of any area from moist to dry, and that the regulative forces at work are cold and heat, the process implies also, in all probability, a special vital role of the sun in bringing about flourishing of the areas, as is the case in animals and plants, not simply the influence of the sun on the process of drying up.

It is necessary further to correct another misunderstanding. Those who thought that the role of the sun made the hypothesis of floods superfluous supposed that Aristotle had in view in the beginning of the *Meteor.* I. 14 the permanent cycle of periodical moistening, drying up, new moistening and so on. But the sentence *διὰ δὲ τούτα καὶ τὴν δύναμιν τὰ μέρη τῆς γῆς λαμβάνεται διαφέροντα, ὅστε μέγιστα τὸς ἔνδοξα δύναται δυνάμεν, εἴτα ἑπαιώνεται καὶ γηρόσκει πάλιν* (351 a 32-35) only seemingly support this understanding. The exact meaning of this statement is, first, that the revolutions of the sun influence fundamental features of areas in question, namely their capacity to hold water, not the seasonal level of moisture, and, second, that Aristotle describes not the permanent reciprocal cycle of moistening and drying up, but the non-cyclical drying up and decay of a given area. I suppose that Aristotle sees the process as follows: at first the annual approach of the sun effects the process of flourishing. One of the effects of its approaching is certainly drying up, while its moving off results in

32 Cf. Strohm (n. 10) 162: 35, 6.

33 One striking example of differences between areas are mountainous districts with their permanent cold and their landscape features which serve as reservoirs of rivers in Aristotle's doctrine (*Meteor.* I.13.350 a 3-13; 14.352 b 7-11, see further). Already Solmsen (n. 13) 436 n. 179, supposed that Aristotle means differences between regions more or less exposed to the sun. The summer approach of the sun evaporates the moisture also in such areas, but this process is counterbalanced by intensive condensation of water, so that the rivers flowing down from these areas are 'perennial' in a sense that they do not dry up in summer time.

34 The influence of the sun on the processes of condensation and evaporation is discussed in *Meteor.* I.9.346 b 35-347 a 12: during its motion in the ecliptic the sun effects the processes of evaporation when it approaches a given area (increase of warmth) and the contrary processes of condensation when it moves off (increase of cold) (cf. Strohm [n. 10] 162: 35, 6). These effects of the sun's motion are certainly involved in the notion of its influence on flourishing and decay of areas in *Meteor.* I.14, but they do not explain the processes here described in all their complexity.



precipitation. But the long term influence will result in a more complex process, in the first part of which the influence of the sun will be, *inter alia*, that of transforming the moisture of the area into a vital factor of it, and in the final part this influence, albeit still remaining vital, progressively yields to the opposite forces, especially to the growing dry of the area, caused again by the sun.

It is also clear that the regular annual processes of precipitation and evaporation cannot explain the progressive drying up of the area over long periods. On the contrary, this drying up would be understandable if Aristotle considered over-moistening to be the starting point of this process every time. It is tempting to suppose that the flood was for him the cause of this abundant moisture. As was said before, Aristotle explains the changes of the borders between the sea and the earth ultimately by temporal excesses of rains in certain areas, as during the flood of Deucalion (see Meteor. I.14.352 a 29-b 17, briefly resumed at II.3.356 b 31-357 a 3; in both cases Aristotle argues against the view that the drying up of the sea is a one-sided process pointing to the future destruction of the universe).

Now let us turn for a confirmation and some additional details to the passage on the flood and its consequences (Meteor. I.14.352 b 3-16):

ὅταν οὖν γένηται τοιαύτη ὑπερβολὴ ὑγρῶν, νομίζεν γὰρ ἐπὶ τοῦτον διαρκεῖν, καὶ ὅτε περὶ τῶν δένδρων εἶναι τινας τῶν ποταμῶν τοὺς δὲ μὴ οἱ μὲν φασιν αἰῶνα εἶναι καὶ μέγεθος τῶν ὑπὸ γῆς χωρίων, ἤματι δὲ τοῖς μέγεθος τῶν ὑψηλῶν τόπων καὶ τὴν πενυσιότητα καὶ νηχρότητα αὐτῶν (οὐτοὶ γὰρ πλεόντων καὶ ἐξοχῶνται ὕδαρ καὶ στεγνοῦσιν καὶ ποιοῦσιν), ὅσοις δὲ μικροὶ αἱ ἐμπροσθέντα τῶν ἠθῶν συστράσεις ἢ κοίται καὶ λιθώσεις καὶ ἀγρῶνάδεας, τούτους δὲ προσαρκεῖναι, οὐτως οἰεῖσθαι δεῖ τότε, ἐν οἷς ἂν γένηται ἡ τοιαύτη τοῦ ὑγροῦ φορὰ, οἷον δένδρων ποιεῖν τὰς ὑπόστρας τῶν τόπων μᾶλλον, τῶ γρῶν δὲ ταῦτα ἐπιπυθίεται γυνώμενα μᾶλλον, θάτερα δ' ἐλάττω τὰ ἔφυδρα, ἕως ἂν ἐξήη πάλιν ἡ καταβολὴ τῆς περιόδου τῆς αὐτῆς.

