ABŪ'L-FARAǦ IBN AṬ-ṬAYYIB ON PLANTS AN INQUIRY INTO HIS SOURCES

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Botanical literature of the Arabs[1] is not only based on empirical observations. On a large scale it used Greek sources. Among these Aristotle's book on plants became very important. It was known to the Arabs in the summarizing redaction by Nicolaus Damascenus (born 64 B.C.), in the 10th century Arabic translation of Isḥāq Ibn Ḥunain, which was revised by Ṯābit ibn Qurra. The Greek original of Aristotle's work and Nicolaus' summary are lost. Therefore, the oriental tradition of Nicolaus' text is very important. Nicolaus' redaction was translated into Syriac, from Syriac into Arabic, from Arabic into Hebrew and Latin and from the Arabic-Latin version into Greek. All these translations, including the fragments in Syriac and Hebrew, are published now in the Dutch project *Aristoteles Semitico-Latinus* with an English translation by H. J. Drossaart Lulofs.[2]

In his summary of Aristotle's book *On plants* Nicolaus used numerous observations by Aristotle's pupil Theophrastus (371-287 B.C.), the author of *Historia plantarum* and *Causae plantarum*.[3] In this way Nicolaus transmitted to the Arabs Aristotelian theories together with Theophrastean empiricism.

The morphology and description of plants became a main merit of Theophrastus.[4] According to the *Fihrist* of Ibn an-Nadīm[5] only Theophrastus' *Causae plantarum* was translated into Arabic by Ibrāhīm Ibn Bakkūs

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[1] Compare M. Ullmann, *Die Natur-und Geheimwissenschaften im Islam*, Leiden 1972 (= Handbuch der Orientalistik, 1. Abt., Ergänzungsband VI/2), pp. 62-94; F. Sezgin, *Geschichte des arabischen Schrifttums* IV, Leiden 1971, pp. 303-346.

[2] Nicolaus Damascenus: *De plantis*. Five translations. Ed. and introduced by H.J. Drossaart Lulofs and [the Latin-Greek translation] E.L.J. Poortman, Amsterdam, Oxford, New York 1989. = Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, afd. Letterkunde, nieuwe reeks, d. 139.

[3] Cf. H.J. Drossaart Lulofs, *Aristotle's Peri phytōn*, in: *The Journal of Hellenic Studies* 77, London 1957, pp. 75-80.

[4] Cf. Brigitte Hoppe, *Ursprung der Diagnosen in der botanischen und zoologischen Systematik*, in: Sudhoffs Archiv. Zeitschrift für Wissenschaftsgeschichte 62, Wiesbaden 1978 (pp. 105-130), pp. 109ff.

[5] Ed. G. Fluegel (Leipzig 1871-2; reprint Beirut 1964), p. 252, 9f.

(or: Bakkūš). The translation, however, is not preserved. Ibn Bakkūs (or: Bakkūš) is an older contemporary and colleague of the Nestorian ʿAbū'l-Farağ Ibn aṭ-Ṭayyib (died 435/1043)[6] at the ʿAdudīya-hospital in Baghdad. Therefore, it is possible that Ibn aṭ-Ṭayyib used Ibn Bakkūs' translation in his monograph on plants.

Ibn aṭ-Ṭayyib's monograph on plants is preserved in a collection of scientific and philosophical texts by Ibn aṭ-Ṭayyib, in Escoral 888, fols. 14r-75v.[7] In the introduction Ibn aṭ-Ṭayyib informs us that he collected (*ğamaʿa*) material on plants, because Aristotle's book on plants appears to be lost. Ibn aṭ-Ṭayyib's collection is rather unsystematic and pretends to offer primarily an explanation of the phenomena in the botanical world. A section often starts with the phrase *al-ʿillatu fī* "the cause of...", a peculiarity which the text shares with other works by Ibn aṭ-Ṭayyib.[8] The material is presented in 31 chapters and discusses the following themes:

[6] G. Graf, *Geschichte der christlich-arabischen Literatur* II, Roma 1957, pp. 160ff.

[7] H.P.J. Renaud, *Les manuscrits arabes de l'Escurial* II/3, Paris 1941, pp. 100-104.

