

Names for the *Anopheles gambiae* Complex

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The *Anopheles gambiae* complex is a group of six sibling species. Some of them are major vectors of human malaria and other diseases. Others are of little importance or vary in importance with local conditions. For epidemiological purposes accurate naming is thus essential.

One species (*Anopheles gambiae* D) is considered entirely new and thus presents no nomenclatorial problem. Another (*An. merus* Dönitz 1902) can be equated with reasonable confidence with the type (Paterson 1963, Coluzzi 1964). The remaining four are only partly identifiable except by chromosome banding which does not permit of comparison with the types where these exist. There is, however, widespread agreement as to their probable identity on a variety of evidence which is set out below. It is to be hoped that the names currently considered most appropriate will in future be generally accepted partly in the interest of nomenclatorial stability and partly because it is proposed to supplement the types in question with plesiotype material thereby rendering identification more reliable.

*Anopheles gambiae* A

This appears to be the nominotypical member of the complex, i.e. the form described under the name *Anopheles gambiae* by Giles (1902). The unique type specimen, now in the British Museum, was sent to Theobald by a Mr. J. S. Budgett of Trinity College, Cambridge who collected it in the rest house on McCarthy Island, Gambia in June to August 1900 while studying the fishes of the Gambia River. The label on the type reads "Gambia, Dr. Burdett". That this represents a *lapsus* on Theobald's part is shown by a letter from Budgett, preserved among his correspondence in the B. M., describing the collecting of the specimen.

The type specimen clearly belongs to one of the fresh water breeding members of the complex since McCarthy Island is 150 miles up river. *An. gambiae* C and D are ruled out on distributional grounds, being unknown from West Africa and only *An. gambiae* A and B call for consideration. Both species occur widely in West Africa but *An. gambiae* B is absent from the more humid parts (Davidson et al. 1967). A recent thorough survey of the type locality by Dr. M. T. Gillies, at the appropriate time of the year and in a variety of habitats, revealed only *An. gambiae* A and the few available partial morphological characters (Gillies & De Meillon 1968), while not fully discriminatory, are consistent with the assignment of the holotype to this species.

No other name has priority. The name *An. costalis* Loew (1866) employed by Theobald (and stoutly defended by him on the ground that "The species has so long been known as *costalis* by all the important medical men in Africa" (Theobald 1903b)) is now known to have been incorrectly assigned. It is probably

attributable to a member of Series *Paramyzomyia*. Theobald's authority was such that despite its rejection by Dönitz (1902) it long continued in use. The name *An. gambiae* was revived by Christophers (1924) but did not finally replace *costalis* until the publication of Edwards' *Genera Insectorum* monograph in 1932.

The only other name which might claim priority is *An. gracilis* Dönitz (1902) which was published in the same year as *An. gambiae*. The exact date of publication is not known but a variety of evidence suggests that it was late in the year. In the first place it appeared in the third volume of the journal concerned to be published during the year. Secondly the very long paper in which it was published contains, early on, a reference to a contribution of Theobald's to the Proceedings of the Royal Society of London dated March 7th of that year. Thirdly the reprint of his paper sent by Dönitz to Theobald was not received until October 1st. In contrast to this the second edition of Giles' book, containing the original description of *An. gambiae*, is known from advertisements in the Journal of Tropical Medicine to have become available to the public between May 15th and June 22nd.

As to the identity of *An. gracilis* the only available indications are those afforded by distribution. Dönitz's original description was based on one female and two male adults. None can any longer be traced and there is no indication that any was marked as type. They were sent to Dönitz by Ziemann from "Togo und Kamerun". Ziemann collected them during a tour of duty lasting from 1899 to 1901. He lists his collecting localities as the Douala area and from there to the upper reaches of the Wouri River, in the former French Cameroons, Victoria in the former British Cameroons and Klein Popo (=Anecho) in Togoland (Ziemann 1902). The only members of the complex so far known to occur in any of these areas are *An. gambiae* A and *An. melas*. The palp index given by Dönitz (0.84) favours *An. melas* but is within the joint range (Gillies & DeMeillon 1968). Nor is it clear that his measurement involved more than one of the specimens. For reasons given below considerable confusion would be caused if the name *An. gracilis* were to be transferred to the species currently known as *An. melas*. Accordingly, since there is no reason to suppose that the material did not consist at least in part of *An. gambiae* A, it is proposed that the name *An. gracilis* Dönitz be relegated to the synonymy of *An. gambiae* Giles.

