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THE EARLIEST EPOCH IN THE STUDY OF MAYFLIES (EPHEMEROPTERA); TOWARDS A REAPPRAISAL OF THE WORK OF AUGERIUS CLUTIUS

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Abstract. **An insect called Ephemeron was briefly described by Aristoteles and no further information was added until the sixteenth century. J. C. Scaliger mentioned some facts in 1557, but it lasted until 1634 before a description and figures were given by Augerius Clutius, which made it possible to recognize the Ephemeron. Because of the method used, the booklet by Clutius is regarded to be transitional between the encyclopedical works from the sixteenth century and earlier and the more empirical works from the second half of the seventeenth century onwards.**

Aristoteles, "Ephemeron", 16th and 17th century, Clutius

F. J. Pictet gave in 1843 a survey of older literature on the study of Ephemeroptera. Regarding the authors who dealt with the metamorphosis of these insects, Clutius appeared to be the first who, in 1634, wrote on this subject. But as Clutius' description is short and contains errors, Pictet considered the year 1675 to be the real start. In that year the famous work "Ephemeri Vita" by Jan Swammerdam was published. Pictet judged Clutius to belong still to the epoch of the commentators. Not much is known about Mayflies in the earliest periods of the history of science and even less is known about Clutius, his aims for writing on Ephemeroptera and his importance for the study of this group of insects. Therefore, a brief account on these subjects is given.

THE EARLIEST TRADITION

About 2400 years ago the Greek philosopher Aristoteles wrote a few lines about a peculiar bloodless animal which emer-

ged from a river near the Black Sea. The animal had four wings and four feet and a life-span of only one single day. Therefore it was called "Ephemeron", which means "one day living".

It is likely that Ephemeroptera were observed indeed, but as the description is short and vague, this cannot be proved. Nevertheless, this passage from ancient literature can be traced through history until the seventeenth century, where it gave rise to a more detailed and unequivocal definition of the insects actually known as Ephemeroptera.

Two hundred years after Aristoteles' death in 322 B.C., Athens was conquered by the Romans. Many things, like pieces of art and scrolls of manuscripts were brought to Rome. The zoological writings of Aristoteles were among them and, like many other Greek works, they became well-known in Rome.

Thus one need not to wonder to find the Ephemeron-story again in the writings on natural history by the Roman encyclopedist C. Plinius Secundus, who lived in the first century A.D. He repeated the description of Aristoteles, although he called the animal "Hemerobius", a name with the same meaning as the Greek "Ephemeron".

The words on the Ephemeron by Aristoteles were kept in Rome for a long time, as appears from the writings of another Roman author, Aelianus, who told in about 200 A.D. the same story again. But from the fourth century onwards the Roman Empire declined, the existing knowledge gradually submerged and, as a result, the Ephemeron seemed to be forgotten in Western Europe. That is to say, we do not find it mentioned in the scarce books from the early Middle Ages that have come down to us.

But the works of Aristoteles were not lost, as copies were kept in Constantinople. From there they were brought eastwards to Baghdad and translated into Arab in the seventh century. Together with the expansion of the Islam, copies of these books reached Spain, where Western Europe was confronted with the Arab world. And in Spain, during the twelfth century, the books of Aristoteles were translated again, now from Arab into Latin. From the thirteenth century onwards these newly rediscovered works became incorporated into the encyclopedical writings, like those by Albertus Magnus or Thomas of Cantimpré. In these encyclopedias we meet again the Ephemeron of Aristoteles, this time called "Dies", which means "Day". But here the animal is not mentioned among the insects, but among the fish. A rather strange fish indeed, possessing wings and two feet, but no blood and living for just one day. It will be clear that this fish-mayfly is no ideal subject to give rise to a better understanding of the Mayflies as we know them now.

A revival of the knowledge of the Greek language came at the beginning of the fifteenth century when scientists from Constantinople arrived in Italy, escaping the destruction of Greece by the Turkish armies. And with them, they brought copies of the original works of ancient writers, among which

those of Aristoteles. About the same time bookprinting was invented and soon afterwards the Greek texts and new Latin translations were spread all over Europe.

So we see that the words of Aristoteles on the Ephemeron became known to Western Europe three times: The first time through the Romans, but the knowledge probably disappeared together with the Roman Empire, the second time through the Arabs, but the Ephemeron turned into a fish and the third time by the Greeks themselves.