[8] See the *mağmūʿa* Nuruosmaniye (Istanbul) 3610 (new number 3095); copied 1076/1665-6. As this collection (entitled *Kitāb an-Nukat wa-l-aṯmār aṭ-ṭibbīya wa-l-falsafīya)* of scientific and philosophical texts by Ibn aṭ-Ṭayyib has not yet been described, we give here an enumaration of the texts:
fols. 1v-21v: *Masāʾil al-Iskandar* = Alexander of Aphrodisias, *Iatrika aporemata kai physika problemata* (n. 27), extract. On the Syriac translation s. L. Filius, *Problemata physica arabica*, thesis Free University Amsterdam 1989, p. 7*f.
fols. 22r-33v: *Ṯimār al-masāʾil aṭ-ṭibbīya ʿalā waǧh āḫar.*
fols. 34r-86v: *Ṯimār masāʾil Arisṭūṭālīs al-maʿrūfa bi-mā bāl* = Aristotle, *Problemata physica*, chapter 1-15 (Arabic and Hebrew translation ed. L. Filius, s. above), extract.
fols. 86v-92v: *Ṯimār min kalām Ğālīnūs fīʾt-tiryāq;* apparently collected from several works by Galen; it is rather different from Galen, *Peri theriakes pros Pisōna* [Arabic translation ed. L. Richter-Bernburg, *Eine arabische Version der pseudogalenischen Schrift De Theriaca ad Pisonem*, thesis Göttingen 1969] or *Peri theriakes pros Pamphilianon*. On both texts in Arabic transmission, F. Sezgin, *Geschichte des arabischen Schrifttums* III, Leiden 1970, p. 121 (no. 67 and 68) and VII (1979), p. 377.
fols. 92v-94r: *Ṯamarat kalām li-ʿĪsā Ibn Māssawaih fīʾl-ğimāʿ wa-mā yataʿallaqu bihī.* = ms. Escorial 888, fols. 149r-157v; Sezgin III 257 (Ibn Māssa).
fols. 94v-99v: *Ṯimār masāʾil ṭibbīya ʿalā waǧh āḫar.* Different from the text fols. 22r-33v.
fols. 99v-121r: *Šurūṭ ilqāʾ al-adwiya.* Consists of several sections which are not closely connected with each other.
fols. 121r-125r: *Ṯimār masāʾil ṭibbīya.* Different from fols. 22r-33v and 94v-99v.
fols. 125r-v: *Fīʾr-rūḥ wa-n-nafs* (= ms. Escorial 888, fols. 85v-86v) = extract from Qustā Ibn Lūqā, *Risāla fīʾl-faṣl bain ar-rūḥ wa-n-nafs;* M. Ullmann, *Die Medizin im Islam*, Leiden/Köln 1970 (= Handbuch der Orientalistik I, Ergänzungsband VI/1), p. 128.
fols. 125v-126v: *al-ʿAṭaš* = ms. Escorial 888, fols. 86v-88v = (?) Qusṭā Ibn Lūqā, *Kalām fīʾl-ʿaṭaš* (Sezgin III 272, no. 16), extract.

1) Chapter 1 (fols. 14r12-14v, ult.): *The seed of plants is hot and humid.* Starting-point is Theophrastus' teaching of warmth and humidity as primary substances of animals, a modification of Aristotle's theory of the primary qualities.[9] Theophrastus, however, is not as detailed as Ibn aṭ-Ṭayyib who —perhaps proceeding from his medical knowledge— adds a parallel from Hippocratic-Galenic medicine by refering to the function of warm, cold, humid and dry in the constitution of man.[10] Moreover, Ibn aṭ-Ṭayyib illustrates the importance of warmth and humidity by a remark on the influence of hot male semen upon menstrual blood and on the impact of hot rennet *(infaḥa)* on the coagulation of milk. These ideas are orientated to Aristotle, *De generatione animalium* 729a12ff. and 739b21ff. A comparison with the Arabic translation from the 10th century demonstrates that Ibn aṭ-Ṭayyib apparently did not use this translation: for example the Greek terms *opós* and *pyetía*, both meaning "rennet" in *De Generatione animalium* 729a13, are rendered in the Arabic translation by a different Arabic term, *maswa.*[11] These observations indicate the possibility of a compilation from several sources; Ibn aṭ-Ṭayyib himself

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fols. 126v-127r: Galen, *Fī'l-ḥuqan*, extract = ms. Escorial 888, fols. 88v-91r. Sezgin III 128, no. 100 and VII 377 (wrongly "126b-128b").

fols. 127r-128v: *Fī'r-rawā'iḥ* = ms. Escorial 888, fols. 76v-82v.

fols. 128v-134v: *Qawānīn ḥasana fi'l-adwiya wa-l-aġdiya.*

fols. 134v-137v: *Fī's-sarāb.*

fols. 138r-140v: *Ṯimār maqālat Aristūṭālīs fī tadbīr al-manzil* (= ms. Escorial 888, fols. 145v-149r) = extract from ps.-Aristotle, *Oeconomica*, book I (1343a1-1345b4), Arabic version (edited by ʿĪsā Iskandar Maʿlūfin Mağallat al-mağmaʿal-ʿilmī al-ʿarabī bi-Dimašq 1, 1921, 377-385).

fols. 141r-148v: *Masā'il fi'l-ḥayawān.* The relation of this text to Ibn aṭ-Ṭayyib's excerpts from Aristotle's Books on animals deserves further investigation. On the Arabic, Hebrew and Latin fragments of Ibn aṭ-Ṭayyib's book s. M. Zonta, *Ibn Al-Ṭayyib Zoologist ad Ḥunayn Ibn Isḥāq's revision of Aristotle's De animalibus- New Evidence from the Hebrew Tradition*, in: Aram 3,1/2, 1991, pp. 235-247.

[9] Cf. Br. Hoppe, *Biologie-Wissenschaft von der belebten Materie von der Antike bis zur Neuzeit*, Wiesbaden 1976 (= Sudhoffs Archiv. Zeitschrift für Wissenschaftsgeschichte. Beihefte 17), pp. 142ff. and G. Senn, *Die Entwicklung der biologischen Forschungsmethode in der Antike und ihre grundsätzliche Förderung durch Theophrast von Eresos*, Aarau 1933 (= Veröffentlichungen der Schweizerischen Gesellschaft für Geschichte der Medizin und der Naturwissenschaften VIII), pp. 95ff.

[10] According to Hippocrates and Galen diseases are caused by a disorder of the primary qualities of the humours of the body, of blood, phlegm, yellow and black bile. S. Ullmann (as n. 1), p. 97.

[11] See the edition of the Arabic translation by J. Brugman and H.J. Drossaart Lulofs (Leiden 1971).

could have compiled several sources or he might have used an already existing compilation.

