

OPINIONS AND DECLARATIONS
RENDERED BY THE INTER-
NATIONAL COMMISSION ON
ZOOLOGICAL NOMENCLATURE

VOLUME 7

Edited by

FRANCIS HEMMING, C.M.G., C.B.E.

Secretary to the International Commission on Zoological Nomenclature

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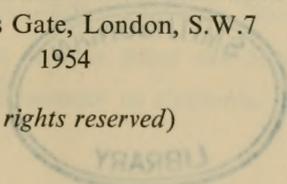
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VOLUME 1

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Secretary to the International Commission on Zoological Nomenclature



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FOREWORD

Each of the volumes of the present work so far published has consisted of a group of consecutively published *Opinions* and *Declarations*. The present volume however, comprises only a single *Opinion*, namely *Opinion 283*, the *Opinion* embodying the decisions in regard to the names properly applicable to the human malaria parasites taken by the International Commission on Zoological Nomenclature at its Session held in Paris in 1948.

This arrangement has been adopted for two reasons. First, the length of this *Opinion* with its enclosures make it more convenient for library use that it should constitute a single unit rather than be bound up as a part of a larger volume. Second, the interest attaching to the present *Opinion* extends over a much wider field than does that of most other *Opinions* rendered by the International Commission. For this reason also, it has been judged that for library purposes the most convenient arrangement would be for it to be issued as a single volume, complete with its own index.

FRANCIS HEMMING

*Secretary to the International Commission
on Zoological Nomenclature*

28 Park Village East,
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LONDON, N.W.1,
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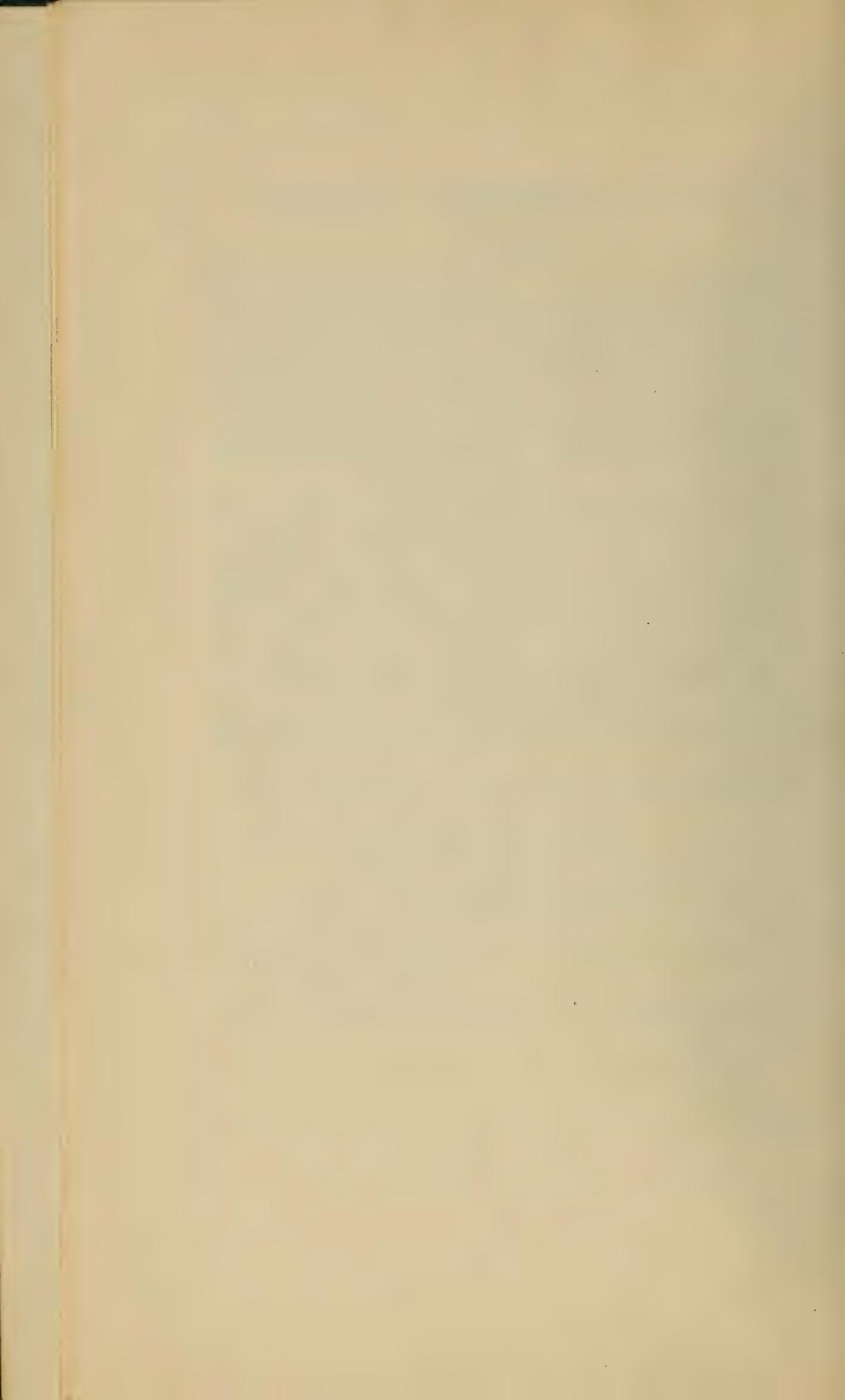


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By FRANCIS HEMMING, C.M.G., C.B.E.,

*Secretary to the International Commission
on Zoological Nomenclature*

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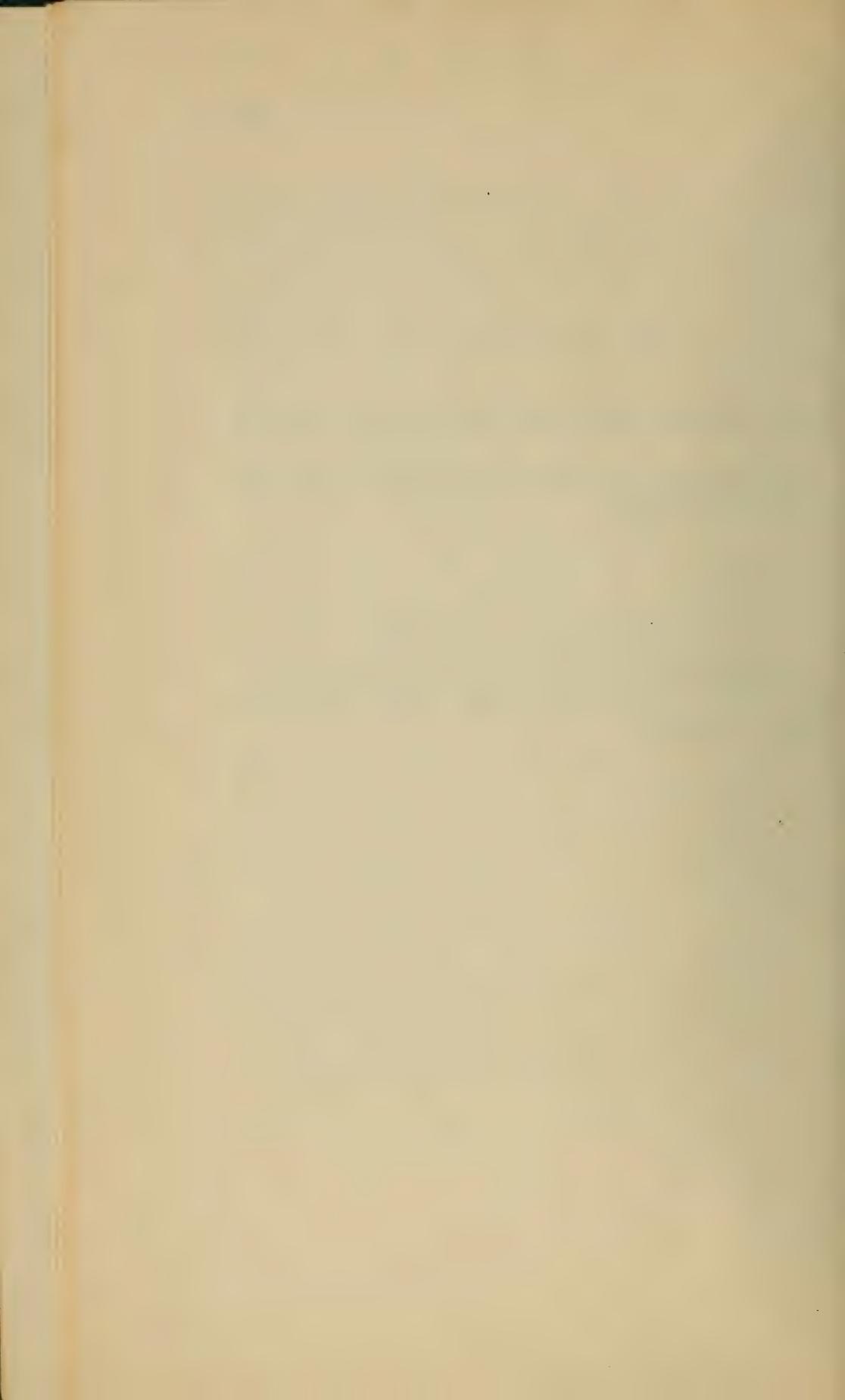
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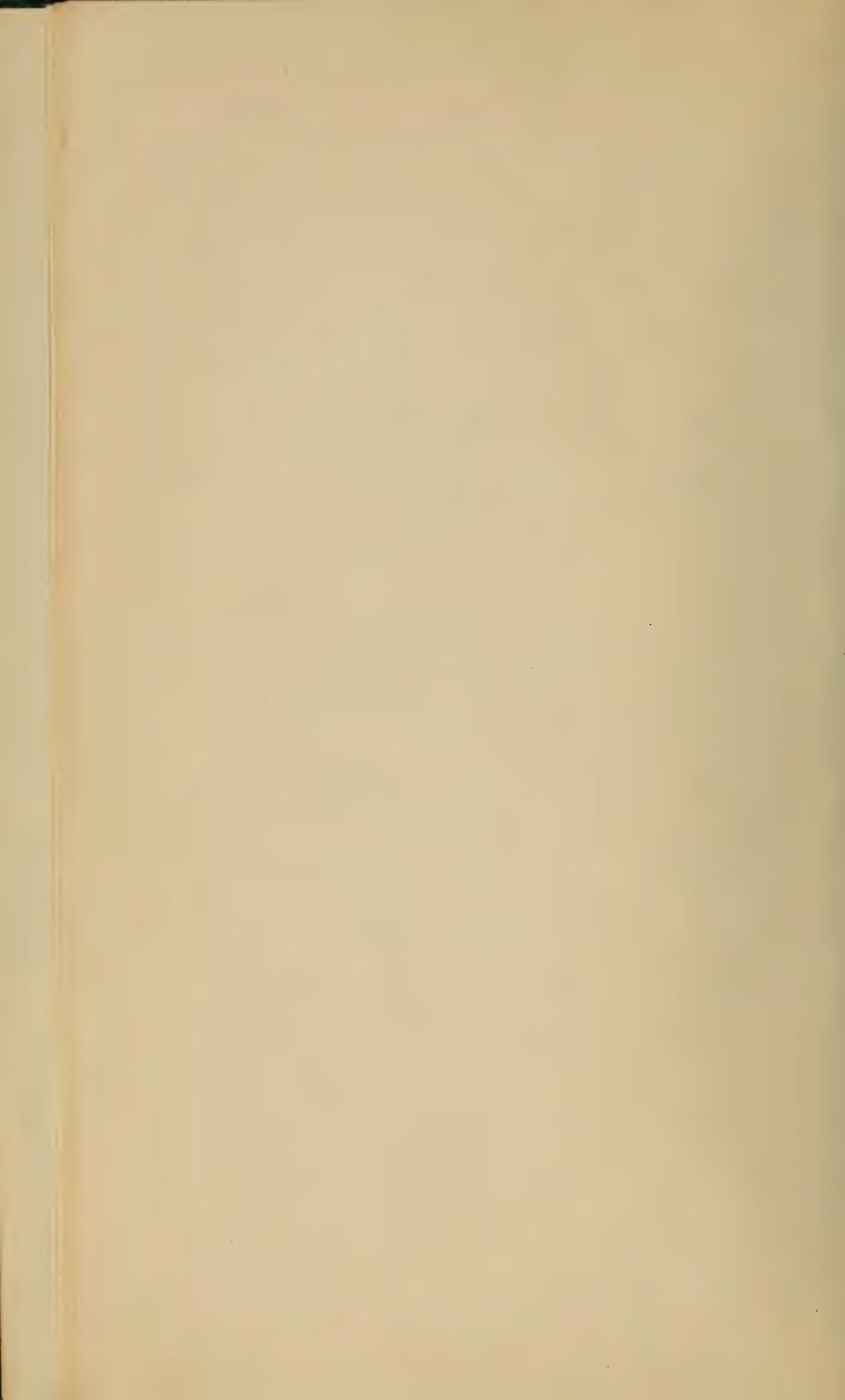
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Secretary to the Commission

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Validation, under the Plenary Powers, of the generic and specific names commonly used for the Malignant Tertian Malaria Parasite and the Quartan Malaria Parasite respectively

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OPINION 283

VALIDATION, UNDER THE PLENARY POWERS, OF THE GENERIC AND SPECIFIC NAMES COMMONLY USED FOR THE MALIGNANT TERTIAN MALARIA PARASITE AND THE QUARTAN MALARIA PARASITE RESPECTIVELY

RULING :—(1) The incorrect particulars relating to the generic names *Plasmodium* and *Laverania* and their type species given in *Opinion* 104 and, in consequence, in the *Official List of Generic Names in Zoology* are hereby cancelled.

