I
HISTORICAL

(*a*) THE NAME 'MOSQUITO'

Mosquito is now the name in common use in English for biting flies of the family Culicidae, suborder Nematocera, order Diptera. Formerly the name for the mosquito in this country was 'gnat' (O.E. *gnaet*). The change took place about 1900, when as a result of Ross's discovery of the mosquito cycle in malaria the importance of these insects to man became realised for the first time and knowledge concerning mosquitoes more generally diffused. Thus Kirby and Spence (1870) in their People's Edition are not at all sure that the foreign 'mosquito' is the same genus as our English *Culex pipiens*. Hurst (1890) uses for his paper the title *The Life Development and History of a Gnat* (*Culex*) and Giles (1900) entitles his book *Handbook of Gnats or Mosquitoes*. But Theobald (1901) and practically all English writers since use simply the name mosquito. It is well to remember therefore when looking up old literature that the reference in the index may be to gnats or Culex. If the name mosquito is used, it probably meant something believed to be fiercer than our English gnats, namely the mosquito of travellers' tales.

The French name is now 'moustique', according to the *Oxford English Dictionary* the metathetic equivalent of the Spanish 'mosquito'. But prior to about 1900, unless described as Culex or Culicidae, mosquitoes were almost invariably referred to by French writers as 'Les cousins' or sometimes 'Les moucherons'. Another French name still given in some dictionaries is 'maringouins'. In German the name 'Stechmücken' is now in general use, the equivalent meaning to our mosquito. But formerly 'Mücke' or 'Schnacke' or sometimes 'Gelse' were not infrequently used. The Italian name 'zanzare' is still used in the literature, though Italian dictionaries mostly give 'muskito'. Other names seen in the older literature and still to be found in dictionaries are: myg (Dano-Norwegian); mygga (Swedish); cinife, cenzalo, zancuda (Spanish); comaro, konops (Russian); konopus (Greek). The word 'empis' in Aristotle has usually been taken by translators as referring to the mosquito (translated as Mücke or gnat according to the language of the translation).

It is interesting to trace the origin and history of this word mosquito and why it of all others should have come to be used. Clearly the word mosquito is of Spanish or Portuguese origin and it is probably correct to say that it must have come originally from Spanish or Portuguese America. It is perhaps more probable that its modern use has come from North America. We first find the name, often with variations in spelling, used in accounts of travellers. Such use dates back to the sixteenth century, for Phillips (1583) in Hakluyt's *Voyages* (1589), p. 568, is quoted in the *Oxford English Dictionary* as saying 'We were almost oftentimes annoyed with a kind of flie, the Spaniards call musketas', and a number of other such early instances of the use of the word by travellers is given under the word mosquito in this dictionary. It is necessary, however, to be cautious in always ascribing such references to mosquitoes as we now use the word. This is made very clear in Humboldt's travels in Equinoxial America (Orinoco). Humboldt (1819) has much to say about

mosquitoes, but he is referring to Simulidae, as he definitely says, and the word used by the natives for mosquitoes he states was 'zancudos' and for a smaller kind 'tempraneros'. The word mosquito he gives as meaning 'little fly' and 'zancudos' as 'long-legged'. The same confusion seems to extend to the use of the French 'moustique', for Humboldt says the French call *Simulium* moustiques and the zancudos 'maringouins'. A curious example of this inversion of names will be found in a letter by Combes (1896). Seemingly this letter might be taken as describing mosquitoes attacking another species of fly as this emerged on the water surface from the pupa. But Combes takes care to say that the 'moustique' is not 'le cousin' of France and the larva is not aquatic, and that the name for 'le cousin' is 'maringouin'. So that it was not the mosquito which did the attacking but the *Simulium*. Indeed, one would scarcely expect the word mosquito to have any exact significance as a native word, for anyone familiar with the usual native's reaction to requests for names of insects could well understand that this might be 'a little fly'.