Chapter 2 (fol. 15rl-12): *Plants have numerous roots, contrary to animals.* Starting-point is an Theophrastean doctrine which is not explicitely mentioned by Ibn aṭ-Ṭayyib and is described in Aristotle, *De generatione animalium* 735a24ff., 738b16f. 741b15 etc., namely the teaching of the heart as the first created principle (*archē* = *ibtidāʾ*[12]) of the parts of animals. This explanation is combined with Hippocrates', Galen's and Aristotle's doctrine that the heart is the origin of the warmth of life.[13] Because roots are less protected than the heart, they must be numerous for the sake of reducing risks.[14] This explanation cannot be found in Greek sources. It can be interpreted as an application of Aristotle's teleological principle that everything in nature has an aim.[15] Theophrastus has no parallel to Ibn aṭ-Ṭayyib's doctrine and generally prefers causality to teleology.[16]

Chapter 3 (fols. 15r13-15v13): *The reason why some plants have many seeds, others not.* Starting-point is again Aristotle's teleology. Ibn aṭ-Ṭayyib explanation is an analogy to his theory of roots: the weaker the nature (*ṭibāʿ*), the more seeds are necessary for the preservation of the species. Aristotle (*De generatione animalium* 750a22ff.) and Theophrastus (*Causae plantarum* II, 11,1) had preferred a causal explanation here: it is not the weak nature which causes plants to have numerous fruits; quite on the contrary, the weakness of nature is caused by excessive fertility.

Chapter 4 (fols. 15v, paenult. -20v, ult.): *On seeds which are the purpose of growing fruits.* Congruous with Aristotle's teleology the main purpose of nature is the preservation of plants. Therefore, seeds must be protected through leaves. Seed which exists in a small quantity and size and which is less good requires more protective leaves. An exact parallel with Aristo-

[12] Aristotle, *De generatione animalium*, 740a18/Arabic translation ed. Brugman/Drossaart Lulofs (as prec. n.) 72,-3 (*ibtidāʾ al-aʿḍāʾ*)

[13] Cf. Hans H. Lauer, *Das Herz in der Medizin des arabischen Mittelalters* in: Heidelberger Jahrbücher 13, Berlin-Heidelberg-New York 1969 (pp. 103-115), p. 108.

[14] Cf. also ms. Escorial 888, fol. 16v (→below chapter 4). This chapter mentions in an analogous manner the necessity of numerous twigs. Unlike in Theophrastus, *Historia plantarum* II 1-2,6 and *De causis plantarum* I 12,9 they can be cut and after being put in the ground they grow again. Ibn aṭ-Ṭayyib explains this (fol. 16v, ult.s.) by the fact that "the soul in plants and trees is in an undivided (*ʿalā waṯīratin*) manner in the whole (*al-kull*)." Cf. this with Aristotle, *De generatione animalium*, 762a22; id., *Parva naturalium* 467a23ff.

[15] Cf. Aristotle, *Physics* II 8. 198b35ff. or *De generatione animalium*, 715b16: *he de physis aei zetei telos.*

[16] Cf. on Theophrastus Senn (as n. 8), pp. 96f. and 107f.

tle does not exist. Ibn aṭ-Ṭayyib's explanation, however, can be seen as a development of the doctrine in Aristotle, *De generatione animalium*:[17] plants which bear fruits only once a year consume all their food for the production of fruits and not for the trunk. Ibn aṭ-Ṭayyib adds an analogy taken from the world of animals:[18] animals which are prolific, for example birds, chickens *(ad-daǧāǧ al-ahlīya)* and silkworms *(dūd al-qazz)*, will soon die. This is not the case with turtle-doves *(qamārīy)* and crows *(ġirbān)*, which have few offspring and are long-lived. Ibn aṭ-Ṭayyib her, too, follows Aristotle, *De generatione animalium*.[19] The animals mentioned, however, do not correspond exactly to the enumeration in the Greek text or its Arabic translation.

Chapter 5 (fols. 21r-23v3): *A discussion of the functional parts of plants and animals and their usefulness.* In accordance with Aristotle's teleology[20] the parts of plants —analogously to the world of animals Aristotle (but not his pupil Theophrastus)[21] classified them as "organs" with a special function —have the function to protect fruits. New is Ibn aṭ-Ṭayyib's idea that nature not only protects *(li-ṣ-ṣiyāna)*, but also embellishes *(li-z-zīna)*.[22] This idea is more extensively discussed by Ibn Sīnā in his book *On Plants*.[23] Although Ibn Sīnā was a contemporary of Ibn aṭ-Ṭayyib we cannot prove that Ibn aṭ-Ṭayyib based his explanations on Ibn Sīnā's monograph. Ibn Sīnā is sometimes shorter or has different details. Moreover, the idea of "embellishment" can already be found in the encyclopaedia *Rasā'il Iḫwān aṣ-Ṣafā'*[24] from the first half of the 10th century.

Chapter 6 (fols. 23v4-25v8): *The reason why the bark (liḥā') of the palm-tree is thin, but is thick in other trees.* As in the preceding chapter Ibn aṭ-Ṭayyib differs from the corresponding section in Ibn Sīnā's book on plants.[25] According to Ibn aṭ-Ṭayyib the bark of palm-trees must have pores

[17] 750a21ff. A different explanation can be found in Theophrastus, *De causis plantarum* II 12, 1ff.