(2) The Plenary Powers are hereby used for the purposes and to the extent specified below:—

(a) The under-mentioned specific names published for the Malignant Tertian Malaria Parasite are hereby suppressed for the purposes both of the Law of Priority and of the Law of Homonymy: (i) *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*; (ii) *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*; (iii) *malariae* Feletti & Grassi, 1889, as published in the combination *Laverania malariae* (in so far as this was published as a new name and does not represent a transfer of *Oscillaria malariae* Laveran, 1881, to the genus *Haemamoeba*);

(b) The under-mentioned specific names published for the Malignant Tertian Malaria Parasite are hereby suppressed for the purposes of the Law of Priority but not for those of the Law of Homonymy: (1) *falciforme* Antolisei & Angelini, 1890, as published in the combination *Ematozoo falciforme*; (ii) *laverani* Labbé, 1894, as published in

the combination *Haemamoeba laverani*; (iii) *falciforme* Thayer & Hewitson, 1895, as published in the combination *Haematozoon falciforme*;

- (c) The indication, by monotypy of *Plasmodium malariae* Marchiafava & Celli, 1885 (the Malignant Tertian Malaria Parasite) as the type species (i) of the genus *Plasmodium* Marchiafava & Celli, 1885, and (ii) of the genus *Haematophyllum* Metschnikoff, 1887 (the name of which was published as a substitute name (*nom. nov.*) for the name *Plasmodium* Marchiafava & Celli, 1885, in the erroneous belief that that name was not available under the *Règles*) is hereby set aside, and, in place of the foregoing species, the species *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite) is hereby designated as the type species both of *Plasmodium* Marchiafava & Celli, 1885, and of *Haematophyllum* Metschnikoff, 1887;
- (d) The under-mentioned specific names are hereby validated as follows: (i) the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, to be the name of the Quartan Malaria Parasite, notwithstanding the fact that, prior to the suppression, under the Plenary Powers, of the names specified in (a) above, that name was an invalid secondary homonym; (ii) *falciparum* Welch, 1897, as published in the combination *Haematozoon falciparum*, to be the name of the Malignant Tertian Malaria Parasite;
- (e) The indication, by monotypy, of *Laverania malariae* Feletti & Grassi, 1889, or, as the case may be, of *Oscillaria malariae* Laveran, 1881 (being names for the Malignant Tertian Malaria Parasite suppressed under the Plenary Powers, under (a) above) as the type species of the genus *Laverania* Feletti & Grassi, 1889, is hereby set aside, and, in

place of the foregoing species, the species *Haematozoon falciparum* Welch, 1897, is hereby designated to be the type species of the genus *Laverania* Feletti & Grassi, 1889;

- (f) The generic name *Laverania* Feletti & Grassi, 1889 (type species, by designation under the Plenary Powers, under (e) above: *Haematozoon falciparum* Welch, 1897, validated under the Plenary Powers, under (d) above, as the name of the Malignant Tertian Malaria Parasite) is hereby validated.

(3) The under-mentioned generic names are hereby declared to be either invalid or not required for the reasons severally stated below against the names in question:—

- (a) *Oscillaria* Laveran, 1881 (in so far as Laveran published this as a new name and not as *Oscillaria* Schrank, 1823): invalid, because a junior homonym of *Oscillaria* Schrank, 1823, that name retaining, under Article 1, its status under the Law of Homonymy, notwithstanding the fact that the genus so named is currently treated as belonging to the Vegetable Kingdom;
- (b) *Haematophyllum* Metschnikoff, 1887: invalid because a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885 (these two nominal genera having the same nominal species as type species);
- (c) *Haemamoeba* Feletti & Grassi, 1889; invalid because a junior objective synonym of the name *Plasmodium* Marchiafava & Celli, 1885 (consequent upon the designation under the Plenary Powers, under (2)(c) above, of *Haemamoeba malariae* Feletti & Grassi, 1889, the nominal species which is the type species, by monotypy, of *Haemamoeba* Feletti & Grassi, 1889, to be also the type species of *Plasmodium* Marchifava & Celli, 1885);

- (d) *Ematozoo* Antolisei & Angelini, 1890: not required, because the type species (*Ematozoo falciforme* Antolisei & Angelini, 1890) of the genus so named is a junior subjective synonym of *Haematozoon falciparum* Welch, 1897, designated under the Plenary Powers, under (2)(f) above, to be the type species of the genus *Laverania* Feletti & Grassi, 1889;
- (e) *Haematozoon* Thayer & Hewetson, 1895: not required because *Haematozoon falciforme* Thayer & Hewetson, 1895, the type species, by monotypy, of the genus so named, is a junior subjective synonym of *Haematozoon falciparum* Welch, 1897, designated under the Plenary Powers, under (2)(f) above, to be the type species of the genus *Laverania* Feletti & Grassi, 1889;
- (f) *Haemosporidium* Lewkowicz, 1897: invalid because a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885 (consequent upon the designation under the Plenary Powers, under (2)(c) above, of *Haemamoeba malariae* Feletti & Grassi, 1889, the type species of *Haemosporidium* Lewkowicz, 1897 (by selection under Article 30, Rule (g)) to be the type species also of *Plasmodium* Marchiafava & Celli, 1885);

(4) The under-mentioned specific names, each of which was published as the name of a new avian parasite but in the description of each of which there appeared an incorrect statement that the parasite in question had been found in the blood of human malaria patients, are hereby declared not to be available as specific names for the Malignant Tertian Malaria Parasite (the parasite misidentified with the avian parasite concerned by the authors in question), these specific names adhering, under the *Règles*, to the avian parasites from which the original

descriptions of these parasites were drawn up by their respective authors:—

- (a) *praecox* Grassi & Feletti, 1890, as published in the combination *Haemamoeba praecox*;
- (b) *immaculata* Grassi, 1891, as published in the combination *Haemamoeba immaculata*.

(5) The under-mentioned terms consisting of Latin adjectives published in the genitive case in agreement not with the generic name (as required by Article 14(1)(a)) but with the specific name, either expressed or understood, are hereby declared to have been published not as subspecific names of human malaria parasites, but as technical designations for those species, and, in consequence, the Latin adjectives of which these terms are composed possess no status as subspecific names in zoological nomenclature:—

- (a) *quartanae* Celli & Sanfelice, 1891, as published in connection with the specific name *Plasmodium malariae*;
- (b) *tertiana* Celli & Sanfelice, 1891, as published in connection with the name *Plasmodium malariae*;
- (c) *quotidiana* Celli & Sanfelice, 1891, as published in connection with the name *Plasmodium malariae*;
- (d) *tertiana* Kruse, 1892, as published in connection with the name *Plasmodium malariae*;
- (e) *quartana* Kruse, 1892, as published in connection with the name *Plasmodium malariae*;
- (f) *irregularis* Kruse, 1892, as published in connection with the name *Plasmodium malariae*;
- (g) *tertiana* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

- (h) *quartanae* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (i) *undecimanae* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (j) *sedecimanae* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (k) *vigesimo-tertiana*e Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*.

(6) It is hereby placed on record that there is no such generic name as *Haematomonas* Osler, 1886, Osler in the passage in question not having published a new generic name but having referred to the previously published name *Haematomonas* Mitrophanow, 1883.

(7) It is hereby recalled that, under the Ruling given in *Opinion* 101, the under-mentioned generic names and the under-mentioned specific name published for human malaria parasites by Danilewsky in 1891 possess no status in zoological nomenclature:—

- (a) the under-mentioned generic names: (i) *Cytamoeba* Danilewsky, 1891; (ii) *Cytosporon* Danilewsky, 1891; (iii) *Cytozoon* Danilewsky, 1891; (iv) *Haemocytosporon* Danilewsky, 1891;
- (b) the specific name *hominis* Danilewsky, 1891, as published in the combination *Laverania hominis*.

(8) It is hereby placed on record that the name *quartana* Labbé, 1894, as published as a subspecific name in the combination *Haemamoeba laverani* var. *quartana*, is an available name but is not required for the Quartan Malaria Parasite, it being a junior subjective synonym of the specific name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, validated under the Plenary Powers, under (2)(d)(i) above.

(9) It is hereby placed on record that the under-mentioned alleged specific names, not having been published, are cheironyms, and, in consequence, possess no status in zoological nomenclature:—

(a) *irregularis* Sakharov, erroneously alleged to have been published in 1892 as a subspecific name in the combination *Haemamoeba febris irregularis*;

(b) *tropica* Koch, erroneously alleged to have been published in 1899 in the combination *Plasmodium tropica*.

(10) The specific name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*, is hereby declared to be the oldest available specific name for, and, therefore, the valid specific name of, the Benign Tertian Malaria Parasite.

(11) It is hereby placed on record that the specific name *tertiana* Labbé, 1894, as published as a subspecific name in the combination *Haemamoeba laverani* var. *tertiana*, is an available name, but is not required for the Benign Tertian Malaria Parasite, it being a junior subjective synonym of the specific name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*.

(12) The following particulars in regard to the generic names *Plasmodium* and *Laverania*, together with the relevant bibliographical references, are hereby inserted in the *Official List of Generic Names in Zoology* in place of the particulars deleted therefrom under (1) above:—

(a) *Plasmodium* Marchiafava & Celli, 1885 (gender: neuter) (type species by designation under the Plenary Powers: *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite));

(b) *Laverania* Feletti & Grassi, 1889 (gender : feminine) (type species, by designation under the Plenary Powers : *Haematozoon falciparum* Welch, 1897 (the Malignant Tertian Malaria Parasite)) (generic name to be used by authors who consider the Malignant Tertian (or Aestivo-Autumnal) Malaria Parasite to be generically distinct from the Quartan Malaria Parasite).

(13) The under-mentioned generic names or alleged generic names are hereby placed on the *Official Index of Rejected and Invalid Generic Names in Zoology* with the Name Numbers severally cited below :—

- (a) the under-mentioned generic names rejected under (3) above, to be entered as Name Nos. 88 to 91 :
 (i) *Haemamoeba* Feletti & Grassi, 1889; (ii) *Haematophyllum* Metschnikoff, 1887; (iii) *Haemosporeidium* Lewkowicz, 1897; (iv) *Oscillaria* Laveran, 1881 (in so far as this was published as a new name and not as *Oscillaria* Schrank, 1823);
- (b) the reputed but non-existent generic name *Haematomonas* Osler, 1886, rejected under (6) above, to be entered as Name No. 92;
- (c) the under-mentioned generic names rejected under (7) above, to be entered as Names Nos. 93 to 96: (i) *Cytamoeba* Danilewsky, 1891; (ii) *Cytosporon* Danilewsky, 1891; (iii) *Cytozoon* Danilewsky, 1891; (iv) *Haemocytosporon* Danilewsky, 1891.

(14) The under-mentioned specific names are hereby placed on the *Official List of Specific Names in Zoology* as Names Nos. 112 to 114: (i) *falciparum* Welch, 1897, as published in the combination *Haematozoon falciparum* (the Malignant Tertian Malaria Parasite); (ii) *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae* (the Quartan Malaria Parasite); (iii) *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax* (the Benign Tertian Malaria Parasite).