The word mosquito was evidently used from very early times in North America and often in a context that does not obviously suggest direct origin from South America. Thus the *Oxford English Dictionary* quotes Whitbourne (1623) writing of Newfoundland as saying 'There is a little nimble fly which is called musketo', and Wood (1634) referring to a pest in New England as 'a musketo which is not unlike our gnats in England'. Only in America in fact does general use of the word mosquito date back as far as the literature makes mention of these insects. Looking at a bibliography of the older literature on mosquitoes it is possible to tell at a glance, with occasional exceptions, whether the writer was English or American by the respective use of gnat or mosquito in the title. Woodward (1876) goes so far as to write 'On the body scales of the English gnat and American mosquito...'. Manson, as did Ross, always spoke of the 'mosquito'. Manson, however, had worked for many years in China. It is not impossible that the use of the word by these two authors and later by those carrying out investigations on yellow fever in tropical America played a decisive role in bringing about general adoption of the name mosquito in modern writings.

We are on firmer ground in noting that the name *Culex mosquito* was given by Robineau-Desvoidy in 1827 to a mosquito from Cuba which he says 'indigenes vocant mosquito, sicut mihi retulit dominus Poey'. This species is now the *Aëdes aegypti* of present nomenclature and *Culex mosquito* Desv. was the name by which it was known to Finlay and under which he considered on various grounds that it was the cause of yellow fever. Thus there is some excuse for regarding *Aëdes aegypti*, the mosquito to which this volume is dedicated, as to some extent responsible for the name mosquito being that which has come into general use.*

What is the correct plural of mosquito? The plural of the Spanish word would be 'mosquitos' and this form has been used by some English writers as being more correct than 'mosquitoes'. As a thoroughly anglicised word, however, it would seem that the latter form must be considered as sanctioned by general acceptance and usage along with 'potatoes' (Spanish patata) and 'tomatoes' (Spanish tamata), these being along with 'mosquitoes' the plurals as given in English dictionaries.

* Curiously enough the name 'Culex mosquito' occurs on p. 382 of Aldrovando (1602). See next section regarding this author.

(*b*) EARLY WRITINGS ON THE MOSQUITO

Among the earliest references in the literature to the mosquito are certain passages in Aristotle (384–322 B.C.) relating to *empis*, a name which as previously noted is generally accepted as signifying the mosquito. Thus in Aristotle's *Historia Animalium** it is stated that many animals live at first in water and afterwards change their form as is the case with *empis* (Book I, cap. I as given in parallel column with the Greek text in Aubert and Wimmer, p. 197, lines 8–12). In another passage (Peck, p. 47), this time in *De Generatione Animalibus*, *empis* is given as being among certain creatures which, coming from putrifying liquids, are neither produced out of other animals nor do they copulate, i.e. they were thought to arise by spontaneous generation of life, a belief in regard to the mosquito larva which still held some two thousand years later.†

About 350 years after Aristotle are the writings of the Roman author C. Plinius Secundus (A.D. 23–79). In the thirty-seven books of his great natural history are some dozen or so references to 'culices'. One passage describes the gnat as an example of the wonderfulness of nature in providing on such a small scale the organs required for the five senses and other life requirements, and among other things comments on the fineness and perfection of the small and sharp sucking tube used to suck in and convey the blood. Other references are to swallows feeding on gnats: 'that gnats love sour things, but to sweet things they do not come near . . . ; that gnats keep a foul stir in gardens with some small trees where water runneth through—but can be chased away by burning a little galbanum'. This reference to water is the nearest to any mention by the author that the insects have an aquatic stage.‡

From A.D. 200 to A.D. 1200 has been described as the dark ages for biology, and following on Plinius Secundus it is not until the seventeenth century that naturalists again begin to write about the mosquito. Though from now till Ross's discovery the mosquito was never considered of any importance it still had features which gave it a special interest to the early naturalists. These centred especially about the origin of the fly from the worm-like aquatic stage, its complicated organ of puncture, the proboscis, and a character for which the insect has always been notorious, its hum. It will be seen from what follows that each of these in its turn has been the subject of observation and comment.