TRADITION IN THE SIXTEENTH AND SEVENTEENTH CENTURY

From the thirteenth century onwards there was an increasing interest in the writings of ancient authors. Scientists started to write comments, although they carefully took notice not to be in disagreement with the words of the ancient writers, as these were considered to be valuable and sometimes even to contain absolute truth.

Julius Caesar Scaliger (1484-1558) from Northern Italy, was the first one who wrote a kind of comment to the Ephemeron of Aristoteles, in which he added some details as he claimed to have observed these animals. He described them as animals with four oblong wings, an unknown number of feet, a head like a fly with large eyes and a trunk rolled up inwards. They had a rather thick belly and a long tail which split in two or three ends. Most probably Scaliger observed Ephemeroptera indeed, but his description is vague. This vagueness is undoubtedly due to the fact that he did not dare to accuse Aristoteles for an incorrectness. According to Aristoteles there were four feet, but Scaliger must have seen that virtually there were six.

Thus the Ephemeron remained a rather unknown animal. This can also be seen in the magnificent book "De Animalibus Insectis" from 1602 by the Italian scientist Ulysses Aldrovandi (1522-1605). The chapter "De Ephemero" contains only citations of others, all based on Aristoteles, as Aldrovandi said not to know the Ephemeron by personal observation.

In spite of this statement, however, he still gave a figure of its larva. But he placed it far apart from the chapter "De Ephemero", as he regarded the animal figured to be kind of caddis larva. It is the oldest published figure of a Mayfly larva as far as we know.

A figure of a Mayfly adult has already been published earlier, in 1592, among many other insects in a series of engravings by the Belgian painter Jacob Hoefnagel (1575- ca. 1630). But there was no accompanying text by which the relation between the classical Ephemeron and the animals figured could be made. The same kind of separation between the traditional Ephemeron and a real insect, already observed in the work of Aldrovandi, is present in the famous English book on insects by Thomas Moffett (1553-1604). Moffett described an animal, which he left

unnamed, in such a way that we are able to recognize it without doubt as an adult Ephemera. But in another chapter the author dealt with the classical Ephemeron, making no connection between this Ephemeron and the animal he described in an earlier chapter.

And even later, in 1653, a voluminous work on insects , written by John Johnston (1603-1675), was almost entirely composed of citations and mixtures of them. It contains, a.o., the statement that the Ephemeron of Aristoteles should come forth from rotten grapes.

From a number of published sources, e.g. Cicero, Erasmus, we know that the Ephemeron was considered to be a kind of symbol of the shortness of human life, rather than a real insect. So we see that several times Ephemeroptera were figured and described, but no connection was made between these animals and the traditional Ephemeron. Scaliger is an exception, but he still prefers a more traditional opinion in favour of own observations in case of a contradiction.

AUGERIUS CLUTIUS; A MORE EMPIRICAL APPROACH

In 1634 a booklet appeared, in which the Dutch physician Outgert Cluyt, or, in Latin, Augerius Clutius, explicitly intended to describe an insect which he considered to be identical with Aristoteles' Ephemeron. From both his descriptions and figures it is easily deducible that this insect belongs to the Ephemeroptera.

Clutius was born in 1575 in The Netherlands as the oldest son of a pharmacist. He grew up among herbs and met famous botanists who came to visit his father. In 1594 Clutius matriculated in the Leyden university to study philosophy and medicine. During several journeys abroad he visited a number of botanical gardens as well as botanists, and when he finished his study in Leyden he went to Montpellier in France for several years. There he assisted in laying out the botanical garden of the university and went to other places in France, Spain and even Northern Africa. Here he was captured by pirates, but escaped. Later he returned to The Netherlands and set up as a physician in Amsterdam. There he stayed until his death in 1636.

Until the end of his life Clutius showed a serious interest in medical botany, but there are no grounds to suppose that he was much interested in entomology. The reason why he dealt with the Ephemeron was merely a supposed medical importance. This was caused, as far as we know, by a note from an acquaintance, called Johannes Dortman, who was a pharmacist and politician from one of the northern provinces of The Netherlands.