(15) The under-mentioned specific names are hereby placed on the *Official Index of Rejected and Invalid Specific Names in Zoology* with the Name Numbers severally cited below :—

- (a) the under-mentioned names suppressed under the Plenary Powers, under (1)(a) above, for the purposes both of the Law of Priority and of the Law of Homonymy, to be entered as Name Nos. 45 to 47: (i) *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*; (ii) *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*; (iii) *malariae* Feletti & Grassi, 1889, as published in the combination *Laverania malariae*;
- (b) the under-mentioned names suppressed under the Plenary Powers, under (1)(b) above, for the purposes of the Law of Priority but not for those of the Law of Homonymy, to be entered as Name Nos. 48 to 50: (i) *falciforme* Antolisei & Angelini, 1890, as published in the combination *Ematozoo falciforme*; (ii) *falciforme* Thayer & Hewetson, 1895, as published in the combination *Haematozoon falciforme*; (iii) *laverani* Labbé, 1894, as published in the combination *Haemamoeba laverani*;
- (c) the under-mentioned specific names published as the names of avian parasites, in so far as in the original description the names concerned were, as noted in (4) above, incorrectly applied also to the Malignant Tertian Malaria Parasite, the names concerned to be entered as Name Nos. 51 and 52: (i) *immaculata* Grassi, 1890, as published in the combination *Haemamoeba immaculata*; (ii) *praecox* Grassi & Feletti, 1890, as published in the combination *Haemamoeba praecox*;
- (d) the under-mentioned terms, which have been alleged to have been published as names but which have been ruled in (5) above to have been published as

technical designations, the entries now to be made to be given the Name Nos. 53 to 63 : (i) *irregularis* Kruse, 1892, as published in connection with the name *Plasmodium malariae* ; (ii) *quartanae* Celli & Sanfelice, 1891, as published in connection with the name *Plasmodium malariae* ; (iii) *quartanae* Kruse, 1892, as published in connection with the name *Plasmodium malariae* ; (iv) *quartanae* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* ; (v) *quotidianae* Celli & Sanfelice, 1891, as published in connection with the name *Plasmodium malairae* ; (vi) *sedecimanae* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* ; (vii) *tertiana* Celli & Sanfelice, 1891, as published in connection with the name *Plasmodium malariae* ; (viii) *tertiana* Kruse, 1892, as published in connection with the name *Plasmodium malariae* ; (ix) *tertiana* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* ; (x) *undecimanae* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* ; (xi) *vigesimotertiana* Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* ;

(e) the name *hominis* Danilewsky, 1891, as published in the combination *Laverania hominis*, which, as noted in (7) above, is invalid under the Ruling given in *Opinion* 101, this name to be entered as Name No. 64;

(f) the under-mentioned alleged names ruled in (9) above to be unpublished cheironyms, to be entered under the Name Nos. 65 and 66 : (i) *irregularis* Sakharov, erroneously alleged to have been published in 1892 in the combination *Haemamoeba febris irregularis* ; (ii) *tropica* Koch, erroneously alleged to have been published in 1899 in the combination *Plasmodium tropica*.

I.—THE STATEMENT OF THE CASE

Detection of errors in "Opinion" 104: In January 1943, Mr. Francis Hemming, Secretary to the International Commission on Zoological Nomenclature, when checking certain miscellaneous documents which in 1939 had been transferred to his charge by Dr. C. W. Stiles on his election as Secretary to the Commission, found an offprint of a paper entitled "The Correct Name of the Malignant Tertian Malaria Parasite" written jointly by Sir Rickard Christophers, C.I.E., F.R.S., Colonel I.M.S. (ret.) (*Leverhulme Fellow under the Medical Research Council, London School of Hygiene and Tropical Medicine, London*) and J. A. Sinton, M.D., D.Sc., Lieut-Colonel I.M.S. (ret.) (*Manson Fellow, London School of Hygiene and Tropical Medicine*), which had been published in December 1938, *Brit. med. J.* **1938** (vol. 2) 1130-1134. It became immediately apparent from this paper that the entries in regard to the generic names *Laverania* and *Plasmodium* made in the *Official List of Generic Names in Zoology* by the Ruling given in the Commission's *Opinion* 104 (1928, *Smithson. misc. Coll.* **73** (No. 5):25-28) contained a number of serious errors which would need to be corrected by the International Commission.

2. Accordingly, in January 1944 Mr. Hemming entered into correspondence with Sir Rickard Christophers (at this time of the *Department of Zoology, Cambridge University, Cambridge*) with a view to elucidating certain questions as a preliminary to the preparation, for the consideration of the International Commission, of a paper drawing attention to the errors in *Opinion* 104 and submitting proposals for their rectification by the use by the Commission of its Plenary Powers for the purpose of stabilising the nomenclature of the human malaria parasites on the basis of the practice currently adopted by malariologists. This correspondence was extremely protracted, fresh nomenclatorial diffi-

culties constantly arising when known difficulties were overcome. A preliminary draft of the required application was completed by Mr. Hemming in the early part of 1944, but a number of important matters still remained to be settled. Mr. Hemming's correspondence with Sir Rickard Christophers and Brigadier Sinton was still in progress when in August 1944 an application to the Commission on similar lines to that in preparation by Mr. Hemming was received from Dr. Curtis W. Sabrosky and Dr. Robert L. Usinger (then of the *United States Public Health Service, Office of Malaria Control in War Areas, Atlanta, Georgia, U.S.A.*). In correspondence between Mr. Hemming and Dr. Usinger, under cover of a letter from whom the foregoing joint application had been transmitted to the International Commission, it was agreed that the application submitted by the latter jointly with Dr. Sabrosky and the application upon the preparation of which Mr. Hemming had been engaged since the beginning of 1943 should be laid before the Commission as complementary applications, each designed to secure the same general ends. It was not long after this that further nomenclatorial problems came to light, including, in particular, the discovery recorded by Sabrosky in 1946 that the material on which the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, was based was not homogeneous and, although consisting primarily of examples of the Malignant Tertian Malaria Parasite, included also examples of the Benign Tertian Malaria Parasite. It was not until January 1948 that Mr. Hemming succeeded in obtaining photostat copies of the last of the papers which it was necessary to consult in order to make sure that it contained no further surprises. Throughout this long period, Mr. Hemming's paper was under constant revision on questions of detail, and, when the last of the required photostats was received, it was not long before the final version was completed. By April 1948 the application in its final form was submitted to the International Commission.

3. *Mr. Hemming's application:* Mr. Hemming's application contains a detailed survey of the history of the names, generic and specific, given to the human malaria parasites from the time when

the first of these species was named by Laveran in 1881 up to the year 1897, in which the name *Haematozoon falciparum* was published by Welch as a name for the Malignant Tertian Malaria Parasite. At the conclusion of his application, Mr. Hemming submitted a series of proposals designed, not only to stabilise existing nomenclatorial practice but in addition to sweep away, with the aid of the Commission, the large number of invalid names and reputed but non-existent names which in the past have contributed so largely to the confusion in which the names for the human malaria parasites have been engulfed. Inevitably therefore Mr. Hemming's paper is both complicated and lengthy. In these circumstances, it has been decided that the most convenient course will be, while incorporating Mr. Hemming's paper in the official records of the present case, to print it in a separate Appendix rather than actually to include it in the body of the present *Opinion*. Mr. Hemming's proposals which are summarised in Part 6 of his paper will be found on pages 213 to 222 of the present *Opinion*.

4. *Joint Application submitted by Dr. Sabrosky and Dr. Usinger:*

As explained in paragraph 2 above, Dr. Robert L. Usinger on 7th July 1944 addressed a letter (which was not however received until 22nd August) to the International Commission covering an application for the use, by the Commission, of its Plenary Powers for the purpose of stabilising the nomenclature of the human malaria parasites on the basis of the existing practice of malariologists. In this paper, Drs. Sabrosky and Usinger accepted the conclusion reached by Christophers and Sinton that, contrary to the view held till then, it was the Malignant Tertian Malaria Parasite and not the Quartan Malaria Parasite which had been described by Marchiafava & Celli when in 1885 they had established the nominal genus *Plasmodium*; but they followed previous authors in assuming that Marchiafava & Celli had not cited any nominal species at the time when they established the foregoing genus, and in consequence of this, they treated the nominal species *Oscillaria malariae* Laveran, 1881, as the type species of

this genus. It transpired in subsequent correspondence that the applicants were not then aware of the rule laid down by the International Commission that all applications submitted to it should, as a preliminary, be published in the *Bulletin of Zoological Nomenclature* and had already submitted their paper for publication in the serial publication *Science*, in which it was published within about a week of its receipt in the Offices of the Commission (Sabrosky & Usinger, 1st September 1944, *Science* **100** (No. 2502): 190-192). The problem dealt with in the foregoing application was further examined by Dr. Sabrosky in 1946 when he published a paper (Sabrosky, 25th October 1946, *Science* **104** (No. 2704): 401-402), in which he stated that an examination of Marchiafava & Celli's paper of 1885 had satisfied him that, contrary all previously published statements, the foregoing authors when establishing the nominal genus *Plasmodium*, had established also a new nominal species to which they had given the new name *Plasmodium malariae*. In the same paper, Dr. Sabrosky reported that the detailed descriptions, the case histories and the figures on Plate VI published by Marchiafava & Celli, when establishing the foregoing nominal species, had been critically analysed by Dr. Martin Young (*National Institute of Health, Bethesda, Maryland*) who had come to the conclusion that, although, as previously stated by Christophers & Sinton (1938), the material on which Marchiafava & Celli had based their nominal genus *Plasmodium* consisted predominantly of examples of the Malignant Tertian Malaria Parasite, it included also—a point that had not been noted by Christophers & Sinton—some examples of the Benign Tertian Malaria Parasite. Since this later paper by Dr. Sabrosky rendered out of date in certain particulars the application which he and Dr. Usinger had submitted to the Commission in 1944, Mr. Hemming, as Secretary to the Commission, wrote to the applicants, asking how they wished this matter to be dealt with when the case came to be laid before the Commission. As the result of this exchange of correspondence it was agreed (letters dated 21st and 26th October 1947 from Dr. Sabrosky and Dr. Usinger respectively) that the original application should be laid before the Commission in the form in which it was submitted

in July 1944, notwithstanding the modifications rendered necessary by the evidence adduced in Dr. Sabrosky's paper of 1946, but that in addition Dr. Sabrosky's (1946) paper should be submitted to the Commission simultaneously with the original application, to which it would thus form a supplement. The two documents are as follows:—

- (1) **Joint Application by Dr. Curtis W. Sabrosky and Dr. Robert L. Usinger submitted under cover of a letter from Dr. Usinger dated 7th July 1944**

NOMENCLATURE OF THE HUMAN MALARIA PARASITES

By CURTIS W. SABROSKY and ROBERT L. USINGER

(United States Public Health Service, Office of Malaria Control
in War Areas, Atlanta, Georgia, U.S.A.)

The names for the malarial parasites of man have long been the subject of discussion, much of which has hopelessly intermixed zoological and nomenclatorial considerations. Stiles (1928, *Opinion* 101, p. 13) has aptly remarked that "the nomenclature of the parasites of malaria in man and birds represents one of the most confusing chapters in the entire history of zoological nomenclature."

The problem has been very ably and painstakingly reviewed by Christophers and Sinton.* We have carefully studied their paper, we concur in their conclusions, and we agree that strict adherence to the International Rules of Zoological Nomenclature would result in great confusion. The nomenclature adopted in *Opinion* 104 is clearly the best solution to the problem and should be maintained. However, we feel it necessary to point out that *Opinion* 104 did not provide an official answer, notwithstanding the fact that zoologists have for years regarded it as the final decision in the matter.

NOMENCLATURE OF THE HUMAN MALARIA PARASITES UNDER A STRICT INTERPRETATION OF THE RULES

Oscillaria Laveran, 1881 (type, *O. malariae* Laveran, 1881, the parasite of malignant tertian malaria; by monotypy). Malariologists are now agreed that Laveran had the sexual forms of this species, only, in his first paper cited above.

* R. Christophers & J. A. Sinton, 1938, *British Medical Journal*, 1938 (vol. 2): 1130—1134.

- = *Plasmodium* Marchiafava & Celli, 1885 (type, *P. malariae* Laveran, 1881, parasite of malignant tertian malaria; by monotypy).
- = *Haemamoeba* Feletti & Grassi, 1890 (type, *H. malariae* Feletti & Grassi, 1890, parasite of tertian and quartan fevers in man; by monotypy). The name has been shown to include two species, and therefore is not really monotypic. Grassi & Feletti later in 1890 restricted *malariae* Feletti & Grassi to the parasite of quartan fever and proposed *H. vivax* for the tertian-producing form. Result: the type of *Haemamoeba* is *H. malariae* Feletti & Grassi, as restricted by Grassi & Feletti to quartan fever. In the genus *Plasmodium* it is a secondary homonym of *malariae* Laveran, 1881, and the next oldest available name, *quartanae* Celli & Sanfelice, 1891, is valid.
- = *Laverania* Feletti & Grassi, 1889 (cf. footnote, Christophers & Sinton, 1938, p. 1133) (type, *Oscillaria malariae* Laveran; by monotypy).
- = *Haematozoon* Welch, 1897 (type, *Haematozoon falciparum* Welch 1897; by monotypy).

Conclusions, under a strict interpretation of the Rules:

(1) If zoologists agree on one genus for the malarial parasites, its name, as shown above, would be *Oscillaria* Laveran, because this name is not invalidated by previous use in botany (Code, Article 1) or by its unsuitability (Article 32). It will be noted that all five generic names were monotypic as originally proposed and that three—*Oscillaria*, *Plasmodium*, *Laverania*—have identical type species and would be isogenotypic synonyms whatever classification is used.

(2) If zoologists decide that two genera are required, the name *Oscillaria* would be strictly correct for the parasite of malignant tertian fever, and *Haemamoeba* for the other two.