The earliest work dealing with the mosquito in what may perhaps be called medieval literature is Aldrovando (1602), a massive work entitled *De Animalibus Insectis* a copy of which is in the University Library, Cambridge. Though the earliest work of any seen in this period, it more than any other of these early works approaches in arrangement a modern text-book of entomology. It deals with insects generally, but is divided into chapters one of which is headed 'De Culicibus'. This again is subdivided into sections such as 'Synonymia', 'Locus', 'Genus', 'Differentia descriptio' and others. It is illustrated with text-figures consisting of coarsely executed but very life-like 'sketches' of insects, in one of

* Those interested in Aristotle should consult Nordenskiold (1929) who gives a very good account of the works of this author. There are ten books of the *Historia Animalium* (three considered spurious); four of *De Partibus Animalium*; five of the *De Generatione Animalibus*; and three on the *Psyche*. Other accounts of Aristotle and other early naturalists are given by Miall (1912) and by Singer (1931). An English translation of the *De Generatione Animalibus* is given by Peck (1943). The standard German translation of the *Historia Animalium* is that of Aubert and Wimmer (1868). For details see references.

† See references later to Bonanni, Joblot, Hooke and others.

‡ An English translation is *The History of the World commonly called the Natural History of C. Plinius Secundus*, Adam Islip, London, 1601. A copy is in the Balfour Library, Cambridge.

which along with easily recognised figures of Panorpids, Ephemerids, etc. is the figure of a mosquito in flight given as *Culex communis*. There seem to be no figures depicting the larva such as are so characteristic of later publications.

Another early work is Moufet, *Insectorum sive minimorum animalium theatrum* (1634), with a chapter of seven pages also headed 'De Culicibus'. He collects references to mosquitoes made by various classical authors including Herodotus and Pausanias. Another author mentioned by Howard, Dyar and Knab (1912)* giving classical references is Cowan (1865), who quotes from Ammianus Marcellinus a statement describing how swarms of mosquitoes in Mesopotamia by attacking the eyes of lions cause these to seek refuge in the rivers and to drown or become mad.

So far such works as have been mentioned are mainly collections of statements about mosquitoes from classical and other authors. Of a different character are the text and plates of Hooke published in 1665. This author, writing at a time when the use of lenses was first revealing new and exciting fields of observation, sets out to describe and figure a great variety of objects as these were seen with the aid of magnifying glasses. Among such he describes and figures the *Culex* larva, seemingly the first author to do so. He describes this as having jaws rather like a crustacean, which can be seen extracting invisible nourishment from the water. The plate of the larva shows this about a foot long, somewhat crude but unmistakeable. The pupa is also depicted and the author observed the sequence of larva, pupa and imago. The adult figured, however, is *Chironomus* which is given as the brush-horned gnat. The copper plates were republished with fresh text anonymously in 1745 under the title *Micrographia restaurata*.†

Other early writers are Wagner (1684); P. Bonanni (1691); San Gallo (1712) and Reviglas (1737). The papers by Wagner, San Gallo and Reviglas are all in the same German journal which in the course of time has several times changed its name, though usually retaining the word *curiosa*. All the papers are short, a few pages only. Wagner, besides giving references to earlier classical authors, describes the stages of metamorphosis, though the eggs described are those of *Chironomus*. San Gallo describes the larva and figures the male and female adult. Reviglas deals with the structure of the proboscis as does Barth (1737). P. Bonanni figures the larva and pupa of *Culex* and discusses the question of spontaneous generation, a belief which died hard. Hooke also refers to spontaneous generation, but thinks it more likely that the mosquito drops its eggs upon the water. Another author named Bonanni (F. Bonanni, 1773) has also written on the mosquito and has described mosquito scales, but almost unrecognisable as such and very different to the clear drawing given by Hogg, referred to later as the first to describe these structures. Another early account is that by Godeheu de Riville (1760), who was the first to describe copulation in the mosquito, an observation that has a special interest in that from the author's description the species was almost certainly *Aëdes aegypti*.