Whenever such an excess of rains occurs it must be supposed to suffice for a long time. To give an analogy – the cause of some rivers flowing today perennially, some not, is considered to be the size of the chasms beneath the earth, but that we considered it to be the size, denseness of rock and low temperature of mountainous districts, for such districts catch, contain and produce most water; while if the mountain systems overhanging a district are either small or porous and composed of stones and clay, the supply of water runs out earlier: so that we must suppose that at the time of the flood, it makes quasi-perennial moisture of the districts themselves where the fall of water is so large. But in the course of time these districts [i.e. those where moisture was previously abundant] dry up and occupy gradually more and more place, while those districts which are still moist, occupy accordingly less and less place, until the beginning of the same cycle returns again (tr. H. D. P. Lee with changes).

To begin with the role of this reasoning in the context of Aristotle's doctrine: periodical floods are the explanation of the vacillations of borders between the sea and dry land that occur in various areas (352 a 17-31), the processes which, according to Aristotle, take place in fact contrarily to the alleged non-cyclical drying up of the sea alleged by his opponents. As the resuming of this section shows, these processes should be seen as a consequence of periodical local floods, which effect the over-moistening of certain areas, and the following drying up of these areas. If one combines this with the reasoning in the beginning of the chapter, these processes should be viewed as follows: the over-moistening during the flood enforces activity of the rivers that flow from the flooded area (or even gives rise to some of them), which leads to mighty silting activity of these rivers, the receding of the sea at this place and its encroaching at

another. The drying up of the moisture initiates the contrary processes, and a new flood at some place will start the whole cycle again (the text at 352 b 13-16 is obscure, but this inference is evident from the brief recapitulation at II.3.356 b 30-357 a 2).<sup>35</sup>

The excess of moisture in the area where the springs of rivers are located, is compared in its effects with the normal seasonal accumulation of water in mountain landscapes of a specific kind. This usual accumulation makes rivers flowing from these mountains perennial, i.e. not drying up during the summer periods, according to the theory Aristotle defended before (I. 13. 349 b 2-350 a 14, and briefly resumed here, 352 b 5-11). The analogy runs as follows: just as the mountain areas of a certain kind are able to accumulate water in amounts that permit the rivers to flow during the drying up of the summer period until before the winter rainy period begins again (Aristotle calls the rivers *dénuoi*, 'perennial', in the sense that they do not dry up in summer as many other rivers do),<sup>36</sup> so the excess of rains, called Great Winter, creates an abundance of water in the area of rivers' springs, which prevents the rivers from drying up during a far more considerable space of time.

It does not, of course, mean that the Great Winter should necessarily occur again at the same place where the previous excess of moisture had been slowly transformed into lack of water and decay. The balance between precipitation and evaporation is sustained, as we have seen, only for the earth as a whole. The flood hence can evidently occur in any area. Nevertheless, although this is not expressed unambiguously in the text,<sup>37</sup> Aristotle in all probability implies that the higher mountains are not only

35 τῶ γρῶν δὲ ταῦτα ἐπιπυθίεται γυνώμενα μᾶλλον, θάτερα δ' ἐλάττω τὰ ἔφυδρα, ἕως ἂν ἐξήη πάλιν ἡ καταβολὴ τῆς περιόδου τῆς αὐτῆς. Webster (n. 21) n. 2 ad loc., following the interpretation of Viconeratio (it was accepted further by Lee [n. 6] and, with reservations, also by Strohm [n. 10] 166; 37, 33) suggested understanding under ταῦτα the areas which are less capable of containing moisture, whereas θάτερα are those mountain areas which can hold it more; he accordingly deleted γυνώμενα (as also Idelet [n. 19] and many other editors) and emended ἐλάττω in ἐλάττω. But the manuscript text may be retained, as it was by F. H. Fobes (ed.), *Aristotelis Meteorologicorum libri quattuor* (Cambridge, Mass. 1919 [repr. Hildesheim 1967]) and P. Louis, (ed.), *Aristote, Météorologiques*, Vol. I Livres I-II (Paris 1982), if one takes μᾶλλον and ἐλάττω as modifying γυνώμενα, not ἐπιπυθίεται. ταῦτα on this interpretation is the districts that were primarily affected by the flood and then the drying up, γυνώμενα μᾶλλον points to the gradual extension of these dried up districts (not to their quantitative increase); on this meaning of μᾶλλον see R. Kühner/B. Gerth, *Ausführliche Grammatik der griechischen Sprache*. II. Satzlehre I [Hannover/Leipzig 1898] 38, with examples of Plat. Phaedr. 93 b and Philib. 41 e). θάτερα τὰ ἔφυδρα (sc. ἐλάττω γίνεσθαι) point out to the diminishing number of areas that remain moist in a given district. This is close to Louis' rendering of the text in his translation, but it is not clear from the latter how he understands ταῦτα.