[18] The making of analogies between plants and animals is typical of Aristotle and is avoided by Theophrastus: cf. Senn (as n. 8), 119-121 and Drossaart Lulofs, *Aristotle's Peri phytōn*, p. 77.

[19] 749b13ff.; 750a7ff.; 756b25f.

[20] *De anima* II 1.412b1f.; *Physics* II, 8. 198b10ff.

[21] Cf. Theophrastus, *Historia plantarum* I, 1.4 and Senn (as n. 8), pp. 118f.

[22] Cf. also chapter 14.

[23] *an-Nabāt* (= *aš-Šifā', at-Ṭabīʿiyāt* VII) ed. ʿAbdalḥalīm Muntaṣir, Saʿīd Zāyid and ʿAbdallāh Ismāʿīl (Cairo 1384/1965) pp. 23,3ff.; 31,11ff. Cf. also Abū'l-Barakāt al-Baġdādī, *Kitāb al-Muʿtabar fī'l-ḥikma* II (Hyderabad 1357-8/1938-9), p. 138,10ff. (perhaps following Ibn Sīnā).

[24] ed. Ḫairaddīn az-Ziriklī (Cairo 1347/1928) II 138, 10ff.

[25] Ibn Sīnā, *an-Nabāt* (as n. 21), p. 22, 4ff.

which enable the evaporation *(tanaffus)* of humidity inside the tree. If it is cold, the pores are closed. Thus, the interior heat remains locked up and transforms the interior humidity to oil, which does not freeze and which is prevented by the humidity from being burnt. Even additional heat from outside does not lead to the fall of oleiferous leaves. Here, Ibn aṭ-Ṭayyib starts from Aristotle's *De generatione animalium*[26] and not from Theophrastus.[27] He adds an illustrative analogy from the world of animals, which is taken from Aristotle's book *De generatione animalium*:[28] grey hair *(šaib)* is also called "mould" *(karaǧ = eyrús)*,[29] because humidity causes mould. Therefore, grey hair results from the prevalence of cold and humidity over heat. Ibn aṭ-Ṭayyib adds a remark about the effects of prevailing heat: it causes the yellow colour and the curl *(taǧa$^{\alpha}$ada)* of fibres. As happens with the hair of negros, earth and fire look for their proper place if they meet; in this case the heat prevails over humidity and earth. This explanation cannot be found in Aristotle, but has a parallel in (ps.) Alexander of Aphrodisias, *Iatrika aporémata kai physika problémata*[30] and in Balīnās, *Sirr al-ḫalīqa*.[31]

Chapter 7 (fols. 25v9-26r, paenult.): *A discussion of the fibres (alyāf)*. As in the preceding chapter Ibn aṭ-Ṭayyib relies on the prevalence of heat over humidity: the more heat and humidity there are, the bigger fibres will be.

Chapter 8 (fols. 26r, paenult.-26v9): *The reason why some trees have few fruits*. Starting-point is Aristotle's doctrine as described in *De generatione animalium*.[32] Similar to animals with a large body and therefore with few offspring big trees have few fruits.

[26] 783b18ff.; cf. also Balīnās (ps. Apollonius), *Sirr al-ḫalīqa* ed. U. Weisser (Aleppo 1979) p. 374,-2ff./commentary by Weisser, *Das "Buch über das Geheimnis der Schöpfung" von Pseudo-Apollonius von Tyana*, Berlin, New York 1980 (= Ars medica, III. Abt., Bd. 2), p. 124.

[27] On Theophrastus cf. Senn (as n. 8), pp. 110f.

[28] 783a9ff.; 784a30ff. [followed by (ps.) Alexander of Aphrodisias, *Iatrika aporemata kai physika problemata*, ed. J.L. Ideler [in: Physici et medici graeci minores I, Amsterdam 1963] questions no. 1ff (= extract by Ibn aṭ-Ṭayyib in ms. Nuruosmaniye 3610, fol. 2r and Aristotle, *Problemata physica* X 34).

[29] The Arabic translation of Aristotle's *De generatione animalium*, (ed. Brugmann/Drossaart Lulofs [as n. 10], p. 188, 10ff.), the extract by Ibn aṭ-Ṭayyib from Alexander of Aphrodisias, *Problemataphysica* (s. prec. note) in ms. Nuruosmaniye 3610, fol. 2r and Faḫraddīn ar-Rāzī, *al-Mabāḥiṯ al-mašriqīya* II, Teheran 1966, pp. 163f. have the variant *takarruǧ*.

[30] Ed. Ideler (as n. 26) 7th question (p. 7 below).

[31] Ed. Weisser (as n. 25), pp. 491f; cf. Weisser (as n. 25), p. 147.

[32] 771a18ff. On the birds, the examples mentioned by Ibn aṭ-Ṭayyib, cf. 774b5ff. and on the analogy between plants and animals s. 725b26ff.; 749b26ff.-An echo of the Aristotelian thought can be found in Balīnās, *Sirr al-ḫalīqa*, ed. Weisser (as n. 25), p. 319,8-10/cf. Weisser (as n. 25), p. 208 (*wilāda* is not "development", but "generation").

Chapter 9 (fols. 26v10-27v2): *The origin of the milk of fig-trees and of other trees.* In accordance with Aristotle's doctrine of pepsis "cooking"[33] the white colour of the milk of fig-trees is explained as a result of the influence of heat on humid and earthy substances which both contain air. If heat prevails, this milk becomes bitter and acrid. Ibn aṭ-Ṭayyib refers to Aristotle, *De generatione animalium*[34] and adds an analogy from the world of animals, namely the white colour of semen.