In 1619 Dortman travelled to Zutphen, a town at the banks of the river Ijsser, a side branch of the river Rhine. There he observed certain insects swarming above the river. He made some notes about their appearance and behaviour and probably some sketches as well. Dortman did not publish his observations and perhaps nobody would have known, if he had not bequeathed

all his scientific papers to Clutius, just before he died. The notes on the animals from Zutphen were among them. As we know from the booklet by Clutius, Dortman made some connection between these animals and the traditional Ephemeron.

Most probably these notes contained some indications for the medical use of the animals as well. For soon after receiving the notes, Clutius started to ask colleagues after their experiences with this kind of medicine. But after some time he discovered that there had been a misunderstanding. Most probably Dortman had confused the worms (= larvae) from which the Ephemeron emerged, with Oil-beetles, in vernacular called Mayworms. These Oil-beetles were sometimes used as a medicine indeed, as Clutius received several recipes from colleagues in which these animals were used. But never the Ephemeron or its worm were used in this way. Clutius also discovered that Oil-beetles were rather dangerous to be used as a medicine, causing more damage than health. This can easily be understood, for they contain, as we know now, cantharidin, which is a most harmful poison.

Clutius decided to publish these findings as a warning not to use the Oil-beetles and not to confuse them with the worms of the Ephemeron. For this reason he wrote his booklet "De Hemerobio...", which contains eight chapters. The first chapter is an introduction in which the problem is explained, followed by four chapters dealing with a number unpleasant diseases and the harmful results if one tries to cure them with the Oil-beetles. The last three chapters deal with the Ephemeron, clearly separated from the foregoing chapters, thus indicating that Mayworms (Oil-beetles) had nothing to do with the Ephemeron.

It is not clear why Clutius payed so much attention to the Ephemeron, as it apparently had no medical value at all. Perhaps the answer is simple; he probably spent a lot of time getting information on the Ephemeron and considered it to be a pity to throw it away.

The first of three chapters dealing with Ephemeroptera contains a survey of what had been written up till then, thus following the tradition of Aldrovandi and other "aristotelian" writers. Clutius never saw the Ephemeroptera alive, but in the next chapter he gave information, a.o., about the places where the larvae occured and the manner in which they were used as a bait by fishermen. This information he obtained from an acquaintance who lived in Schoonhoven, a town near the lower course of the river Rhine. This acquaintance, called Petrus de Cracht, also sent larvae and adults to Clutius for further investigations. In the last chapter of the booklet these animals are briefly described and figured. Clutius even made a drawing of the Ephemerons pupa, probably a damaged subimaginal skin.

The figures by Clutius are not very good and his description is not very detailed, but they leave no doubt that he had observed Palingenia longicauda.

EPILOGUE

Fourty years after the booklet by Clutius was published, another physician from Amsterdam published on Mayflies. It is the already mentioned Jan Swammerdam with his well known "Ephemeri Vita". In this magnificent work Swammerdam clearly demonstrated a new way of thinking: to accept only what you have seen with your own eyes, Swammerdam mentioned Aristoteles and other earlier writers only as a curiosity. When comparing Swammerdam with Scaliger or Aldrovandi, it is hardly possible to detect similarities. Each reflects the way of scientific thinking of his own time: a belief in own observations versus a belief in ancient authorities.

The work by Clutius stands in between. Clutius could not free himself completely from the tradition of ancient authorities, but on the other hand he gave much new information and he was afraid to contradict older opinions. The information given by Swammerdam is much more detailed than the information by Clutius, but the latter nor had the aim to be as complete as possible, like Swammerdam tried, nor had he the technical equipment, like microscopes, Swammerdam possessed.

Rather soon after the appearance of the "Ephemeri Vita" the work by Clutius was merely forgotten. From a biological point of view this seems logical, but from a historical point of view this cannot be justified. When we compare Clutius' findings with those by Moffett, which were published in the same year, or with those by Johnston, almost twenty years later, it will be clear that the method by Clutius has a real empirical base and is by far more modern than the methods of the other authors. The statement of Pictet that Clutius still belonged to the epoch of commentators is surely not true.

The main aim of Clutius was to obtain uniformity in name and object, for as a physician he knew that this was of the utmost importance. As to Ephemeroptera, we may say he succeeded, for after the publication of his booklet in 1634, there has never been any doubt again which animal was meant when the name Ephemeron was mentioned.

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