(3) The names of the classical species of malaria under a single genus would be as follows:—

Oscillaria vivax (Grassi & Feletti, 1890)—Tertian malaria.

Oscillaria quartanae (Celli & Sanfelice, 1891)—Quartan malaria (to replace *malariae* Feletti & Grassi, 1890 *nec* Laveran 1881).

Oscillaria malariae Laveran, 1881—Malignant tertian malaria.

It is generally agreed that such conclusions would result in great confusion in medical and zoological literature. The generic name *Plasmodium* and the specific names *malariae* (quartan)[†] and *falciparum* (malignant tertian) have long been accepted by malariologists throughout the world. The usage was supported by *Opinion* 104 in which *Laverania* and *Plasmodium*, together with 55 other generic names, were placed on the *Official List of Generic Names* with “*malariae* (as restricted to quartan fever)” designated as the type of *Plasmodium* and *falciparum* Welch (1897) designated as type of *Laverania*. The matter would thus appear to have been settled but for the following significant statement by Stiles (1928) in the presentation of the case for *Opinion* 104: “The Secretary has personally checked these names and believes that they are all nomenclatorially available and valid, and that, therefore, they can be adopted in harmony with the Rules instead of as *nomina conservanda*.”

Contrary to this usage in *Opinion* 104, it is clear that *malariae* as used in the combination *Laverania malariae* by Grassi & Feletti was not a homonym but was the original *malariae* of Laveran, that *falciparum* therefore was an unnecessary substitution, that *falciparum* after all was not the next oldest available name, that “*malariae* (as restricted to quartan fever)” could not be the valid type of *Plasmodium* Marchiafava & Celli, 1885, since the *Plasmodium* of that date was based on *malariae* Laveran, the parasite of malignant tertian fever, and that *Oscillaria* Laveran, 1881, antedates both of the above generic names.

To have arrived at any of the conclusions stated in the *Opinion* would therefore have required a Suspension of the Rules. Inasmuch as the Rules were not suspended for any of the names approved in *Opinion* 104, we submit that the names *Laverania* and *Plasmodium* hold a place on the *Official List* in direct contravention of the Rules, rather than being maintained and protected by them.

In the present instance, we are faced with an *Official List* containing certain names which are not official in the sense that the action necessary to make them so was never taken. We can find no justification for believing that names placed on the *Official List*, merely in the absence of any expressed “objection, question, or adverse comment” (*Opinion* 75, p. 35) at the time, are thereby conserved to eternity and not subject to critical evaluation. Since the names *Plasmodium malariae* (quartan) and *falciparum* (malignant tertian) are generally accepted in zoological and medical literature and since it was apparently

[†] According to Christophers & Sinton, 1938, the name *malariae* Laveran was first applied to quartan malaria erroneously by Lühe (1900).

the intention of the International Commission to fix these names, we respectfully request that the International Commission on Zoological Nomenclature legalize *Opinion* 104 as it applies to the malaria parasites by suspending the Rules and taking the following action:—

1. Suppress the generic name *Oscillaria* Laveran (1881) in favour of *Plasmodium* Marchiafava & Celli (1885).
2. Suppress the species name *malariae* Laveran (1881), and any other names for the parasite of malignant tertian malaria, in favour of *falciparum* Welch (1897).
3. Establish *malariae* Feletti & Grassi (1889, 1890) *nec malariae* Laveran (1881) as the valid name for the parasite of quartan malaria.
4. Designate as the type of *Plasmodium* Marchiafava & Celli (1885)—*Haemamoeba malariae* Feletti & Grassi (1889, 1890).
5. Designate as the type of *Laverania* Feletti & Grassi (1889)—*Haematozoon falciparum* Welch (1897).

In summary, the actions recommended above would legalize existing practice as follows:—

Plasmodium vivax (Grassi & Feletti, 1890) parasite of tertian malaria.

Plasmodium malariae (Feletti & Grassi, 1889, 1890), parasite of quartan malaria.

Plasmodium falciparum Welch (1897), parasite of malignant tertian malaria.

(2) Supplement to Application submitted by Dr. Sabrosky and Dr. Usinger on 7th July 1944

**CORRECTION ON THE NOMENCLATURE OF HUMAN
PLASMODIUM**

By CURTIS W. SABROSKY

(United States National Museum, Washington, D.C., U.S.A.)

In the nomenclatorial and zoological confusion in the names for the human malaria parasites (Sabrosky & Usinger, *Science*, 1944, **100**, 190-192; Beltrán. *Gaceta Med. Mexico*, 1944, **74**, 61-74), one further point has been discovered.

It has usually been considered that there were only two different proposals involving *malariae* as a new specific name—*Oscillaria malariae* Laveran, 1881, and *Haemamoeba malariae* Feletti & Grassi, 1890. Actually it now appears that there were three !

Careful reading of Marchiafava & Celli (*Fortschr. Med.*, 1885, 3: 791-797) shows that they too were proposing what they regarded as a distinct new form, quite unlike any previously described: "Aus dem Gesagten geht hervor, dass die beschriebenen Körperchen nicht verwechselt werden dürfen mit irgend welchen zufälligen oder pathologischen Dingen, die man bisher inden roten Blutscheiben bemerkt hat . . . so scheint es uns nicht fernliegend, sie als parasitäre Organismen anzusprechen und ihnen den Namen *Plasmodium malariae* zu geben." The name was italicized and unquestionably intended as a formal scientific name. This proposal of *Plasmodium* as a new generic name has been accepted, but the new specific name has apparently been quite generally overlooked.

Of the three identical specific names, it is now generally agreed that *malariae* Laveran applied only to the parasite of *falciparum* or malignant malaria. *Malariae* Feletti & Grassi, which originally included both quartan and tertian parasites, was later restricted by Grassi & Feletti (*Arch. ital. biol.*, 1890, 13: 300) to the quartan parasite, at which time they named the tertian parasite *vivax*.

The situation is not so clear, however, with reference to the *malariae* of Marchiafava & Celli, 1885. Their detailed descriptions, case histories, and figures in Plate VI have been critically analysed by Martin Young, of the National Institute of Health, as follows:—

It seems to me definitely that most of the infections that they saw were *falciparum*. However, they seem occasionally to have run across a *vivax* infection. Some of the descriptions are definitely of *vivax* segmenters while others of the descriptions, especially where they mention the finding of crescents, are definitely *falciparum*.

The generalized figures on the plate are difficult to identify, with some suggestive of *vivax* and *falciparum*. The confusion arises from the fact that some of the cases they were looking at were very severe infections of *falciparum*. In such cases, it is not uncommon for the developmental forms of *falciparum* to be found in the blood stream. Therefore, from pictures with so little detail, it is hard to tell whether the forms shown are young stages of *vivax* or older stages of *falciparum*.

Throughout the paper, Marchiafava & Celli referred frequently to such characteristics of *falciparum* or malignant malaria as the comatose fever, rapid onset of death, remarkable number of parasites (especially in the capillaries of the brain), and the presence of crescents. Besides this evidence, it may be noted that their cases originated during a very severe epidemic in Rome and the Pontine Marshes, where *falciparum* is the principle species of malaria.

There seems to be little doubt, therefore, that *Plasmodium malariae* Marchiafava & Celli was based mainly on the malignant tertian parasite (*falciparum*). The benign tertian parasite (*vivax*) was seen, but there is no evidence of quartan.

If *malariae* Marchiafava & Celli be considered to represent one species only, then the malignant tertian form would have to be considered the genotype of *Plasmodium*, in which case *Oscillaria* Laveran, *Plasmodium* Marchiafava & Celli, and *Laverania* Feletti & Grassi are isogenotypic, all based on the same species (properly called *malariae* Laveran, under strict interpretation of the Rules of Nomenclature, but generally known as *falciparum*).

On the other hand, if *malariae* Marchiafava & Celli be regarded as originally composed of two species, it would then appear that the type has never been restricted to a single entity because the species name has been so long overlooked. Even though the malignant tertian parasite is unquestionably the basis of Marchiafava & Celli's description, it appears that at this late date considerable confusion could be avoided by restricting the name *malariae* Marchiafava & Celli to the benign tertian form. If such action were taken, and considering that all the human malaria parasites are congeneric (as they are usually regarded), the name would then be a homonym, and the correct name would be the next valid and available name, hence *vivax* Grassi & Feletti, 1890 (= *malariae* Marchiafava & Celli, 1885, *nec malariae* Laveran, 1881). Thus (1) *vivax* would become the genotype of *Plasmodium* Marchiafava & Celli; (2) it would not be necessary to suspend the Rules of Nomenclature in order to designate a type for *Plasmodium*; and (3) the status of *Laverania* as a possible generic name for the malignant parasite (if segregated) would not be disturbed.

In order not to complicate any other action by the International Commission on Zoological Nomenclature, formal designation of the above is withheld, and it is presented as a suggestion to be considered as a part of the whole problem.

II.—THE SUBSEQUENT HISTORY OF THE CASE

5. *Registration of the present application*: Immediately upon a decision being taken by the Secretary that it was necessary to submit an application for the correction of the erroneous entries regarding the generic names *Laverania* and *Plasmodium* in the *Official List of Generic Names in Zoology* made under the directions given in *Opinion* 104, a Registered File was opened (on 17th January 1943) for the present case, the number so allotted being Z.N. (S) 143.

6. *Investigations undertaken by Mr. Francis Hemming in the period 1943-44*: Throughout 1943 and 1944, the Secretary was in correspondence in regard to this case with Sir Rickard Christophers and Brigadier Sinton. Full particulars of this correspondence have been given by Mr. Hemming at the appropriate points in his application.

7. *Receipt in 1944 of the Joint Application prepared by Dr. Curtis W. Sabrosky and Dr. Robert L. Usinger*: On 22nd August, 1944 the joint application, dated 7th July 1944, prepared by Dr. Curtis W. Sabrosky and Dr. Robert L. Usinger, reproduced in the first section of paragraph 4 of the present *Opinion* was received in the Offices of the Commission.

8. *Arrangements made for the concurrent submission of the independent applications received*: In a letter dated 6th September 1944, Dr. Robert L. Usinger wrote:—

... Our paper in *Science*, [i.e. the joint application by Dr. Sabrosky and Dr. Usinger reproduced in paragraph 4(1) of the present *Opinion*] will serve as a supporting appeal from an entirely independent source. I might add that this support is considerable, since our paper was approved by the leading malariologists of the Public Health Service, Office of Malaria Control in War Areas, by malariologists of the National Institute of Health, and by the Chairman of the Committee on Malaria Terminology of the National Malaria Society.

9. *Issue in 1944 of an Appeal to Specialists for advice on the problems involved in the present case*: In October 1944 it was decided to take further steps to bring this important case to the notice of interested workers, especially in Europe, where in the

war conditions then obtaining it was unlikely that such workers would have an opportunity of seeing the issue of *Science* containing the paper by Drs. Sabrosky and Usinger. Accordingly, the following note was prepared by the Secretary and despatched to the serial publications *Nature* and the *British Medical Journal*; a copy was also sent to *Science*. This note was published in the first and third of these periodicals in their respective issues of 2nd December 1944 (*Nature* 154:701; *Science* 100:404, 405); It appeared in the *British Medical Journal* in January 1945 (*Brit. med. J.* 1945 (4385):85):—

Generic and Specific Trivial Names of the Tertian and Quartan Malaria Parasites

By FRANCIS HEMMING

*Secretary to the International Commission on
Zoological Nomenclature*

The *Official List of Generic Names in Zoology* was established by the International Congress of Zoology in order to promote stability in zoological nomenclature by placing on record the correct names of the principal genera in each of the Classes and Orders of the Animal Kingdom, together with their type species. Hitherto names have been placed on the *Official List* in *Opinions* rendered by the International Commission on Zoological Nomenclature, but in 1943, the International Commission decided that it was desirable to make the *Official List* more readily available and accordingly decided to publish it as soon as possible in convenient book form and with a full index. The preparation of the *Official List* for publication in this way, which was begun in 1943, involved the checking in detail of all the relevant bibliographical and other references to the generic names concerned and their type species. In the course of this work, errors were detected in a number of the *Opinions* containing decisions relating to the *Official List*. These errors are being brought at once to the attention of the International Commission with a view to their rendering an *Opinion* as soon as possible containing such rectifications as may be necessary.

Among the errors detected were errors in the entries in *Opinion* 104 (published in 1928) relating to the author's name and date of publication of the generic name for the Malignant Tertian Malaria Parasite (*Laverania* Feletti & Grassi, 1889). Further, in the case both of this name and of that for the Quartan Parasite (*Plasmodium* Marchiafava & Celli, 1885) the type species was found to have been cited under a name which was not the correct name under the International Code of Zoological Nomenclature.