Ibn aṭ-Ṭayyib shares his principle of the co-operation of heat and humidity in the process of *pepsis* with Theophrastus[35] and Nicolaus Damascenus' summary of Aristotle's book on plants.[36] In the details, however, he is closer to the description in Aristotle's *De generatione animalium*, which is also echoed in Balīnās, *Sirr al-ḫalīqa*.[37]

Chapter 10 (fols. 27v3-29r3): *On the different (kinds) of the burning of charcoal made from the wood of the one tree and on the absence of burning (of charcoal made from the wood) of the other tree.* Starting-point is Aristotle's *Meteorology*, book IV[38] according to which the burning of wood depends on the existence of pores, of respiratory tracts. In the additional introduction of earthiness as one of the preconditions of burning wood Ibn aṭ-Ṭayyib follows in a selective manner Theophrastus, who in *Historia plantarum* V 9 regarded as the best charcoal the "most compact" *(pyknótaton)* and that wood which in a moderate manner *(symmetrōs)* is compact *(pyknon)*, earthy *(geōdes)* and humid *(hygron)*.[39] Theophrastus' explanation that charcoal and wood burn if they are fanned *(physōmenon)* by air[40] apparently enabled Ibn aṭ-Ṭayyib to combine Theophrastus' classification of the best wood as something "compact" with the porosity in Aristotle's *Meteorology* and to introduce simultaneously the "earthiness" of wood.

[33] Cf. Aristotle, *Meteorology* IV 3.380a11f.; Hoppe (as n. 8), p. 163. Theophrastus and Nicolaus Damascenus took over Aristotle's teaching and explained the substances of plants as a result of "cooking": s. Hoppe, pp. 149ff. and (on Nicolaus) Paul Moraux, *Der Aristotelismus bei den Griechen* I (Berlin, New York 1973. = Peripatoi 5), pp. 507ff. Aristotle's doctrine of *pepsis* was taken over by Averroes in his *Colliget*: s. H. Gätje, *Zur Lehre von den vier Temperamenten bei Averroes*, in: Zeitschrift der Deutschen Morgenländischen Gesellschaft 132, 1982 (pp. 243-268), p. 262.

[34] 735a11ff. and b11ff.

[35] See note n. 31.

[36] Cf. ed./transl. Drossaart Lulofs (as n. 2)§§ 239ff.

[37] Ed. Weisser (as n. 25), p. 391; cf. the paraphrase by Weisser, 1980 (as n. 25), p. 127.

[38] Chapter 9.387a19ff.

[39] Cf. also Theophrastus, *De igne*, ed. (with introduction, translation and commentary) V. Coutant (Assen 1971)§§ 3 and 8.

[40] Theophrastus, *De igne*, ed. Coutant (as prec.n.) and 28 end; cf. and 37.

Chapter 11 (fols. 29r4-29v13): *The reason why cypresses and junipertrees do not rot.* In conformity with the doctrine of pepsis, "cooking",[41] putrefaction is the result of the interacting of heat and humidity.[42]

Chapter 12 (fols. 29v14-32r10): *The reason why plants and trees have different natures and why they can be broken or are flexible.* Although Theophrastus dedicated a whole chapter to wood in his *Historia plantarum* (book V), and although he mentions several times its flexibility and breakage which depend upon the presence of humidity,[43] he does not give a detailed theory. More can be found in the 4th book of Aristotle's *Meteorology.*[44] Here, we find the same dependence of the flexibility upon the quantity of the humid and the dry substance; according to Aristotle (385a26ff.) the bodies consisting of warmth and the bodies consisting of earth incline to the lack of humidity. This Aristotelian theory is the starting-point of Ibn aṭ-Ṭayyib's enumeration of seven possible qualities of plants and their causes:

1) The lack of humidity causes the fragility of plants.

2) The prevalence of humidity over heat and the earthy substance causes the flexibility of plants.

3) The preponderance of earthy substance and of heat causes the fragility of plants.

4) The prevalence of earthy substance and of heat over humidity makes it difficult to cut plants.

5) The preponderance of heat and humidity causes the flexibility.

6) The prevalence of earthy substance and of humidity over heat causes the flexibility of plants or parts of them (e.g. the pith of plam-trees).

7) The prevalence of warmth and humidity over earthy substance facilitates combustion and melting.

Ibn aṭ-Ṭayyib compares the principle behind these possible qualities with the co-operation of water, fire, air and earth in the minerals; e.g. crystal *(billaur)*, glas *(zuǧāǧ)* and sapphire *(yāqūt)* have much watery substance and little earth, but no fire and no or little air. A comparable but much shorter note which mentions the ruby, is Aristotle, *Meteorology* IV 9.387b16f. More

[41] S above ch. 9.

[42] Cf. also Aristotle, *De generatione animalium*, 762a15 and Theophrastus, *De causis plantarum*, III 23,3 (end) and 5.

[43] Theophrastus, *Historia plantarum*, V 7.4.

[44] Chapter 8 and above all 9; on humidity and dryness cf. ch. 4.

elaborate is Nicolaus Damascenus in his summary of Aristotle's *De plantis.*[45] But neither Nicolaus nor, by the way, Ibn Sīnā correspond in their details with Ibn aṭ-Ṭayyib.[46] Their common source is the Aristotelian doctrine.