36 According to this theory, most rivers flow from the highest mountains, which are specifically capable of condensing moisture (due to the prevailing cold there) and of containing both condensed water and rainfall due to their stones, whereas the smaller mountains with mixtures of clay and stone have fewer springs of rivers, and the plains only few sources.

37 It is unfortunately unclear whether τῶν τόπων (352 b 13) refers back to two kinds of mountain areas mentioned above, as is usually understood (see further on this difficulty). The recapitulation (II.3.356 b 30-357 a 2) also does not allow one to decide whether Aristotle thinks that the areas affected by floods are mainly mountain ones.

suitable to contain water fall during regular periods of raining but also to accumulate the great rainfall during the flood. The reason for supposing this is that the flood and the following drying up of excessive moisture are for him the ultimate reason for the changes in the borders between the sea and the dry land. This can be plausibly explained on Aristotle's view only through the changes in amount of water carried by rivers (and in intensity of their silting activity respectively), and rivers flow, according to Aristotle, almost exclusively from mountain areas.

This analogy thus has a double purpose: first, the comparison between a normal winter and the long time period of the rains should demonstrate that the flood played the role of reservoir for the affected districts, comparable with the role of mountains for the rivers in usual time, but overriding them in the amount of moisture it brings (*μελλόν* 352 b 14); second, it demonstrates that just as the sources of rivers are not inexhaustible but need a supply of moisture every winter, so it is plausible to think that the excess of moisture after the flood would have been wiped out by drying up during a period that is incomparably longer than the usual summer.<sup>38</sup> This drying up invites an analogy with a returning Great Winter with a new excess of rains.

To estimate the significance of the flood in Aristotle's doctrine it is necessary to pay attention to a difference between a normal winter and the Great Winter. As Aristotle puts it, the winter supply of water makes some rivers "perennial", i.e. allows them to flow even during the summer excess of evaporation, whereas the flood makes "quasi-perennial" moisture in the areas from which the rivers flow (*ὁβρός οὐδέου δέι τόρε, ἐν οἷς ἄν γένηται ἢ τοιαύτη τοῦ ὑγροῦ ποσά, οἷον δένδρους πολεῖν τὰς ὑπόρητας τῶν τόρων μελλόν*).<sup>39</sup> The flood thus should explain why the rivers appear and flow constantly in the course of the incomparably longer periods of time, and why they should disappear at the end when the initial supply of water will be exhausted. Aristotle does not say why it is plausible to think that the seasonal fluctuations of moisture should have a negative balance which makes it necessary to assume the floods as a sort of reservoir of moisture. Possibly he took the disappearance of rivers for granted, and this made him suppose that supplies of water should be limited. What is certain is that

38 The doctrine presented at 349 b 20-350 a 15 and resumed here, according to which certain areas due to their temperature and character of landscape can absorb more the moist during winter than they lose during summer, which results in their over-moistening, might indeed have been for Aristotle an alternative explanation of the persistent flowing of rivers. Nevertheless, as the passage under discussion shows, the existence of such areas does not explain for him why such rivers should dry up in the long run of great geological periods, and he assumes that there was an initial source of moisture at the beginning (due to the flood), which should run dry at some point.