A more modern approach is seen in the work of the great naturalist Swammerdam. Even as early as 1669, in his *Historia insectorum generalis*, he figures the larva, pupa and adult. In his famous work *Biblia naturae* (1737) he deals systematically with the larva and nymph of various insects, showing that the parts of the imago are already present beneath

* These authors give a very full account of the early history of mosquitoes in their first volume which is all the more valuable as they quote *in extenso* translations from many of the authors cited.

† A copy of Hooke's original work is in the library of the Royal Society and one of the *Micrographia restaurata* with the copper plates in the Balfour Library, Cambridge.

the skin and can be shown by dissection.* His description of the mosquito and its life history is remarkably like what might have been written as a short account at the present time. A footnote to the description of the larva is of special interest in relation to later work on insect physiology and is almost prophetic. In the English translation of the work this footnote reads as follows:

> There is not in all the insect world a creature more happily suited to show the several operations of life than this. A moderate microscope discovers to us very clearly what passes within the transparent body.—At this time [i.e., as he explains, when the larva is especially transparent at ecdysis] the beats of the heart and the motion of the stomach and intestines are perfectly seen and the two principal pulmonary tubes may be traced along their whole length.

The most complete account among the early writers is, however, that by Reaumur (1738). Reaumur's *Mémoire XIII. Histoire des cousins* appeared to leave little to be further observed, and for many years remained unchallenged by any other work of a like nature dealing with the mosquito.

(*c*) THE MOSQUITO AS A NATURAL HISTORY OBJECT

During the period comprised in the latter half of the eighteenth and first half of the nineteenth century, roughly 1750–1850, the mosquito was mostly written about as a natural history object, being dealt with sometimes in a few lines, sometimes more extensively, in the many natural histories that characterised this period in zoology. Its systematic position, its life history and stories as to its attacks upon travellers were given with monotonous sameness when its place in the Diptera called for its mention. Among accounts more especially deserving of notice is the section 'Des Cousins' in the work of De Geer (1776) figuring the larva of a species of *Aëdes*. Goldsmith (1779) gives a very original account (seven pages) including reference to mosquitoes retiring into caves and with the curious statement that they are capable of parthenogenetic development. In a supplement to Rosel's *Insecten Belustigungen* are additions to Reaumur's work with plates by Kleeman (1792). In the first two editions of Cuvier's great natural history, *Le règne animal* (1817, 1829) are some few pages by Latreille. In the third edition of 1849 (the so-called Apostle's Edition) is a section containing some observations on the structure of the proboscis by E. Blanchard. A quite interesting account of the 'gnat' is given in an addendum by Griffith and Pidgeon in the English edition of the same work, 1832.

Many other short accounts of gnats, culices, cousins or other names occur during this period in the literature,† many of them little more than a page or two in encyclopaedias or natural histories. The larva is now frequently referred to, often as a grub or worm-like creature, for example, 'Der Schnackenwurm' (Ledermuller, 1761), 'Wurm von der Singschnacke' (Slabber, 1781), 'Ver du cousin' (Joblot, 1754). Joblot figures the *Culex* larva in several stages of growth, saying that he only recognised that they were the aquatic stage of 'le cousin' when he had hatched out 'moucherons'. Joblot in the same paper was

* Swammerdam uses the term nymph for the pre-imaginal stage of insects as do many other early authors. The term pupa now used for this stage in holometabolous insects was given by Linnaeus to the chrysalis of Lepidoptera from its resemblance to a baby that is swathed or bound up as is customary with many peoples (pupa = Latin for a girl or doll). (Comstock, 1920, p. 186.)