Chapter 13 (fols. 32r11-33r7): *On the male and female in plants.* Here, Ibn aṭ-Ṭayyib seems to have used Nicolaus Damascenus' summary of Aristotle's *De plantis,*[47] perhaps in addition to Aristotle's *De generatione animalium.*[48] In conformity with this book by Aristotle he denies the existence of sexual differentiation in plants,[49] refuses any analogy between earth and uterus of animals,[50] between the strongest part of the seed and the male semen and between the remaining seed and the menstrual blood.

Chapter 14 (fols. 33r8-34v5): *What is similar in trees or what possesses the same function: leaves and their origins.* This theme was already discussed in chapter 5. In addition, Ibn aṭ-Ṭayyib explains the quick fall of leaves by the fact that a plant in this case has concentrated all its energy on the production of fruits. Ibn aṭ-Ṭayyib adduces an analogy from the world of animals: Human beings who have much sexual intercourse will soon become bald and animals laying many eggs will soon lose their feathers. This analogy is taken from Aristotle's *De generatione animalium.*[51] —The section in Ibn aṭ-Ṭayyib does not correspond exactly to the chapter in Ibn Sīnā's book on plants[52] and is longer.

Chapter 15 (fols. 34v6-36r10): *The reason why some trees are heavy and others are light. On the nodes of reed.* This chapter has no exact parallel in Theophrastus.[53] Starting-point is Aristotle's and Theophrastus' doctrine of wood as a combination of compact, earthy and humid substance, which is already discussed in chapter 10. The qualities mentioned cause the heaviness of trees. An example is ebony (*abnūs;* fol. 35v) which becomes black under the influence of heat, for this closes the pores and prevents humidity from going outside. This explanation follows Aristotle's

[45] Ed./transl. Drossaart Lulofs (as n. 2) book II (pp. 172ff.)

[46] *aš-Šifā', aṭ-Ṭabī'iyāt* VII: *an-Nabāt* (as n. 21) 34,1ff.

[47] Book I, ed./transl. Drossaart Lulofs (as n.2) 126ff.

[48] Cf. 716a 15f. and 731a27 ff.

[49] This differs from the *Rasā'il Iḫwān aṣ-Ṣafā':* S. Diwald, *Arabische Philosophie und Wissenschaft in der Enzyklopädie Kitāb Iḫwān aṣ-Ṣafā,'* (III). Die Lehre von Seele und Intellekt Wiesbaden 1975, p. 157.

[50] Cf. also fol. 51r8f. (mentions explicitly Aristotle as author of this analogy).

[51] 783b8ff.; cf. Aristotle, *Problemata Physica,* X 57.

[52] aš-Šifā', aṭ-Ṭabī'iyāt VII: *an-Nabāt* (as. n. 21), p. 23, ult. ss.

[53] Cf. Theophrastus, *Historia plantarum,* I 8.

Meteorology, 4th book,[54] apparently without being based on the Arabic translation.[55]

Chapter 16 (fols. 36r11-37r, ult.): *The reason why plants have branches which are comparable with the veins of animals.* Starting-point is Aristotle's teleology:[56] "everything exists because of an aim" *(wa-l-kullu bi-sababi'l-ġāya)*. An example are branches *(aš-šuʿab)*. As Aristotle in *De generatione animalium*[57] told, branches are comparable with the veins of animals, because they serve for the transportation of food.

Chapter 17 (fols. 37r,ult.-40r11): *On the thorn and on the resin in trees and plants.* In chapter 5 Ibn aṭ-Ṭayyib had given the explanation that the thorn protects and embellishes plants. Here, we are informed that the thorn can also be a kind of deformity *(taŝwīh)*. This classification is seen is an analogy to the world of animals. Here, the author has in mind the description of monsters in Aristotle's *De generatione animalium*[58] and explains the thorn which is a deformity as a deficiency symptom. This is caused by a lack of food intake and can be found in dry trees. Similarly resin is a deficiency symptom (fol. 39v, -2ff.) if humidity and food are not used up completely, for example during the winter. —The chapter has no corresponding section in Nicolaus Damascenus' summary of Aristotle's *De plantis*[59] or in Ibn Sīnā's book on plants.[60] Similar explanations of the thorn and the resin, perhaps based on a common source, can be found in Balīnās, *Sirr al-ḫalīqa*.[61]

Chapter 18 (fols. 40r11-42r5): *On the origin and the aim of nature in plants.* Plants grow without artificial plantation *(ġars)*, if there are suitable soil, air and water. At first sight a parallel seems to be Theophrastus' explanation that place and climate are decisive for the growth; Theophrastus considered the place to be more important than cultivation *(ergasîa)* and fertilizing *(therapîa)*.[62] This explanation can also be found in Ibn aṭ-Ṭayyib's book, but later, in an excerpt from Nicolaus Damascenus' summary of Aristotle's *De plantis*.[63] Here, however, Ibn aṭ-Ṭayyib refers to Aristotle's doc-

[54] 384b18-20.

[55] Cf. ed. C. Petraitis, *The Arabic version Aristotle's Meteorology*, Beyrouth 1967, p. 115, 10-12.

[56] Cf. above ch. 5.

[57] 738a13ff.

[58] 769b11ff.

[59] Ed./transl. Drossaart Lulofs (as n. 2) p. 200 (and 213) and (on resin), p. 210 (§§ 241ff.)

[60] *aš-Šifāʾ; aṭ-Ṭabīʿiyāt* VII: *an-Nabāt* (as n. 21), p. 31.