The names of these parasites, as recorded in *Opinion* 104, are the names now universally employed for these species in the enormous medical and technical literature relating to malaria and it would clearly be as wrong as it would be impracticable to attempt to introduce changes in such names merely on grounds of zoological nomenclature. In the present case such changes would be particularly undesirable, since they would involve the transfer of the specific trivial name "*malariae*" from the Quartan Parasite (on which it was bestowed by Grassi & Feletti, 1890) by which name this species is universally known to the Malignant Tertian Parasite on which in 1881 it had been independently bestowed by Laveran (and by which name this species is never called). Transfer of trivial names in this way cause great confusion and the only solution in such a case is for the International Commission to use its Plenary Powers to suspend the rules in order to validate the names currently in use.

It was accordingly decided early in 1943 to invite the International Commission to deal with this question under its Plenary Powers and, for this purpose, a thorough investigation into the highly complicated literature of these names was made, with the assistance of Sir Rickard Christophers and Brigadier J. Sinton, whose paper "The correct name of the Malignant Tertian Malaria Parasite," published in 1938 (*Brit. med. J.* 6, 1938 (vol. 2) 1130-1134) must form the starting point of any work on this subject. In the course of this investigation, names previously overlooked were brought to light and other unsuspected nomenclatorial difficulties were disclosed. A paper setting out in detail the present position under the International Code and containing recommendations to the Commission for placing the whole matter on a satisfactory footing has been prepared and will appear in the next part of the *Bulletin of Zoological Nomenclature*¹, the Official Organ of the International Commission on Zoological Nomenclature.

Quite recently the Officer in Charge of Malaria Control in War Areas, Atlanta, Georgia, U.S.A., communicated to the International Commission an application prepared by Drs. Curtis W. Sabrosky and Robert L. Usinger, U.S. Public Health Service, drawing attention to the errors in *Opinion* 104 and requesting the International Commission to use its Plenary Powers to suspend the rules for the purpose of validating existing nomenclatorial practice in regard to these parasites. This application has since been published in the issue of *Science* of the 1st September 1944. It is extremely gratifying to the Executive Committee of the International Committee to find that malariologists in the United States, working independently, have reached substantially identical conclusions in regard to this matter, since this should greatly facilitate the early adoption by the International Commission of an *Opinion* setting this matter at rest once and for all.

¹ Owing to printing difficulties arising in the immediate post-war period the paper here referred to was not published in the *Bulletin of Zoological Nomenclature*. It is published for the first time in the Appendix to the present *Opinion*.

In order to secure the widest support for the action proposed to be taken, the Executive Committee, on behalf of the International Commission, invite expressions of opinion from specialists, concerned in any aspect of the malaria problem. Such communications, which should be addressed to the International Commission on Zoological Nomenclature at its Publications Office, at 41, Queen's Gate, London, S.W.7, will at once be published in the Commission's Official Organ, the *Bulletin of Zoological Nomenclature*, in order that the whole of the material relating to this case may be before the Commissioners when reaching their decision.

10. *Comments elicited by the Public Notices issued in 1944:* The publication of the foregoing note elicited letters of support for the action proposed from: (1) Colonel Paul F. Russell, Medical Corps, (*Chief, Division of Parasitology, Army Medical School, Army Medical Center, Washington, D.C., U.S.A.*); (2) Dr. David Weinman (*Columbia University, College of Physicians and Surgeons, De Lamar Institute of Public Health, New York, N.Y., U.S.A.*). These letters are reproduced in the immediately following paragraphs.

11. *Comment received from Colonel Paul F. Russell:* On 27th January 1945, Colonel Paul F. Russell, Army Medical Corps (*Chief, Division of Parasitology, Army Medical School, Army Medical Center, Washington, D.C., U.S.A.*) wrote the following letter to the International Commission:—

Reference note by Mr. Hemming in *Nature* of 2nd December 1944 just in hand.

I thoughtfully agree that it would be not only impractical but illogical at this late date to make the changes in generic and in specific trivial names of the tertian and quartan malaria parasites, although such changes might be in strict accord with a narrow reading of the law. It would seem to be sound procedure for the International Commission to use its Plenary Powers to avoid widespread and persisting confusion.

12. *Comment received from Dr. David Weinman:* On 27th February 1945, Dr. David Weinman, M.D. (*Columbia University,*

College of Physicians and Surgeons, De Lamar Institute of Public Health, New York, N.Y., U.S.A.) addressed the following letter to the Secretary to the Commission:—

Thank you for sending the reprint on “Generic and Specific Trivial Names of the Tertian and Quartan Malaria Parasites.”

I am in whole-hearted agreement with your position as stated in this article to wit: that transfer of the specific name *malariae* from the quartan to the malignant tertian parasite would be the cause of great confusion. This seems to be one of those cases foreseen in the section “Suspension of Rules in Certain Cases,” where power to suspend the Rules is conferred upon the International Commission when “the strict application of the *Règles* will clearly result in greater confusion than uniformity.”

I wish you complete success in this endeavour.

13. Further investigations undertaken by Mr. Hemming: At the beginning of 1945 there still remained a number of difficult questions relating to the names published for—or alleged to have been given to—the human malaria parasites which required elucidation before a comprehensive presentation of the problems involved could be laid before the International Commission. The extreme rarity of some of the serial publications concerned made progress inevitably slow, and it was not until early in 1948 that a conclusion was reached in regard to the last of these problems. The following specialists assisted in the unravelling of the problems involved: (1) Miss I. M. Bellis (*The Wellcome Foundation, London*); (2) Sir Rickard Christophers, C.I.E., F.R.S. (*Department of Zoology, Cambridge University, Cambridge*); (3) Dr. G. Robert Coatney (*Assistant Chief, Subdivision on Malaria, Division of Tropical Diseases, National Institute of Health, U.S. Public Health Service, Bethesda, Maryland, U.S.A.*); (4) Dr. Curtis W. Sabrosky (*United States National Museum, Division of Insects, Washington, D.C., U.S.A.*); (5) Professor Robert L. Usinger (*University of California, Division of Entomology and Parasitology, Berkeley, California, U.S.A.*); Dr. C. M. Wenyon, C.M.G., C.B.E., F.R.S. (*The Wellcome Foundation, London*). In addition,

Dr. Robert Coatney and Dr. C. F. W. Muesebeck (*United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, U.S.A*) were kind enough to furnish photostat copies of some of the rarest of the early papers in which names had been given to genera or species of human malaria parasites. Dr. Coatney also was good enough to furnish a separate of an important paper not otherwise readily obtainable. To all these specialists grateful thanks are offered by the Commission for the assistance so rendered.

14. Receipt of Dr. Sabrosky's Supplementary Statement: On 10th January 1947 the Commission received from Dr. Sabrosky a copy of the paper containing certain corrections of the account of the history of the generic name *Plasmodium* Marchiafava & Celli, 1885, given in the application regarding the names of the human malaria submitted by himself and Dr. Usinger in July 1944. As has already been explained, it was subsequently arranged, at the request of Dr. Sabrosky and Professor Usinger, that this paper should be treated as a supplement to their original application. It has accordingly been reproduced as such in paragraph 4(2) of the present *Opinion*.

15. Issue of Public Notices: On 5th November 1947 Notice of the possible use by the International Commission on Zoological Nomenclature of its Plenary Powers in the present case was issued to the serial publications prescribed by the Ninth International Congress of Zoology, Monaco, 1913. The publication of the Notices elicited no objection to the action proposed.

16. Completion of examination of bibliographical problems: The completion early in 1948 of the consultations referred to in paragraph 13 made it possible for Mr. Hemming to complete the outstanding portions of his survey of the names given, or alleged to have been given, to the human malaria parasites which formed the basis of his application to the Commission. This document was completed on 23rd April 1948. Mr. Hemming's paper is given in the Appendix attached to the present *Opinion*.

III.—THE DECISION OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

17. The two applications submitted in the present case were considered by the International Commission on Zoological Nomenclature at the Fourteenth Meeting of its Paris Session held at the Sorbonne in the Amphithéâtre Louis-Liard on Monday, 26th July 1948 at 2030 hours. The following is an extract from the Official Record of the Proceedings of the International Commission, summarising the discussion which then took place (1950, *Bull. zool. Nomencl.*, 4:594-612):—

On being invited by the Acting President to open the discussion on the proposal which, jointly with Dr. C. W. Sabrosky, he had submitted to the Commission on this subject, ALTERNATE COMMISSIONER ROBERT L. USINGER (U.S.A.) said that when he had taken part in preparing that application, he had examined the nomenclatorial problems involved and had satisfied himself that the action under the Plenary Powers there recommended was necessary, if the gravest confusion in malariological literature was to be avoided. The detailed considerations involved were, however, no longer fresh in his memory. He would therefore greatly prefer that this problem should be placed before the Commission by the Acting President, who, he knew, was thoroughly familiar with every aspect of this case.

* * * * *

[Here followed (1950, *Bull. zool. Nomencl.*, 4:596-612) a summary of the statement made by Mr. Hemming summarising the case as presented in the then unpublished application which he had submitted to the International Commission. For the text of Mr. Hemming's application see the Appendix to the present *Opinion*].

* * * * *

IN THE DISCUSSION which ensued, the view was expressed on all hands that it was the clear duty of the Commission to use its Plenary Powers in the manner proposed, in order to prevent the catastrophic confusion not only in the systematic literature of

Protozoa, but also—and, in this case, this was of much greater importance—in the vast medical and technical literature of malariology. The Secretary to the Commission was congratulated upon the masterly fashion in which he had assembled the complex mass of data which it was necessary to consider in order to determine the correct position as it existed under the *Règles*.

18. The following is an extract from the Official Record of the Proceedings of the International Commission, giving the decision reached by it on this case at the foregoing meeting (Paris Session, 14th Meeting, Conclusion 59) (1950, *Bull. zool. Nomencl.*, **4**: 594-624):—

THE COMMISSION agreed:—

(1) to cancel the incorrect particulars relating to the generic names *Plasmodium* and *Laverania* contained:—

(a) in *Opinion* 104;

(b) in consequence of (a) above, in the *Official List of Generic Names in Zoology*;

(2) to use its Plenary Powers:—

(a) to suppress for all purposes the under-mentioned trivial names published for the Malignant Tertian Malaria Parasite:—

malariae Laveran, 1881, as published in the binominal combination *Oscillaria malariae* ;

malariae Marchiafava & Celli, 1885, as published in the binominal combination *Plasmodium malariae* ;

malariae Feletti & Grassi, 1889, as published in the binominal combination *Laverania malariae* (in so far as this was published as a new name and not as the trivial name *malariae* Laveran, 1881);

- (b) to suppress for all purposes other than Article 35 the under-mentioned trivial names published for the Malignant Tertian Malaria Parasite:—

falciforme Antolisei & Angelini, 1890, as published in the binominal combination *Ematozoo falciforme* ;

laverani Labbé, 1894, as published in the binominal combination *Haemamoeba laverani* ;

falciforme Thayer & Hewetson, 1895, as published in the binominal combination *Haematozoon falciforme* ;

- (c) to set aside the indication, by monotypy, of *Plasmodium malariae* Marchiafava & Celli, 1885 (the Malignant Tertian Malaria Parasite) as the type species (i) of the genus *Plasmodium* Marchiafava & Celli, 1885², and (ii) of the genus *Hämatophyllum*² Metschnikoff, 1887 (the name of which was published as a substitute name (*nom. nov.*) for *Plasmodium* Marchiafava & Celli, 1885, in the erroneous belief that that name was not available under the *Règles*), and in place of the foregoing species to designate *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite) to be the type species both of the genus *Plasmodium* Marchiafava & Celli, 1885, and of the genus *Hämatophyllum* Metschnikoff, 1887;

- (d) to validate the undermentioned trivial names:—

malariae Feletti & Grassi, 1889, as published in the binominal combination *Haemamoeba malariae*, to be the name for the Quartan Malaria Parasite, notwithstanding the fact that, prior to the suppression under the Plenary Powers of the trivial names consisting of the word “*malariae*,” specified in (a) above, that name had been an invalid secondary homonym;

² See paragraph 24 of the present *Opinion*.

falciparum Welch, 1897, as published in the binominal combination *Haematozoon falciparum*, to be the name for the Malignant Tertian Malaria Parasite:

- (e) to set aside the indication, by monotypy, of *Laverania malariae*, Feletti & Grassi, 1889, or, as the case may be, *Oscillaria malariae* Laveran, 1881, being names for the Malignant Tertian Malaria Parasite suppressed under (a) above, as the type species of the genus *Laverania* Feletti & Grassi, 1889, and in the place of the species so named to designate *Haematozoon falciparum* Welch, 1897, to be the type species of that genus;
- (f) to validate the generic name *Laverania* Feletti & Grassi, 1889 (type species, by designation under the Plenary Powers, under (e) above: *Haematozoon falciparum* Welch, 1897, validated under the Plenary Powers, under (d) above, as the name for the Malignant Tertian Malaria Parasite);
- (3) to declare the under-mentioned generic names to be invalid or not required for the reasons severally stated below against the names in question:—

<i>Generic name</i>	<i>Reason why generic name cited in Col (1) is invalid or not required</i>
(1)	(2)
<i>Oscillaria</i> Laveran, 1881 (in so far as Laveran published this as a new name and not as <i>Oscillaria</i> Schrank, 1823)	Invalid because a homonym of <i>Oscillaria</i> Schrank, 1823, that name retaining under Article 1 its rights under Article 34, notwithstanding the fact that the genus so named has been transferred to the Vegetable Kingdom;

- Hämatophyllum*³Metschnikoff, 1887 Invalid because an objective synonym of *Plasmodium* Marchiafava & Celli, 1885, the two nominal genera having the same nominal species as type species;
- Haemamoeba* Feletti & Grassi, 1889 Invalid because the type species of this genus (*Haemamoeba malariae* Feletti & Grassi, 1889) has, under (2)(c) above, been designated under the Plenary Powers to be the type species of the genus having the older name *Plasmodium* Marchiafava & Celli, 1885;
- Ematozoo* Antolisei & Angelini, 1890 Not required because its type species (*Ematozoo falciforme* Antolisei & Angelini, 1890) is a subjective synonym of *Haematozoon falciparum* Welch, 1897, designated under the Plenary Powers, under (2) (f) above, to be the type species of the genus *Laverania* Feletti & Grassi, 1889;
- Haematozoon* Thayer & Hewetson, 1895 Not required because its type species (*Haematozoon falciforme* Thayer & Hewetson, 1895) is a subjective synonym of *Haematozoon falciparum* Welch, 1897, designated under the Plenary Powers, under (2)(f) above, to be the type species of the genus *Laverania* Feletti & Grassi, 1889;

³ See paragraph 24 of the present *Opinion*.