† See: Geoffrey (1764), Olivier (1791), Jordens (1801), Latreille (1805–25), Guérin (1835), Packard (1869), Pagenstecher (1874).

the first to describe the larva of *Anopheles* with a large and excellent figure such as might have been a recent representation of this now much studied form. According to Burmeister (1832) the larva of *Anopheles* was first described by Goeze (1775) and later by Lichtenstein (1800), but was only identified as the larva of *Anopheles* by Fischer (1812). There can be no doubt, however, but that Joblot, as given above, figured the *Anopheles* larva as early as 1754. Apart from his figure, he states that the head of the new creature was 'très mobile, tournant à droite & à gauche comme sur un pivot'. It was over 100 years later that Jourdain (1893) described as the larva of a culicine of which he had not determined the genus or species a creature with such a singular movement of rotation of the head. Furthermore, according to Howard (1900), what Fischer described as the larva and pupa of *Culex claviger* Fabr. were those of a species of *Corethra*. Dobell in his life of Leeuwenhoek states that Leeuwenhoek in a letter dated 1700, besides giving a description of the gnat larva, distinguished the attitude of the larva of *Anopheles* from that of *Culex*, but no details are given by the biographer. Brauer (1883) is stated by Nuttall and Shipley (1901), p. 48, to have mistaken the larva of *Anopheles* for that of *Dixa*. Brauer gives an excellent line drawing of an *Anopheles* larva showing the palmate hairs. He gives it, however, as the larva of *Dixa* sp. (*Culex nemorosus* Heeg). The genus *Anopheles* was erected by Meigen, 1818, and the larvae of the two forms clearly described by Mienert, 1886.

Characteristic of the period 1850–1900 are accounts of mosquitoes as encountered in northern latitudes and in the tropics by travellers. Many of the references to polar regions really say very little except that mosquitoes were found extremely tormenting. Regarding the tropics one of the most important travellers' descriptions are passages in Humboldt when describing experiences in the Orinoco. The passages are given *in extenso* by Howard, Dyar and Knab (1912). Another feature of the literature are references to 'swarms' of mosquitoes. Those interested will find many accounts of such in the various editions of Kirby and Spence, especially the People's Edition (1870).

Whilst the above gives an outline of the general trend in the literature on mosquitoes prior to what may be called the modern period, such an account would be incomplete if it failed to take note of letters and brief communications to journals more especially from 1850 to 1900, such as *Nature*, *Science Gossip*, *Entomologist's Monthly Magazine*, and especially *Insect Life*. At first sight these brief and often ephemeral communications may seem of little value. Historically, however, they cannot be neglected, for though a considerable proportion relate to seemingly rather trivial matters, some give the first indication of observations or ideas which have later become important. Among such may be mentioned references by Howard to the first use of oil against larvae, the first use of larvivorous fish, the first reference to natural enemies of mosquitoes and early observations on remedies and preventives against mosquito bites.

These communications further show very strikingly how complete has been the change in character of the literature on mosquitoes from the year 1900 or so onwards. This is very notably so in relation to the subject of our present study, the now notorious vector of yellow fever. For, apart from various names given by systematists, often without any significance attaching to the mosquito they were naming, almost the only author attaching special importance to this species was Finlay, who as early as 1881 had associated it and another mosquito with the transmission of yellow fever and had made observations on its habits. The larva does not seem ever to have been described or figured until it was depicted by James in 1899 as the larva of the 'tiger' mosquito. From 1900 onwards, however, whilst

Anopheles became widely known as 'the malarial mosquito' and has become the subject of an enormous literature, *Stegomyia fasciata* from about the same time became 'the yellow fever mosquito' and under this name and that of *Aëdes aegypti* has since acquired a literature almost as great.