[61] Ed. Weisser (as n. 25), 379, 1ff/Weisser (as n. 25), p. 125.

[62] Theophrastus, *Historia plantarum*, II 2.7ff.; VIII 6ff.; id., *De causis plantarum*, II 4,1-12.

[63] Cf. fol. 56r, ult.ss with Nicolaus ed./transl. Drossaart Lulofs (as n. 2), p. 166 (and 126).

trine of the primary qualities:[64] the growth of plants depends upon the harmony of heat and cold, dryness and humidity.

Chapter 19 (fols. 42r6-42v9): *The reason why plants do not move as animals do.* Ibn aṭ-Ṭayyib describes a theory which is different from the explanation given in Nicolaus Damascenus' summary of Aristotle's *De plantis*[65] and which resumes the explanation of the differing weight of trees as described in chapter 15. Big plants have earthy substance, therefore they are heavy and cannot be moved. Moreover, plants must be connected with the soil, because this supplies them with food.

Chapter 20 (fols. 42v10-47r5): *On fruits, the origin of their kernels*[66] *and on their coverings and leaves.* In addition to the teleological explanation according to which leaves protect fruits (s. chapter 5), Ibn aṭ-Ṭayyib stresses the importance of the balance of humid and dry, warm and cold. Deviations cause varied degrees of ripening and varied forms of protecting leaves. Here, too, Ibn aṭ-Ṭayyib does not follow Theophrastus.[67] As in chapter 18, his starting-point is Aristotle's doctrine of the primary qualities heat, cold, dryness and humidity.

Chapter 21 (fols. 47r6-48v5): *On the tastes and coverings of fruits.* Starting-point is again Aristotle's theory of the primary qualities: the taste depends upon the intensity of heat and cold, as well as upon earth and humidity. This explanation is combined with the Aristotelian and Theophrastian doctrine of *pepsis* "cooking": heat causes the bitter taste of the colocynth *(ḥanẓal)* and of the bitter mountain almond *(al-lauz al-murr al-ǧabalī).*[68] A similar explanation of the varied tastes of plants can be found in Nicolaus Damascenus' summary of Aristotle's *De plantis*[69] and in Ibn Sīnā's book on plants.[70] Both authors, however, differ in details from Ibn aṭ-Ṭayyib.

Chapter 22 (fols. 48v6-49r10): *The reason why the leaves of trees do not ripen and why the taste of the tree-bark is varied.* In conformity with the Aristotelian theory of warm and humid and of the Aristotelian Theophrastian *pepsis* "cooking", irregularities in the ripening of leaves are caused by the lack of heat and humidity. The bitter taste of the bark is the result of too much heat inside the tree.

[64] On this see above n. 8.
[65] See ed./transl Drossaart Lulofs, p. 134 (and 22 [fragment]).
[66] *an-nawā.* The ms. wrongly has <' Inqr>.
[67] Cf. Theophrastus, *Historia plantarum*, I 14.
[68] Fol. 47r,-2
[69] Ed./transl. Drossaart Lulofs (as n. 2), p. 212 (§§ 252ff.)
[70] *Kitāb aš-Šifā', aṭ-Ṭabīʿyāt* VIII: *an-Nabāt* (as n. 21), p. 27,10ff.

Chapter 23 (fols. 49r11-50r4): *On the firm and the soft peels.* Again according to Aristotle's doctrine solid and soft peels depend upon the proportion of the primary qualities. For example nuts and almonds have solid peels, which result from the cooperation of earthy substance, heat and humidity.[71]

Chapter 24 (fols. 50r5-13): *The reason why trees and plants continue to exist.* As opposed to Theophrastus, who considered changes to be caused by changed conditions of the soil,[72] Ibn aṭ-Ṭayyib stressed the idea that trees and plants "generate something similar" *(yalidāni'l-miṯl).*[73] This is an application of Aristotle's doctrine of the preservation of the essence of animals.[74] Ibn aṭ-Ṭayyib adds the teleological explanation that flowers protect the fruits with their blossoms against wind, heat, cold and against touching by twigs. This teleological argument has a parallel in the protective function of leaves as described in chapter 5.

The following chapters 25-30 (fols. 50r4-57v5)[75] are a paraphrase and partly a literal rendering of the Arabic translation of Nicolaus Damascenus' summary of Aristotle's *De plantis*, book I:

Chapter 25 (fols. 50r14-50v10): *Fī i'tiqād Anaksāġūras fī š-šahwa wa-l-ḥiss fī n-nabāt.* An abridgement of Nicolaus Damascenus ed./transl. Drossaart Lulofs (as n.2)§§ 3.4.9.10.[76]

Chapter 26 (fols. 50v10-51v13): *Fī ḏ-ḏukūr wa-l-ināṯ fī n-nabāt.* An abridgement of Nicolaus Damascenus ed./transl. Drossaart Lulofs (as n.2)§§ 37.38.40-46.49.50.51.55-59. At the beginning of the chapter Ibn aṭ-Ṭayyib attributes to Aristotle a comparison of the earth with the womb. This comparison cannot be found in Nicolaus. Ibn aṭ-Ṭayyib took it from Aristotle, *De generatione animalium*[77] and already mentioned it in chapter 13.

[71] Cf. also ch.s. 5 and 12.

[72] Cf. Theophrastus, *Historia plantarum*, II 3-4 and above ch. 18.

[73] Fol. 50r6.