Haemosporidium
Lewkowicz, 1897

Invalid because its type species, *Haemamoeba malariae* Feletti & Grassi, 1889 (by selection under Article 30, Rules (g) and *Opinion* 46) is the same nominal species as that which, under the Plenary Powers, has under (2)(c) above, been designated as the type species of the genus having the older name *Plasmodium* Marchaifava & Celli, 1885 ;

- (4) to declare that the under-mentioned trivial names, each of which was published as the name of a new avian parasite but in the description of each of which there appeared an incorrect statement that the parasite in question had been found in the blood of human malaria patients, were not available as trivial names for the Malignant Tertian Malaria Parasite (the parasite misidentified with the avian parasite concerned), these trivial names adhering under the *Règles* to the avian parasites, from which the original descriptions of these parasites were drawn up by their respective authors:—

praecox Grassi & Feletti, 1890, as published in the binominal combination *Haemamoeba praecox*;

immaculata Grassi, 1891, as published in the binominal combination *Haemamoeba immaculata*;

- (5) to declare that the under-mentioned terms consisting of Latin adjectives published in the genitive case, in agreement not with the generic name (as required by Article 14(1)(a)) but with the specific trivial name, either expressed or understood, were published not as subspecific trivial names for human malaria parasites, but as technical designations for those species and that

the Latin adjectives in question accordingly possess no status under the *Règles* as subspecific trivial names:—

quartanae Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae*;

*tertiana*e Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae*;

*quotidiana*e Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae*;

*tertiana*e Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae*;

*quartana*e Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae*;

irregularis Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae*;

*tertiana*e Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

*quartana*e Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

*undecimana*e Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

*sedecimana*e Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

*vigesimo-tertiana*e Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium*;

(6) to place on record:—

- (a) that there was no such generic name as *Haematomonas* Osler, 1886, Osler in the passage in question not having published a new generic name but having referred to the previously published name *Haematomonas* Mitrophanow, 1883;

(b) that the undermentioned generic and trivial names published for human malaria parasites by Danilewsky, 1891, possessed no status under the *Règles*, the paper in which they were published having been declared by the Commission in *Opinion* 101 to be unavailable for nomenclatorial purposes:—

(i) the generic names:—

Cytamoeba Danilewsky, 1891

Cytosporon Danilewsky, 1891

Cytozoon Danilewsky, 1891

Haemocytosporon Danilewsky, 1891

(ii) the trivial name *hominis* Danilewsky, 1891, as published in the binominal combination *Laverania hominis*;

(c) that the trivial name *quartana* Labbé, 1894, as published as a subspecific trivial-name in the trinominal combination *Haemamoeba laverani* var. *quartana*, is not required for the Quartan Malaria Parasite, it being a junior subjective synonym of the trivial name *malariae* Feletti & Grassi, 1889, as published in the binominal combination *Haemamoeba malariae*, validated under the Plenary Powers under (2)(d) above;

(d) that the under-mentioned alleged trivial names, not having been published, were cheironyms and accordingly possessed no status under the *Règles*:—

irregularis Sakharov, erroneously alleged to have been published in 1892 as a subspecific trivial name in the trinominal combination *Haemamoeba febris irregularis* ;

tropica Koch, erroneously alleged to have been published in the binominal combination *Plasmodium tropica* in 1899 ;

(7) to declare that the trivial name *vivax* Grassi & Feletti, 1890, as published in the binominal combination *Haemamoeba vivax*, is the oldest available trivial name for, and therefore the valid trivial name of, the Benign Tertian Malaria Parasite;

(8) to declare that the trivial name *tertiana* Labbé, 1894, as published as a subspecific trivial name in the trinominal combination *Haemamoeba laverani* var. *tertiana*, is not required for the Benign Tertian Malaria Parasite, being a subjective synonym of the earlier published trivial name *vivax* Grassi & Feletti, 1890;

(9) to substitute the following particulars in regard to the generic names *Plasmodium* and *Laverania* in the *Official List of Generic Names in Zoology* in place of the particulars deleted therefrom in accordance with (1) above:—

Plasmodium Marchiafava & Celli, 1885 (type species by designation under the Plenary Powers: *Haemamoeba malariae* Feletti & Grassi, 1889) (the Quartan Malaria Parasite);

Laverania Feletti & Grassi, 1889 (type species, by designation under the Plenary Powers: *Haematozoon falciparum* Welch, 1897) (the Malignant Tertian Malaria Parasite) (generic name to be used by authors who consider the Malignant Tertian (or Aestivo-Autumnal) Malaria Parasite to be generically distinct from the Quartan Malaria Parasite);

(10) to place the undermentioned generic names and alleged generic names on the *Official Index of Rejected and Invalid Generic Names in Zoology*:—

Cytamoeba Danilewsky, 1891 (a name possessing no status under the *Règles*, the Commission having ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes);

Cytosporon Danilewsky, 1891 (a name possessing no status under the *Règles*, the Commission having ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes);

Cytozoon Danilewsky, 1891 (a name possessing no status under the *Règles*, the Commission having ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes);

Haemamoeba Feletti & Grassi, 1889 (invalid because a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885, as defined under the Plenary Powers in (2)(c) above, but available for the purposes of Article 34);

Haematomonas Osler, 1886 (a cheironym based upon a misreading of a passage referring to the generic name *Haematomonas* Mitrophanow, 1883);

*Hämatophyllum*⁴ Metschnikoff, 1887 (invalid because of a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885, but available for the purposes of Article 34);

Haemocytosporon Danilewsky, 1891 (a name possessing no status under the *Règles*, the Commission having ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes);

Haemosporidium Lewkowicz, 1897 (invalid because a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885, as defined under the Plenary Powers in (2)(c) above but available for the purposes of Article 34);

Oscillaria Laveran, 1881 (in so far as published by Laveran as a new name) (invalid as a junior homonym of *Oscillaria* Schrank, 1823);

⁴ See paragraph 24 of the present *Opinion*.

(11) to place the undermentioned trivial names on the *Official List of Specific Trivial Names in Zoology*:—

falciparum Welch, 1897, as published in the binominal combination *Haematozoon falciparum* (the Malignant Tertian Malaria Parasite);

malariae Feletti & Grassi, 1889, as published in the binominal combination *Haemamoeba malariae* (the Quartan Malaria Parasite);

vivax Grassi & Feletti, 1890, as published in the binominal combination *Haemamoeba vivax* (the Benign Tertian Malaria Parasite);

(12) to place the undermentioned trivial names and alleged trivial names on the *Official Index of Rejected and Invalid Specific Trivial Names in Zoology*:—

falciforme Antolisei & Angelini, 1890, as published in the binominal combination *Ematozoo falciforme* (suppressed under the Plenary Powers, under (2)(b) above, for all purposes other than Article 35);

falciforme Thayer & Hewetson, 1895, as published in the binominal combination *Haematozoon falciforme* (suppressed under the Plenary Powers, under (2)(b) above, for all purposes other than Article 35);

hominis Danilewsky, 1891, as published in the binominal combination *Laverania hominis* (a name possessing no status under the *Règles*, the Commission having ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes);

immaculata Grassi, 1891, as published in the binominal combination *Haemamoeba immaculata* (not applicable to the Malignant Tertian Malaria Parasite, but available for the avian parasite, on which the description by the original author was based);

irregularis Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

irregularis Sakharov, erroneously alleged to have been published in 1892 as a subspecific trivial name in the trinominal combination *Haemamoeba febris irregularis* (a cheironym possessing no status under the *Règles*);

laverani Labbé, 1894, as published in the binominal combination *Haemamoeba laverani* (suppressed under the Plenary Powers for all purposes other than Article 35, under (2)(b) above);

malariae Feletti & Grassi, 1889, as published in the binominal combination *Laverania malariae* (in so far as this was a new name and not merely a use of the trivial name *malariae* Laveran, 1881) (suppressed for all purposes under the Plenary Powers under (2)(a) above);

malariae Laveran, 1881, as published in the binominal combination *Oscillaria malariae* (suppressed for all purposes under the Plenary Powers under (2)(a) above);

malariae Marchiafava & Celli, 1885, as published in the binominal combination *Plasmodium malariae* (suppressed for all purposes under the Plenary Powers under (2)(a) above);

praecox Grassi & Feletti, 1890, as published in the binominal combination *Haemamoeba praecox* (not applicable to the Malignant Tertian Malaria Parasite, but available for the avian parasite, on which the description by the original authors was based);

quartanae Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

quartanae Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

quartanae Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

quotidiana Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

sedecimanae Lewkowicz, 1897, as published in connection with the generic name *Haemosporidium* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

tertiana Celli & Sanfelice, 1891, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

tertiana Kruse, 1892, as published in connection with the binominal combination *Plasmodium malariae* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

tertiana Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

tropica Koch, erroneously alleged to have been published in 1899 as a specific trivial name in the binominal combination *Plasmodium tropica* (a cheironym possessing no status under the *Règles*);

undecimana Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium* (published as a technical designation not as a trivial name, and in consequence possessing no status under the *Règles*);

vigesimotertiana Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium* (published as a technical designation, not as a trivial name, and in consequence possessing no status under the *Règles*);

- (13) to place on record their grateful thanks to the protozoologists, bibliographers and other specialists who, by furnishing information and advice on systematic and bibliographical questions or by supplying photostat copies of rare papers needed in the course of the present investigation into the nomenclature of the human malaria parasites or otherwise, had contributed to the successful elucidation of the complex problems involved;
- (14) to congratulate Secretary Hemming on the masterly fashion in which he had marshalled the evidence in the light of which the decisions now taken had been reached;
- (15) to render an *Opinion* recording the decisions specified in (1) to (12) above.

19. Having taken the decision set out in Point (5) of the Conclusion quoted from the Official Record in paragraph 18 above, that certain Latin adjectives cited in the genitive singular in grammatical agreement not (as required by Article 14) with the generic name but with a specific name, either expressed or understood, were not acceptable as specific (or subspecific) names, the Commission at the same Meeting (Paris Session, 14th Meeting, Conclusion 60) decided to recommend the International Congress of Zoology to insert words in the *Règles* for the purpose of making it clear that the publication of a Latin adjective in this way did not constitute the valid publication of that adjective as a specific or subspecific name and therefore that the provisions previously agreed upon for the automatic correction of infringements of certain Articles of the *Règles*, including Article 14, did not apply in such a case. This recommendation was later approved both by the Section on Nomenclature (1950, *Bull. zool. Nomencl.*, **5** : 121-122) and by the Congress in Plenary Session. The following is an extract from the Official Record of the Proceedings of the Commission setting out the foregoing recommendation (1950, *Bull. zool. Nomencl.*, **4** : 624-625):—

THE COMMISSION agreed:—

- (1) to recommend that words should be inserted in the *Règles* to make it clear:—
 - (a) that the provision relating to the automatic correction of orthographical and other infringements of Articles 14-16, 18 and 20, which it had been agreed to recommend should be inserted in the *Règles*, did not apply to a case where a subspecific or infra-subspecific form of a species, the trivial name of which consisted of a noun in the genitive case, was denoted by an adjective in grammatical agreement not with the generic name (as required by Article 14) but with the specific trivial name, either expressed or understood;

- (b) that an adjective used in the manner indicated in (a) above for the purpose of distinguishing a subspecies or infra-subspecific form did not acquire thereby the status of a subspecific, or infra-subspecific, trivial name;
- (2) to report to the Section on Nomenclature the recommendation specified in (1) above and the conclusions reached in regard to the nomenclature of the human malaria parasites, as recorded in Conclusion 59 above⁵;
- (3) to invite the Acting President, in his capacity as Secretary to the Commission, forthwith to submit to the Section on Nomenclature the Report referred to in (2) above.