(*d*) EARLY OBSERVATIONS ON STRUCTURE

Reference has already been made to the fact that one of the features relating to the mosquito that had a special interest for the early naturalists was the structure of the proboscis, and in the early literature are many references to the number and nature of its components. Most of these observations are now purely of historical interest, being made under conditions very different to those of the present day with the modern miscroscope.* Swammerdam (1737–8) describes without naming five stylets plus the sheath. All the stylets are shown ending similarly with fusiform swollen ends devoid of any further detail. Authors up to a century or more later gave little more detail than this and in the naming of the parts were not always correct. Thus Blanchard (1849) in his figure of the mouth-parts of *Culex pipiens* shows labrum (upper lip), labium (lower lip), maxillae (labelled as mandibles) and a central bifid structure labelled mâchoires (maxillae). Gerstfeldt (1853) describes a sheath formed of the lower lip only, containing six setae, but like many other writers also gives the maxillae as mandibles. Many other authors have referred to or given some description of the mouth-parts, including Becher (1882) who summarises work to that date in this respect. For all practical purposes, however, the first describer of the mouth-parts in any adequate modern sense was Dimmock (1881) in his classical treatise on the mouth-parts of some Diptera, and later in his paper in *Psyche* on the mouth-parts and suctorial apparatus of *Culex*. After surveying work already done in some detail this author goes on to describe fully and accurately all the parts and gives a plate showing sections through the proboscis at different levels. He describes also the mouth-parts in the male (1884). The parts were briefly described in the same year by Meinert and more fully later by Macloskie (1887, 1888). There are also contributions by Muir (1883); Murphy (1883); Smith (1890, 1896); and Kellog (1899); the last mentioned two authors tracing the parts through their development from the larva. The complete working out of the problems connected with the minute structure and functioning of the parts was not, however, achieved until much later as described in a subsequent chapter.

Beyond drawings of the egg-raft of *Culex pipiens* by Reaumur and others little is to be found in the literature as to any details of egg structure until Howard (1900) and Theobald (1901) figure the eggs of one or two species of Culicines, and Grassi, Nuttall and Shipley and others give descriptions of the eggs of *Anopheles*. That the eggs of *Stegomyia fasciata* were laid singly on the water was noted by Finlay in 1886, by Daniels and by Ross (both in Theobald, 1901), the figure of the egg by Daniels being one of the first, if not the first, to be published. It shows the chorionic bodies on the outline of the egg, but incorrectly as air chambers as many at first thought them to be.

In spite of many representations of the larva in the early literature accurate and detailed figures are not given until relatively late. The siphon appears to have been first described in detail by Haller (1878). In 1886 came the classic by Meinert on the eucephalous larvae of Diptera giving descriptions of mosquito larval structure. A paper in quite modern style

* See: Barth (1737), Sulzer (1761), Roffredi (1766–9), Savigny (1816), Durkee (1855).

is that by Raschke (1887) in which he describes the mouth-parts and other structural features of the larva of *Culex* (now *Aëdes*) *nemoralis*. The plate accompanying the paper is noticeable for the delineation given of the sclerites at the base of the flabella or feeding brushes. At the end of his paper he gives a list of some sixteen references to earlier writers on larval structure. Other authors giving early descriptions of larval characters or structure are: Lacordaire (1838), one of the very early writers on structure of the mosquito and one who has even described the micropilar apparatus on the egg of *Culex*; Pouchet (1847); Kraepelin (1882); Brauer (1883); Wielowiejski (1886); Miall (1895); Howard (1900). Pouchet describes the eight vesicular stomachs (caeca) of the larva. Wielowiejski describes the pericardial cells, oenocytes and fat body. Howard's figures of the larval parts were widely copied and like his figures of the adult will be found repeated in many authors' works. Nuttall and Shipley's study of the *Anopheles* larva, as also Grassi's work, more correctly fall in the modern period and will be referred to later.

An outstanding contribution which will be extensively referred to later is that of Hurst (1890) on the structure of the larva and pupa of *Culex* and the anatomical changes connected with pupal ecdysis and emergence.