39 I suppose that Aristotle stresses here τῶν τόρων in contrast to τῶν ποταμῶν at 352 b 15 to oppose two kinds of perenniality, one of rivers provided by precipitation in usual winter, and another of the areas provided by the Great Winter. Webster (n. 21) suggested deletion of μελλόν, but on the interpretation I suggest it would be understandable, either in the sense 'rather' (this would stress the contrast between "perenniality" of rivers and areas) or the sense 'more than usual' (in this case Aristotle stresses also quantitative difference between the usual seasonal moisture and the one that resulted from the flood). The difficulty of the phrase made some scholars already in antiquity read here τῶν ποταμῶν instead of τῶν τόρων μελλόν (Olympiodorus in his commentary and Par. 2032).

this view is in harmony with his reasoning in the beginning of Meteor. I.14, where he also sees the process of changes in the areas as inevitable drying up. There Aristotle stated that in accordance with the influence of the sun's revolutions the areas from which the rivers flow are transformed from flourishing to decay; this leads to drying of rivers' sources, and this in turn to a diminishing of their silting activity and thus to encroaching of the sea back on the dry land. The ultimate reason for changes in this activity, i.e. in the appearance and gradual drying of the rivers, as the passage under discussion now shows, is not the influence of the sun by itself, but its effect combined with the initial over-moistening of a given area.

In course of his discussion in the Meteor. I.14 Aristotle mentions only two civilizations, in the development of which changes of the border between dry earth and sea played a prominent role: the *exemplum classicum* is for him Egypt, created as such by the silting activity of the Nile and the resulting encroachment of dry land on the sea (351 b 25-352 a 8). The origin of this river and its long-time abundant activity is for him in all probability an over-moistening of the area from which Nile flows.<sup>40</sup> This reasoning, which precedes discussion of the flood, incidentally shows that the influence of the sun's revolutions presupposes an initial over-moistening; this time not in the areas of rivers' springs, but in the alluvial pieces of land formed by silting: such areas are marshy in the beginning, then gradually get dry and become good land, and at last become completely dry and fruitless.

The whole cycle of this transformation can be observed, according to Aristotle, at various areas of Greece (I.14.352 a 9-18): Mycenae was thriving in the time of the Trojan war, while Argos was then marshy; afterwards, in Aristotle's time, Mycenae became over-dry and fruitless, and Argos, due to the same drying up, became cultivated.<sup>41</sup> As Argos in comparison with Mycenae is closer to the sea, Aristotle probably implies, as in the case of Egypt, that the area of the former was a later result of gradual retardation of the sea than the area of the latter.<sup>42</sup> It suggests that in the case of Greece Aristotle may have supposed silting activities of rivers at some point, which made the sea recede, and that the Greeks were for him settlers of the land, which gradually dries up. Perhaps Aristotle supposed that this increase of silting activities was a result of the excess of rains in the time of the flood of Deucalion.

40 Egypt as "the work of the river" 352 b 20-23; all the land of Egypt was once a sea (352 a 31-32); the Nile like other rivers is not eternal: the place whence it flows was once dry (353 a 15-17). The section on this activity of the Nile follows immediately the doctrine of Great Winter and its effects on changes of borders between earth and sea. It is thus plausible that the appearance of the Nile was for Aristotle the result of an excess of rains at some time in the past.

41 The reasons for Aristotle's assertion are uncertain. May be, it was only suggestion founded on established tradition about decay of Mycenae after the Trojan war; on the one hand, and relative prosperity of Argos in comparison with Mycenae in Aristotle's own days on the other.

42 O. Longo, "Mycene/Argo: un modello aristotelico di interpretazione geostorica", SIFC A. 77, Ser. 3, Vol. 2 (1984) 202-216, at 215 rightly regards these changes in the areas of Mycenae and Argos as the result of silting activity of rivers and of gradual retardation of the sea, although he fails to see the flood as the ultimate reason of these processes.

Aristotle does not adduce any example of the contrary process of migration of population from the drying of areas he describes as continuous and interrupted by various disasters that make it impossible to retain the process as a whole in the memory of posterity (351 b 8-22). As this reasoning immediately follows the section on the changes of borders between the sea and dry land, Aristotle in all probability thinks not only about the drying of rivers in such areas, but also about the resulting encroachment of the sea on the earth, which results in migration of the population away from the affected area. Was contemporary Greece for him an example of this unavoidable decay, as his remarks on Mycenae and Argos may imply?

To summarise, under closer scrutiny the beginning of Meteor. I.14 and the following part of this chapter turn out as complementary, not as contradicting each other. According to the first part the changes in borders between the sea and the dry land are dependent on the activity of rivers: abundant rivers with their silting activity that makes the sea recede and encroach on the shore somewhere else. With the diminishing of water level in these rivers the silting activity decreases, the sea returns back where it previously receded, and accordingly it recedes at the place of its former encroachment.

The level of water in rivers is regulated by the processes of flourishing and decay of areas where the springs of rivers are located. These processes are dependent on the annual revolutions of the sun, which on the analogy of their influence on the growth and perishing of living beings cause similar processes at various areas of the earth. One result of these processes is the diminishing capacity of the relevant areas to contain moisture. The process is thus seen as a progressive drying up, but Aristotle does not explain in this part why the seasonal fluctuations of moisture should result in this non-cyclical decay.