#### *Anopheles gambiae* B

The only one among the remaining names which appears applicable to this species is *Anopheles arabiensis* Patton (1905). It was applied by Patton to the member of the complex occurring in the Aden hinterland where *An. gambiae* B is the only member of the complex known to occur. Nor is any other member known to occur in the rest of Arabia or the adjoining dry parts of the horn of Africa and the Sudan. Patton did not designate a type and a neotype will be required. A single very fragmentary specimen is all that remains of material sent by him to Theobald and there is no evidence that this formed part of the material on which his description was based (White 1975).

*Anopheles gambiae* C

The name proposed for this species is *Anopheles quadriannulatus* Theobald (1911) which was based on a unique specimen collected by L. H. Gough at Onderstepoort, on the highveld of the Transval, in May 1909. The type is in the British Museum (Natural History) on permanent loan from the Liverpool School of Tropical Medicine. It is a melanic specimen with an additional dark band on the palps such as is more commonly found in the brackish water than in the fresh water members of the complex. It was sent to Theobald along with 125 other specimens which Theobald distinguished from it as *Pyretophorus costalis* (= *An. gambiae*). These appear to have resulted from a sporadic population burst such as is well known to occur on the highveld (De Meillon 1940). *An. gambiae* was not found again at Onderstepoort until five years later (Bedford 1928). The type of *An. quadriannulatus* may have been an exceptionally melanic member of the same population or it may have been an isolated introduction from the lowveld. To test the latter hypothesis I removed and mounted the palps and as much as possible of the antennae. (the holotype is glued to a piece of card). On examination the palp ratio (0.84/0.85) was found to favour *An. merus* while just within the joint range with the fresh water species (Gillies & De Meillon 1968). The total number of coeloconic sensillae (23) is also intermediate but the number of sensillae on the first and second flagellar segments (2 and 3 respectively in both cases) seems decisively to favour the fresh water species (Ismail & Hammoud 1968). The numbers of sensillae on the various antennal segments are inconclusive as between the three fresh water forms (A, B and C) known from the highveld. *An. gambiae* C is, however, the most widespread and would seem for this reason to be the species of choice. White (1975) has argued that should it be found at Onderstepoort, as would be expected from its distribution and biology, "...use of *quadriannulatus* as the priority name for it will be fully justified". I would accept this as strengthening the case but would not accept as a corollary that recovery of *An. gambiae* A or B would necessarily negate it. Bearing in mind the length of time that has elapsed, the environmental changes during that time, the sporadic nature of findings of any member of the complex at Onderstepoort and the atypical markings of the type specimen I would hesitate to accept such evidence as at all conclusive.

*Anopheles melas* Theobald (1903a)

This name has been traditionally associated with the West African brackish water breeding member of the complex for so many years and in so many publications that it would be very undesirable to change it. Unfortunately the morphological characters of the type are intermediate with those of *An. gambiae* A while the data on which Evans (1938) based her association of the type with the brackish water form were incorrectly cited by her. The back of the card to which the unique type specimen is pinned is inscribed "Caught at the Cape, Police Quart., Gov House, Dec. 27". These data are clearly inconsistent with Evans' description of the holotype as "an extreme example of melanic variation among a collection of specimens bred from brackish water on the coast near Bathurst".

In the hope of clarifying the situation I removed and mounted the head of the holotype and examined the palps and antennae for diagnostic characters. The palp ratio was found to be 0.84 which, while favouring the brackish water species, falls just within the joint range with *An. gambiae* A (Gillies &

De Meillon 1968). At the same time the total number of sensillae on the flagellum (25) is also intermediate (Gillies & De Meillon 1968). On the other hand the small number of sensillae (4) on the basal segment of each flagellum has been estimated to be diagnostic of the fresh water species within 95% confidence limits (Ismail & Hammoud 1968). It is true that, as with *An. merus*, these authors examined only one strain of the brackish water species and that examination of other strains might reveal a wider range of variation. Even so there would still remain a decided possibility that the type of *An. melas* is an abnormally melanic *An. gambiae* A such as is well known to occur from time to time. Nevertheless, in view of the long association of the name *An. melas* and the seeming impossibility of proving conclusively the identity of the type, it seems altogether desirable to retain this name for the West African brackish water form.

Finally, as to synonymy, it is suggested that the name *An. gracilis* should be treated provisionally as a synonym of *An. gambiae* Giles. *Anopheles gambiae litoralis* Halcrow (1957) and *Anopheles tangensis* Kuhlöw (1962) are clearly synonyms of *An. merus* Dönitz. *Anopheles gambiensis* Giles of Theobald (1903a) was a *lapsus* published in synonymy. *Anopheles gambiae* var. *minor* Holstein (1958) was relegated by Stone et al. (1959) to the synonymy of *An. gambiae* Giles, citing in support "Holstein (1958) corr. syn.". The reference, otherwise unexplained, is to a letter from Holstein to Stone (*vide* Knight). The original description seems to have been based on material from several different parts of Africa and may have covered any or all of the three West African forms. The name proposed by Gillett (1975) is a *nomen nudum* and therefore invalid (Crosskey 1976, White 1976).