Of works relating to the structure of the adult may be mentioned Dufour (1851) on the structure of the digestive tract and generative organs of *Culex* (now *Theobaldia*) *annulata*; Schindler (1878) who first described the mid-gut and Malpighian tubules; Lecaillon (1899) on the filamentous processes in the latter structures and, 1900, on structure of the ovary; and later others whose work will be noted when dealing with the adult structure. Of papers of outstanding character are those by Johnston (1855) and Child (1894) describing the organ at the base of the antenna now known as Johnston's organ, and that by A. M. Mayer (1874) showing that the hairs of the male antenna responded to particular notes and that the antennae acted as sensory organs enabling the male to locate the female. An author, P. Mayer (1879), has also written on certain antennal sense organs in Diptera in Italian, but I have so far been unable to see this work. Mention should also be made of Kowalevsky (1889) who described the pericardial cells, and Hogg (1854, 1871) who described the scales of mosquitoes, followed by Anthony (1871), Newman (1872) and Woodward (1876). In 1899 Ficalbi had given an account of the external structure describing many of the characters used later by systematists, such as those of the palpi, tarsal claws, wing venation and even some indication of genitalic characters. With the discovery of the part played by the mosquito as intermediary host in the life history of the malaria parasite the internal structure of the mosquito assumed an enhanced importance and, at the close of the period we have taken as covering early research, was dealt with for the first time systematically in accounts by Grandpré and Charmoy (1900); Grassi (1900); Christophers (1901); and very fully by Nuttall and Shipley (1901).

(*e*) EARLY SYSTEMATIC WORK ON MOSQUITOES

The main objectives of systematists may be given as: (1) the correct naming of species in accordance with the rules of zoological nomenclature; (2) their identification; and (3) their natural classification. The naming of mosquitoes on the binomial system, as does that for all forms of animal life, dates from 1758, the year of publication of the 10th edition of Linnaeus's *Systema Naturae*. It may be worth while mentioning in this respect that a photo-

stat facsimile of the relevant first volume of this work has been published by the British Museum (Brit. Mus. Publ., 1939), a form in which this famous work may be studied for all practical purposes in the original. Some mosquitoes it is true had been given names before this crucial date, and some of these look very like names on the binomial system, though these must be considered as descriptive names only and invalid. This point has some interest in connection with the synonymy of our species, because in the first edition of Hasselquist *Aëdes aegypti* had already been described as 'Culex (aegypti) articulationibus candidis etc.'. But it is only in the second edition (*Reise nach Palestina*, 1762) edited in respect to nomenclature by Linnaeus that the name given as *Culex aegypti* is valid in form and date.* In 1805 Fabricius in his revision of the Diptera, classified on the basis of their mouth-parts, gives a list of described species of mosquitoes. They number fifteen, including one or two that were possibly not mosquitoes. In 1818 Meigen described thirteen more species and erected two further genera in addition to the original genus *Culex* of Linnaeus, namely *Anopheles* and *Aëdes*, the latter for the European species *Aëdes cinereus* which remained almost the only species in the genus for many years until, following Dyar and Knab (1906), Dyar (1922) and Edwards (1932), the genus *Aëdes* was expanded to cover as subgenera a large number of previously erected genera, so that it now includes probably a quarter or more of the known species of mosquito. By 1889 about fifty-six species of mosquito had been described from Europe, North Africa and Egypt.

In the same period a number of species had been added to the list by Wiedemann (1821) from the East; Robineau-Desvoidy (1827) from South and Central America; Walker (1848–65) from material received at the British Museum from various countries; Skuse (1889) from Australia; Arribalzaga (1891) from South America; which with a certain number described by Loew, Van der Wulp, Macquart, Doleschall, Coquillett and others brought the total number of valid species as given by Theobald prior to publication of his first two volumes (1901) to about 164, that is, something like a tenth of the number now known. To these may be added about eighty-two names placed by Theobald as synonyms, thus giving a total of about 250 namings prior to 1901, though this number might have to be added to somewhat on a close study of the literature.