[74] Cf. Aristotle, *De generatione animalium* 715a19ff.; 747b30ff. and Klaus Oehler, *Ein Mensch zeugt einen Menschen*, Frankfurt a.m. 1963 (= Wissenschaft und Gegenwart 27) = id., *Antike Philosophie und byzantinisches Mittelalter*, München 1969, pp. 95-145.

[75] An edition with English translation can be found in Drossaart Lulofs (as n. 2), pp. 218-232.

[76] A German translation with commentary can be found in H.J. Drossaart Lulofs, *Das Prooimion von Peri Phytōn*, in: Aristoteles. Werk und Wirkung. Paul Moraux gewidmet. II, hrsg.v. J. Wiesner, Berlin, New York 1987, (pp. 1-16), pp. 5ff.

[77] 716a15f.; 740a26f.

Chapter 27 (fols. 51v14-53r7): *Fī aǧzā' aš-šaǧar wa-n-nabāt.* This chapter is a continuation of chapter 14 and abridges, with some transpositions, Nicolaus Damascenus ed./transl. Drossaart Lulofs §§ 60-85.

Chapter 28 (fols. 53r8-54r13): *Fī qismat an-nabāt.* An abridgement of Nicolaus Damascenus ed./transl. Drossaart Lulofs §§ 88-104 *(kabīrin).*

Chapter 29 (fols. 54r14-55r4): *Fīl-ʿuṣārāt.* A paraphrase of Nicolaus Damascenus ed./transl. Drossaart Lulofs §§ 105-109.

Chapter 30 (fols. 55r5-57v5): *Fī alwān az-zahr wa-ṯ-ṯamar wa ḫawāṣṣihī.* A paraphrase of Nicolaus Damascenus ed./transl. Drossaart Lulofs §§ 110-134 *(an-naum).*

The last section (chapter 31) of Ibn aṭ-Ṭayyib's monograph on plants (fols. 57v6-75v, ult.) has the title *Nukat ʿaǧība fī n-nabāt* "Remarkable peculiarities of plants." It does not present new ideas and is, on the basis of Aristotle's doctrine of primary qualities and pepsis "cooking", an unsystematic recapitulation of features of plants, including many details based on empirical observations. The chapter is not akin to the contents of Nicolaus Damascenus' book on plants and pays much attention to the seed, the growth, the ripening and the origin of the tastes of juices.

Our analysis has shown that Ibn aṭ-Ṭayyib combined at least three different texts in his monograph: 1) in chapters 1-24 a compilation which borrowed extensively from Aristotle's book *De generatione animalium*[78] and in some places from Aristotle's book *On meteorolgy*.[79] We did not find any correspondences with the Arabic translations of these two books nor —in chapters 13 and 14— with Nicolaus Damascenus' summary of Aristotle's *De plantis.* Although the text presupposes details of the botanical scientific discussion since Theophrastus,[80] the starting-point is mainly Aristotle's doctrine, his teleology, his theory of primary qualities and of *pepsis* "cooking." Some features are shared with Ibn Sīnā's book on plants without being dependent upon this book.[81] In addition, the text has some explanations in common with the section on plants in the 9th century Arabic compilation *Sirr al-ḫalīqa* ascribed to Apollonius (Balīnās).[82] From these observations we can conclude that Ibn aṭ-Ṭayyib might have used

[78] See chapters nos. 1, 2, 4, 6, 8, 9, 11, 14, 16, 17 and 24.
[79] See chapters nos. 10, 12 and 15.
[80] Cf. chapters nos. 1, 10, 15 and 18.
[81] Cf. chapters nos. 5, 6, 12, 14, 17 and 21.
[82] Cf. notes 25, 31, 36, 60 and above all chapter 6, n. 3.

in chapters 1-24 a late-Hellenistic compilation from the time after Nicolaus Damascenus, a compilation which contains some explanations so far not available in Greek sources.[83] To this compilation Ibn aṭ-Ṭayyib added two other texts:

2) In chapters 25-30 a paraphrase of book I from Nicolaus Damascenus' summary of Aristotle's *De plantis*, in the translation of Isḥāq Ibn Ḥunain, revised by Ṯābit Ibn Qurra.

3) In chapter 31 an enumeration of features of plants, perhaps a compilation by Ibn aṭ-Ṭayyib himself.

Although Ibn aṭ-Ṭayyib's book on plants is a compilation from at least three different sources and although —unlike Nicolaus Damascenus' summary of Aristotle's *De plantis*[84] —it has apparently not influenced later botanical literature of the Arabs, the importance of this text should not be underestimated. It contributes to our knowledge of botanical discussions in Hellenistic times and its reception in Islamic times. Moreover, the text is an example of the adaptation of ideas from Aristotle's *De generatione animalium* and *Meteorologica*, in combination with ideas from Theophrastus' botanical works, which partly reached Ibn aṭ-Ṭayyib through Nicolaus Damascenus' summary of Aristotle's *De plantis*. Finally, the text gives us an idea of Ibn aṭ-Ṭayyib's method of compilation and of his scientific knowledge, which so far has not yet become the object of a detailed study.

[83] Cf. chapters nos. 2, 3, 5, 7, 22-24.

[84] Cf. Manfred Ullmann, *Die Natur-und Geheimwissenschaften im Islam*, Leiden 1972 (= Handbuch der Orientalistik, 1. Abt., Ergänzungsband VI/2), pp. 71ff., 77ff., 87, 449f.