#### References

- Bedford, G. A. H. 1928. South African mosquitoes. Rep. vet. Res. S. Afr., 13 & 14 (2): 881-990.
- Christophers, S. R. 1924. Provisional list and reference catalogue of the Anophelini. Indian med. Res. Mem. 3.
- Coluzzi, M. 1964. Morphological divergences in the *Anopheles gambiae* complex. Riv. Malariol. 43: 197-232.
- Crosskey, R. W. 1976. The *Anopheles gambiae* complex; naming the sibling species. Trans. R. Soc. trop. Med. Hyg. 70: 166-167.
- Davidson, G., H. E. Paterson, M. Coluzzi, G. F. Mason & D. W. Micks. 1967. The *Anopheles gambiae* complex. in Wright, J. W. & R. Pal (Eds.) Genetics of Insect Vectors of Disease. Amsterdam: Elsevier.
- De Meillon, B. 1940. Rep. S. Afr. Inst. med. Res., 1939, pp. 30-37.
- Dönitz, W. 1902. Beiträge zur Kenntniss der *Anopheles*. Z. Hyg. Infektkr. 41: 15-88.

- Edwards, F. W. 1932. Genera Insectorum. Fasc. 194. (Diptera, Culicidae). Brussels.
- Evans, A. M. 1938. Mosquitoes of the Ethiopian Region II. Anophelini. London: Brit. Mus. (Nat. Hist.).
- Giles, G. M. 1900. A Handbook of the Gnats or Mosquitoes. 1st Edn. London: John Bale, Sons & Danielsson.
- Giles, G. M. 1902. A Handbook of the Gnats or Mosquitoes. 2nd Edn. London: John Bale, Sons & Danielsson.
- Gillett, J. D. 1975. The *Anopheles gambiae* complex; naming the sibling species. Trans. R. Soc. trop. Med. Hyg. 69: 366-367.
- Gillies, M. T. & B. De Meillon. 1968. The Anophelinae of Africa South of the Sahara (Ethiopian Zoogeographical Region). Pubs. S. Afr. Inst. Med. Res. 54.
- Halcrow, J. G. 1957. A new sub-species of *Anopheles gambiae* Giles from Mauritius. E. Afr. med. J. 34: 133-135.
- Holstein, M. 1949. Le problème d'*Anophèles gambiae*. Bull. méd. A. O. F. (Special Number). p. 156.
- Ismail, A. H. & E. I. Hammoud. 1968. The use of coeloconic sensillae on the female antenna in differentiating the members of the *Anopheles gambiae* Giles complex. Bull. Wld Hlth Org. 38: 814-821.
- Kuhlow, F. 1962. Beobachtungen und experimente über den *Anopheles gambiae*-komplex, abtrennung von *Anopheles tangensis* n. sp. Z. Tropenmed. Parasit. 13: 442-449.
- Loew, H. 1866. Beschreibung einiger Afrikanischen Diptera Nemocera. Berl. ent. Z. 10: 55-62.
- Paterson, H. E. 1963. On the naming of the East African salt-water species of the *Anopheles gambiae* complex. WHO/Mal./421. pp. 7-10.
- Patton, W. S. 1905. The culicid fauna of the Aden hinterland, their haunts and habits. J. Bombay nat. Hist. Soc. 16: 623-637.
- Stone, A., K. L. Knight & H. Starcke. 1959. A Synoptic Catalog of the Mosquitoes of the World. Washington: Thomas Say Foundation.
- Theobald, F. V. 1901. A Monograph of the Culicidae or Mosquitoes. I. London: Brit. Mus. (nat. Hist.).
- Theobald, F. V. 1903a. Report on a collection of mosquitoes or Culicidae etc., from Gambia and descriptions of new species. Mem. Lpool Sch. trop. Med. 10 (Appendix).

- Theobald, F. V. 1903b. A Monograph of the Culicidae or Mosquitoes. III. London: Brit. Mus. (nat. Hist.).
- Theobald, F. V. 1911. The Culicidae or mosquitoes of the Transvaal. Rep. vet. Res. S. Afr. 1:232-272.
- White, G. B. 1975. Notes on a catalogue of Culicidae of the Ethiopian Region. Mosquito Systematics 7: 303-344.
- White, G. B. 1976. Zoological nomenclature in medical parasitology and entomology. Trans. R. Soc. trop. Med. Hyg. 70:166.
- Ziemann, H. 1902. Beitrag zur *Anopheles* fauna West-Afrikas. Arch. f. Schiffs- u. Tropenhyg. 6: 360-361.