This summary, however, gives no hint of the confusion and lack of co-ordination regarding the tropical species. The reasons for this are not far to seek. Almost the only systematic work devoted wholly to mosquitoes prior to Theobald was a small volume of reprinted papers by Ficalbi (1899) giving a revision of the European forms. The descriptions given by dipterologists were commonly quite inadequate. Those given by Walker for the considerable number of species he described averaged four to seven lines. Synoptic tables such as are now in such extensive use scarcely existed, and had such existed they would have been useless, for they could have included but a small fraction of the species actually existing. It is not surprising therefore that *Aëdes aegypti* as a world species escaped recognition. It had been described often enough, but the trouble was that it had so many aliases, almost one for every country and systematist, that as a species it is no exaggeration to say that up to 1900 it was still virtually unknown.

On the discovery of the mosquito cycle of malaria by Ross and the work of Grassi and other Italian workers, followed within a year or so by the proof by Reed and his co-workers that *Aëdes aegypti* was the agent in transmission of yellow fever, interest in mosquitoes became general. Collections began to pour in from different tropical countries. Medical

* See, however, remarks later under synonymy of this species.

men and others interested in the new developments not only collected but intensively studied the many species in their natural surroundings. For the first time careful detailed descriptions were given and structural characters studied and made use of in identification and classification.

The first to attempt to correlate the mass of published descriptions in a treatise on world species was Giles, who in 1900 published his *Handbook of the Gnats or Mosquitoes* and himself added some seventeen new species mostly from India. There can be no doubt, however, that it was Theobald who, in his gigantic task of grappling with the Culicidae of the world, in the five volumes of his monograph published over the years 1901–10 opened up the study of mosquitoes to workers all over the world. We have already noted that in his first two volumes this author records 164 previously described valid species with eighty-two synonyms. To these were added in his first two volumes 132 new species under his own name, which with twenty-eight described by Giles and some other contemporary authors brought the total of species described in the two years 1900 and 1901 to about as many as had been described in the previous century and a half. The total of known species at this time was about 320 or with synonyms 400 namings.

Though we are here not so much concerned with systematics as such it is perhaps of interest to note that the final number of species as given by Smart (1940) for Theobald's revision (1910) was 1050, and that in Edwards's *Genera Insectorum* (1932) 1400. Probably the number at the present time is about 2000. This great increase in the number of known species is especially noticeable in the case of certain countries. The number of species described from Africa and its islands prior to 1900 was five. In 1941 the number listed in Edwards's monograph of Ethiopian mosquitoes was 405 (*Anopheles*, 86; *Aëdes*, 132; *Culex*, 99; other genera, 88). The number known from India before 1900 (that is before Giles's 1st edition) seems to have been about three. In Barraud's revision (1934) it was 245 (sixty-eight being new species under that author's name).

Besides this increase in the number of described species much more attention has been given to classification. To some seven genera described prior to 1900, mostly relating to outstandingly distinct forms (*Megarhinus*, *Sabethes* and *Psorophora* by Robineau-Desvoidy; *Janthinsoma*, *Taeniorhynchus* and *Uranotaenia* by Arribalzaga; *Haemagogus* by Williston), Theobald in his first two volumes added some ten further genera (subject, however, to considerable modification later), among which occurs for the first time the now familiar name *Stegomyia*, a name which though later subordinated to the rank of a subgenus is still valid.

It was as the type species of this genus and as *Stegomyia fasciata* Fabr. that *Aëdes aegypti* was first introduced to the world by Theobald in its proper perspective, a name by which it was familiarly known until those changes in nomenclature took place which are discussed in the section on synonymy and which after many vicissitudes finally by general agreement ended in the present designation of *Aëdes aegypti*.

(*f*) RESEARCH ON *AËDES AEGYPTI* AND ITS ROLE IN DISEASE

As already noted there is a large literature relating to *Aëdes aegypti*, its systematics, its distribution, its breeding places, its bionomics, its relation to disease, its control, its use in the laboratory as a test animal and much else. All these subjects will be dealt with in