This would be clear, if the starting point of this process was for Aristotle the superabundant moistening of a given area. And this is in fact confirmed by the following part of ch. 14: the periodical excess of rains, the Great Winter, makes, especially in mountain areas, the abundant moisture capable of supporting the perennial flowing of the rivers in the course of millennial periods, on the analogy of winter rains which having accumulated in mountains support the flowing of the rivers during the summer. The latter supply is not, however, sufficient to maintain the flow of rivers in long run, and this is explained by Aristotle's doctrine in the beginning of the chapter: the influence of the sun makes progressive drying up inevitable. The returning Great Winter, which does not necessarily occur at the same place, should start a new process of flourishing and decay.

Thus the floods in Aristotle's theory are not a superseded stage of his thought, but an essential component of his general vision of meteorological processes. Being only local as compared with Plato's floods, they remain recurrent and regular, albeit not in a sense of strict mathematic-astronomical regularity, but in terms of general balance between precipitation and evaporation on the earth as a whole. This means that **factum** remaining destructive for all of civilisation as they were for Plato, floods according to Aristotle **also** have an important positive effect in supporting the stability of the whole.

## Ist die Schrift 'De Plantis' von Aristoteles?\*

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مقدم به دوست عزیزم احمد خلیلی

### I. Überblick über den Forschungsstand und Folgerungen

Trotz aller Entstellungen durch eine außerordentlich verwickelte Überlieferungs-geschichte darf die Schrift *De plantis* noch in ihrer ältesten vollständig erhaltenen Fassung, der vor 900 von Isḥāq ibn Ḥunain in Bagdad aus dem Syrischen angefertigten arabischen Übersetzung<sup>1</sup>, als das Tiefgründigste gelten, das bis zur Entdeckung der Sexualität der Pflanzen durch Rudolf Jakob Camerarius (1665-1721) und der Photosynthese durch Jan Ingenhousz (1730-1799) zum Wesen der Pflanze und zum Funktionieren ihres Körpers gesagt worden ist. Besonders eindrucksvoll ist etwa zu Beginn des ersten Buchs die Auseinandersetzung mit den Vorsokratikern und mit Platon über die Stellung der Pflanzenseele im Vergleich zur Tierseele und zur unbelebten Natur, die nach den noch heute maßgeblichen vier Kriterien des Lebendigen geführt wird, nämlich Formbeständigkeit, Stoffwechsel, Produktivität und Reizbarkeit. Anders etwa als in den eng fachbezogenen Pflanzenschriften des Theophrast wird dabei immer wieder auf die Vorstellung einer Stufenleiter der Natur<sup>2</sup> angespielt, indem die Wesensbestimmung der Pflanze universell mit der Frage nach ihrer kosmologischen Position verknüpft wird und neben zoologischen auch meteorologische und physikalische Argumente herangezogen werden. Ein Gesichtspunkt in der Diskussion über die Abgrenzung gegenüber dem Tierreich ist das zuvor von Empedokles ausführlich behandelte

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1 Vgl. Lulofs 1989, 121-124.

2 Vgl. besonders HA 8,1 / 588a18-589a9, wo ausführlich und in voller Übereinstimmung mit der Schrift *De plantis* die Stellung der Pflanzen definiert wird; siehe aber bereits das Konzept der Trelostufen im Schlußkapitel des vierten Buchs der *Meteorologie* 4,12 / 389b26-390b22 und dazu Düring 1966, 384f. Zu Bedeutung und Vorkommen dieser echt aristotelischen Vorstellung s. jetzt die Übersicht bei Jochen Althoff, Artikel, *zôê / Leben* sowie *zôon / Tier* in: *Oxford Hôffe* (Hg.), *Aristoteles-Lexikon*, Stuttgart 2005, 614-620; vgl. Düring 1966, 528-530 und Wôhrle 1985, 13-15, auch 1997, 394f. Die syrische Bearbeitung und die arabische Übersetzung der *Doxographie*, die in typisch aristotelischer Manier die Schrift *De plantis* einleitet, wird vergleichend interpretiert von Lulofs 1989, 26-32; ein mittelalterlicher hebräischer Kommentar zu den Kapiteln 1-33 liegt in dem sogenannten *Huntington-Fragment* vor, abgedruckt bei Lulofs 1989, 446-463, vgl. dazu ebd. 373-386. Siehe auch die Erklärungen von Moraux 1973, 493-501.