20. The original references for the names placed on *Official Lists* and *Official Indexes* by the Ruling given in the present *Opinion* are given in paragraph 250 of the application submitted by Mr. Hemming reproduced in the Appendix to the present *Opinion* (see pp. 186—188).

21. The decision taken in the present case was reported to, and approved by, the Section on Nomenclature of the Thirteenth International Congress of Zoology, Paris, 1948, at its Sixth Meeting held on Monday, 26th July, 1948 (1950, *Bull. zool. Nomencl.*, **5** : 121-122).

22. The Ruling given in the present *Opinion* was concurred in by the sixteen (16) Commissioners and Alternate Commissioners present at the Paris Session of the International Commission, namely:—

Beltrán *vice* Cabrera; Boschma; Bradley; di Caporiacco; Hemming; Hindle *vice* Jordan; Jorge *vice* do Amaral; Kirby *vice* Stoll; Lemche *vice* Dymond; Mansour *vice* Hankó; Metcalf *vice* Peters; Riley *vice* Calman; Rode; Spärck *vice* Mortensen; van Straelen *vice* Richter; Usinger *vice* Vokes.

⁵ The Conclusion here referred to has been quoted in full in paragraph 18 of the present *Opinion*.

23. The Ruling given in the present *Opinion* was dissented from by no Commissioner or Alternate Commissioner present at the Paris Session.

24. When the present case was considered by the International Commission at its Paris (1948) Session, the treatment to be accorded to names based upon words containing letters bearing diacritic marks was regulated by Article 20 of the *Règles* which provided that in the formation of names consisting of words derived from languages using the Latin alphabet "the exact original spelling, including diacritic marks, is to be retained." It was for this reason that in the application submitted in this case and in the Commission's decision on it the German umlaut was retained over the first vowel of the generic name *Hämatophyllum* Metschnikoff, 1887, instead of being indicated by the addition of the letter "e" after the letter "a." At Copenhagen, however, in 1953 the Fourteenth International Congress of Zoology amended the foregoing Article abolishing the use of diacritic marks over letters in words used as zoological names and prescribing in the case of a name in which an umlaut had appeared over a vowel at the time of the first publication of the name that the umlaut is to be indicated by the insertion of the letter "e" after the vowel concerned (1953, *Copenhagen Decisions zool. Nomencl.* : 57-58, Decision 101). Accordingly, in the Ruling given in the present *Opinion* the foregoing generic name has been transcribed as *Haematophyllum*.

25. At the time of the adoption of the Ruling given in the present *Opinion*, the expression prescribed for the second portion of the binomen which constitutes the scientific name of a species was the expression "trivial name" and the *Official List* reserved for recording such names was styled the *Official List of Specific Trivial Names in Zoology*, the word "trivial" appearing also in the title of the *Official Index* reserved for recording rejected and invalid names of this category. Under a decision taken by the Fourteenth International Congress of Zoology, Copenhagen, 1953, the expression "specific name" was substituted for the expression "trivial name" and corresponding changes were made in the titles of the *Official List* and *Official Index* of such names

(1953, *Copenhagen Decisions zool. Nomencl.* : 21). The changes in terminology so adopted have been incorporated in the Ruling given in the present *Opinion*.

26. The prescribed procedures were duly complied with by the International Commission on Zoological Nomenclature in dealing with the present case, and the present *Opinion* is accordingly hereby rendered in the name of the said International Commission by the under-signed Francis Hemming, Secretary to the International Commission on Zoological Nomenclature, in virtue of all and every the powers conferred upon him in that behalf.

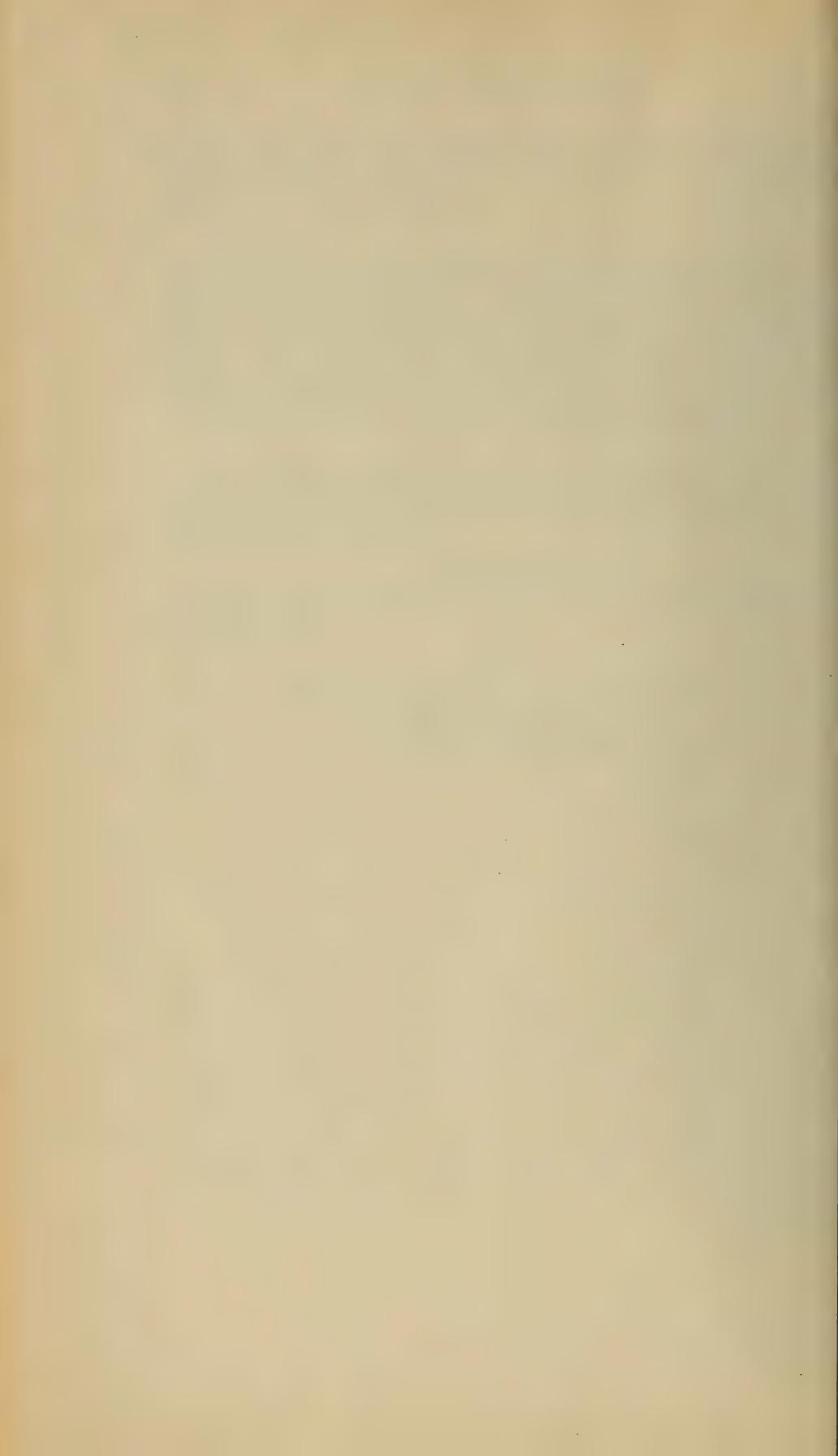
27. The present *Opinion* shall be known as *Opinion* Two Hundred and Eighty-Three (283) of the International Commission on Zoological Nomenclature.

DONE in London, this Fifteenth day of May, Nineteen Hundred and Fifty-Four.

*Secretary to the International Commission
on Zoological Nomenclature*

FRANCIS HEMMING

APPENDIX
TO
OPINION 283



**THE HUMAN MALARIA
PARASITES**

**A proposal for the stabilisation of nomenclature
on the basis of current usage**

By

FRANCIS HEMMING, C.M.G., C.B.E.

Secretary to the International Commission on Zoological Nomenclature

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INTRODUCTORY

(a) Purpose and scope of the present paper

The purpose of the present paper is to draw attention to the serious discrepancies which exist between the names currently used by malariologists for the human malaria parasites and the names strictly applicable to those species under the *Règles* and, in the light of the evidence so brought forward, to formulate proposals for consideration by the International Commission on Zoological Nomenclature for the use of its Plenary Powers for the purpose of validating existing nomenclatorial practice and, thus, of providing a stable nomenclature for these species.

2. In scope the present paper aims at providing a comprehensive survey of all the papers containing new names—including papers which it has been alleged contain new names—for the human malaria parasites published in the period from 1881, when the first name for any of these parasites was published by Laveran, up to 1897, the year in which the most recent of the names currently in use (the name *falciparum* Welch) was published. A thorough survey of this kind is necessary in order to unfold the whole of the action under the Commission's Plenary Powers that will be required if the Commission is to provide an unassailable juridical position for the names currently in use. Such a survey is a necessary preliminary for an application to the Commission for the use of its Plenary Powers in relation to any nomenclatorial problem, but it is all the more necessary in the present case, in view of the great rarity of many of the books and papers involved and of the numerous misstatements on questions of fact with which the literature abounds, as the result, presumably, of authors having accepted at second hand statements published by their predecessors without going back to the original books and papers under discussion.

(b) Historical Narrative

3. Consequent upon the decision announced in 1943 by the International Commission on Zoological Nomenclature (1943, *Bull. zool. Nomencl.* 1 : xxxvi) that the *Official List of Generic*

Names in Zoology should be published as soon as possible in book-form, it became necessary for me, as Secretary to the International Commission, to undertake a detailed study of the bibliographical and other problems connected with the names (between 600 and 700 in number) which up to that date had been placed upon the *Official List*. This was necessary because it is only since 1936 that full references have been included in the *Opinions* in which such names have been added to the *Official List*.

4. Even before I began the detailed study referred to above, I had been aware that the entries in regard to the generic names *Laverania* and *Plasmodium* made in the *Official List* by the Ruling given in the Commission's *Opinion* 104 (1928, *Smithson. misc. Coll.* 73 (No. 5):25-28) were not only incomplete but in addition contained a number of serious errors. That this was so had come to light in January 1943 on the discovery among certain miscellaneous documents which had been sent to me by my predecessor Dr. C. W. Stiles of a copy of a very important paper entitled "The correct names of the malignant tertian parasite" written jointly by Colonel Sir Rickard Christophers, C.I.E., O.B.E., F.R.S. and Lt.-Colonel (now Brigadier) J. A. Sinton, V.C., M.D., D.Sc. This paper had been published at the close of 1938 (*Brit. med. J.* 1938 (Vol. 2):1130-1134) and from an annexed note by Dr. Stiles had, it appears, been communicated to him by the first of the two joint authors on some date in 1939.

5. In these circumstances, it appeared to me to be obvious that the proper course for the Commission was to reconsider the whole question as soon as possible, with a view to correcting the errors contained in *Opinion* 104, by the use of its Plenary Powers for the purpose of preventing the appalling confusion in medical and protozoological nomenclature which would inevitably follow any material change in the names used for the human malaria parasites.

6. Before, however, any proposals could be formulated for submission to the International Commission, it was clearly essential that a thorough examination should be made of the voluminous literature involved, in order to make as sure as

possible that the decision now to be taken rested upon firm foundations and covered the whole ground. The literature is very complicated and much of it is extremely scarce, with the result that progress was necessarily slow. Fortunately, however, there existed at the outset the extremely valuable introduction to the subject in the paper by Christophers and Sinton referred to in paragraph 4 above.

7. It was in January 1943 that I began the detailed examination of the literature necessary for the preparation of the present application to the International Commission on Zoological Nomenclature. This task proved much more formidable than even the paper by Christophers & Sinton (1938) had led me to expect, for on several occasions it happened that, when, with the help of Sir Rickard Christophers, I had traced some obscure paper referred to in the literature as having some bearing on the present subject, I found that it contained a reference to some hitherto neglected name or otherwise raised new problems that called for solution. In spite of these difficulties (and others caused by the evacuation of many libraries from London on account of risk of destruction by air attack) the first draft of the paper was completed by the middle of 1944. In preparing it, I had confined myself strictly to a study of the nomenclatorial, bibliographical and similar questions involved, for, not being a specialist in the group concerned, I could have no opinion on any of the associated taxonomic problems. When references to questions of this character were unavoidable, I based myself upon the views expressed by Christophers and Sinton in 1938.

8. On 22nd August 1944, I received from Dr. Robert L. Usinger (at that time *P.A. Sanitarian (R.), i/c Reports Section, U.S. Public Health Services, Malaria Control in War Areas, Atlanta, Georgia, U.S.A.*) a letter dated 7th July 1944, with which he enclosed a paper written jointly by himself and Dr. Curtis W. Sabrosky in which those authors applied for the suspension of the *Règles* in connection with the names of the parasites of human malaria. This paper, which had already been communicated to *Science*, was published in that serial publication on 1st September 1944 (*Science* **100** : 190-192).

9. The paper by Drs. Sabrosky and Usinger was concerned mainly to point out the errors contained in *Opinion* 104 and to request the International Commission on Zoological Nomenclature to use its Plenary Powers to suspend the *Règles*, in order to avoid the confusion that would inevitably follow any attempt strictly to apply the *Règles* in this case. It was not designed to enumerate in detail all the names which would need to be suppressed by the International Commission if they were to decide to accede to the request presented to them. Since it was primarily for the latter purpose that my own paper had been prepared, I came to the conclusion that it would be useful for me to proceed with its submission to the International Commission, notwithstanding the receipt of the paper directed towards similar ends prepared by Dr. Sabrosky and Dr. Usinger. It was accordingly arranged between the foregoing specialists and myself that the two papers should be submitted to the International Commission as independent (or rather complementary) applications.

10. Although the line of argument and the conclusions of the two papers on the nomenclatorial issues were substantially identical, there was one important difference on a taxonomic question on which, having no opinion of my own, I had accepted in my paper the views expressed by Christophers & Sinton in their paper published in 1938 (see paragraph 6 above). This difference related to the identity of the single nominal species which in 1885 Marchiafava & Celli had placed in the genus *Plasmodium*. On this question Christophers and Sinton had in 1938 taken the view that the species involved was the Quartan Malaria Parasite, whereas in their paper Sabrosky and Usinger had identified Marchiafava and Celli's species with the Malignant Tertian Malaria Parasite. Immediately therefore upon receiving the Sabrosky/Usinger paper, I informed Sir Rickard Christophers of this development and asked him to be so good as to re-examine this particular question. Sir Rickard very kindly complied with this request and in due course informed me that he now accepted, and concurred in, the conclusions reached by Drs. Sabrosky and Usinger. In a later paper published in 1946, Dr. Sabrosky drew attention to the fact that Marchiafava & Celli, when publishing the generic name *Plasmodium*, had published also a new name *Plasmodium malariae*, for the sole species which they included in

that genus; at the same time Dr. Sabrosky noted that the material described and figured by Marchiafava & Celli, though predominantly composed of the Malignant Tertian Malaria Parasite, comprised examples also of the Benign Tertian Malaria Parasite.

(c) Nomenclature adopted for the human malaria parasites by the International Commission on Zoological Nomenclature in "Opinion" 104

11. The generic names *Plasmodium* and *Laverania* were placed on the *Official List of Generic Names in Zoology* by the International Commission on Zoological Nomenclature in its *Opinion* 104 published in 1928. That *Opinion* was not concerned solely with these names but consisted essentially of a list of fifty-seven generic names, of which those with which we are concerned were two, which were then placed on the *Official List* as being available names of nominal genera, the type species of which had been duly determined in accordance with the provisions of Article 30. The "Statement of the Case" contained no reference to the long and complicated history of the names published for the human malaria parasites. The information furnished in regard to these names in this *Opinion* was meagre in the extreme. The following is an extract of the particulars regarding these names given in the "Summary" (i.e. in the operative portion of the *Opinion*, setting out the decision reached by the Commission):—

SUMMARY.—The following.....generic names, with type species cited, are hereby placed on the Official List of Generic Names:—

.....

PROTOZOA:.....*Laverania, Plasmodium*,

.....

12. The foregoing entries were supplemented by the following passages in the section of the *Opinion* entitled "Presentation of the Case":—

PRESENTATION OF THE CASE:—

.....
 PROTOZOA:—

Laverania Grassi & Feletti, 1890a, 60, mt. *falcipara* Welch, 1897, 36, 47, type host *Homo*. [For authors who consider the parasite of aestivo-autumnal malaria generically distinct from that of quartan malaria.] Not *Laverania* Labbé, 1899a, 82, type *ranarum*, type host *Rana esculenta*.

Plasmodium Marchiafava & Celli, 1885d, 791, mt. *tsd. malariae* (as restricted to quartan fever), type host *Homo*.

- (d) Action taken in 1944 preliminary to the use by the International Commission on Zoological Nomenclature of its Plenary Powers for the purpose of validating the names currently used for the human malaria parasites

13. The errors in *Opinion* 104 relating to the names of the human malaria parasites detected in 1943 and 1944 were so serious that it was immediately evident that only by the use by the Commission of its Plenary Powers could the nomenclature of the human malaria parasites be placed upon a satisfactory basis. The Plenary Powers Resolution adopted by the International Congress of Zoology at Monaco in 1913 (see *Declaration 5*, published in 1943, *Opinions and Declarations rendered by the International Commission on Zoological Nomenclature 1*: 31—40) requires that, before the International Commission may use its Plenary Powers to suspend the *Règles*, it shall give Public Notice of the proposal in question in any two of five serial publications specified in the Resolution of 1913. Accordingly, in November 1944 such notices were given to *Science* and to *Nature*, two of the

serial publications specified in the Plenary Powers Resolution and these notices appeared shortly afterwards in those publications. Owing to the European War, it was not possible at that time to give similar notices to the three other serial publications specified in the foregoing Resolution but this action has since been taken¹.

14. The formalities required by the Plenary Powers Resolution have thus been complied with and the International Commission is accordingly in a position to use its Plenary Powers forthwith in the present case, if (as I hope) it agrees that this is the proper course to adopt.

(e) **Terminology employed in the present paper**

15. Every specialist who has ever had occasion to revise the nomenclature of a group of closely allied species has experienced the difficulty, when making that revision, of deciding by what name to refer to each species until such time as, by examining the original descriptions of each of the nominal species concerned and, if possible, their type specimens, he has ascertained what is the oldest available name for each of the collective groups which on taxonomic grounds he accepts as constituting separate specific entities. These difficulties are greatly enhanced where, as with the human malaria parasites, one specific trivial name (in the present case, the specific trivial name *malariae*) has been bestowed independently upon two closely allied species and further where (as also in the present case) that name when published for one of the species concerned has been continuously misapplied to the other species (through a misunderstanding of, or a failure to read, the original description).

¹ The procedure to be adopted in dealing with cases involving the possible use of the Commission's Plenary Powers here described was modified by the Thirteenth International Congress of Zoology, Paris 1948, which decided that in future Public Notice should be given in the *Bulletin of Zoological Nomenclature* but that, apart from this, the compulsory giving of Public Notice should be limited to two serial publications, one published in Europe, the other in America, the serials in question to be selected from time to time by the Secretary to the Commission (1950, *Bull. zool. Nomencl.*, 4 : 51—56). The serials then so selected were *Nature* and *Science*, and this arrangement is still in force (int'l'd. F.H., 10th January 1954).

16. An indispensable preliminary to any revision of this kind is the adoption of precise definitions for the expressions used to denote the various species in the portion of the work which precedes the identification of each of the named forms concerned. Normally, the safest—and often indeed the only practicable—course is to define each of the expressions accepted as representing a specific entity by reference to some work in which that organism is described (and, if possible, figured) in such a way as to preclude the possibility of subsequent misidentification, and, having done so, to allot to that specific entity a number or letter by which alone to refer to it until it has been possible clearly to establish what, under the *Règles*, are the oldest available generic and trivial names for that species.

17. Where the identity of the organisms representing specific entities is generally accepted by specialists in the group concerned and where in any given language there exists for each of the species in question a vernacular name, the meaning of which is clearly understood by those specialists, it may be more convenient in the early stages of the revision of a group to refer to the various species by their vernacular names rather than by numbers or by letters.

18. Vernacular names of this kind exist in the English language for each of the human malaria parasites discussed in the present paper and these names have accordingly been adopted in Parts 1 and 2 of the present paper as the means by which to refer to the separate specific entities now recognised by malariologists on taxonomic grounds.

19. In the present paper the three parasite species discussed are therefore referred to in the following manner:—

<i>Name used in the present paper to indicate species</i> (1)	<i>Identification of taxonomic unit referred to under the name cited in column (1)</i> (2)
Malignant Tertian Malaria Parasite	The parasite with crescent-shaped gametocytes described by Laveran as <i>Oscillaria malariae</i> in 1881 (<i>Nature parasit. Accid. Impaludisme</i> : 87)
Quartan Malaria Parasite	The parasite of Quartan Fever described and figured by Golgi in 1885 (<i>G. Accad. Med. Torino</i> 33 : 734)
Benign Tertian Malaria Parasite	The parasite described by Grassi & Feletti as <i>Haemamoeba vivax</i> in March 1890 (<i>Arch. ital. Biol.</i> 13 : 300)

20. For the purpose of the present paper the vernacular names specified in the first column of the foregoing table are used exclusively in the sense attributed to them in the second column of that table. Wherever therefore it is stated that a given name is a synonym of another name previously published for the same species, that statement represents a subjective taxonomic judgment by whoever is cited in the passage concerned as the authority for the decision to identify with one another the two nominal species in question. Where, in the opinion of competent specialists, that taxonomic judgment is well-founded, the name sunk as a synonym is correctly so sunk for taxonomic purposes. It must be realised however that, while such a judgment implies that the name in question is not required for taxonomic purposes, it does not and cannot affect the nomenclatorial availability of the name concerned. A name so sunk is a subjective synonym and, as such, is not required, so long as the subjective judgment which led to

its being sunk as a synonym is accepted as correct. But immediately that judgment is reversed on taxonomic grounds, the name in question can once more be brought into use. The only names, rejected as synonyms, which can never be brought to life again in this way are names belonging to the relatively rare classes of case where a rejected name is an objective synonym of a previously published name. There are two classes of such synonyms, namely: (1) the name of a genus the type species of which was cited by the author of the generic name under the same specific name as was similarly cited for the type species of a previously established nominal genus having a different name, and (2) the name of a species based upon the same specimen as that on which was based a previously established nominal species having a different name.

(f) Lay-out of the present paper

21. Of the names cited in *Opinion* 104 for the human malaria parasites, the oldest name is "*Plasmodium* Marchiafava & Celli, 1885" and the most recent is the specific trivial name "*falcipara* Welch, 1897" (which was originally published by the binominal combination *Haematozoon falciparum*). There is thus a period of twelve years between the dates of publication of these two names. In actual fact, as we shall see, the Malignant Tertian Malaria Parasite was first named in 1881, when Laveran described it under the name *Oscillaria malariae*. There is therefore a period of sixteen years between the date on which the Malignant Tertian Malaria Parasite was first given a scientific name (1881) and the date when the same species received the specific trivial name *falciparum* (1897). Accordingly it is the literature which appeared during these sixteen years which has to be examined in order to determine the nature and scope of the errors contained in *Opinion* 104.

22. The first Part of the present paper is designed to provide a list in historical sequence of all the specific trivial names bestowed (or alleged to have been bestowed) between 1881 and 1897 upon the Malignant Tertian Malaria Parasite and upon the Quartan Malaria Parasite. In order to establish the status of every name which may need to be dealt with by the International Commission for the purpose of validating the erroneous entries

in *Opinion* 104, I have included in this list also all the names bestowed during the same period upon the Benign Tertian Malaria Parasite and also upon certain parasites of birds which some authors have claimed to identify with human malaria parasites.

23. Part 2 is devoted to a corresponding examination of every generic name bestowed (or alleged to have been bestowed) upon human malaria parasites during the period 1881-1897.

24. In Part 3 of the paper synonymies are compiled for the Malignant Tertian Malaria Parasite, the Quartan Malaria Parasite and the Benign Tertian Malaria Parasite on the basis of the material assembled in Parts 1 and 2. In the light of these synonymies, attention is drawn to the extent of the errors embodied in *Opinion* 104 in regard to the generic names *Plasmodium* and *Laverania* and the names of the type species of those genera.

25. Part 4 contains proposals for the stabilisation of the names, both generic and specific, for the human malaria parasites on the basis of current nomenclatorial usage. In Part 5 I submit a proposal for the clarification of certain aspects of Article 14, this being, in my opinion, necessary, in view of certain doubts as to the proper interpretation of that Article which were encountered in the examination of certain terms alleged to have been published as specific or subspecific trivial names for one or other of the human malaria parasites.

26. A summary of the recommendations submitted in Parts 4 and 5 is given in the concluding Part (Part 6).

27. Two appendices are annexed to the present paper, for the first of which I have to thank Sir Rickard Christophers. Appendix 1 gives particulars of the early papers by Golgi in which the Quartan Malaria Parasite was first definitely distinguished from the Malignant Tertian Malaria Parasite but in which no name was given to the species so determined. Appendix 2 contains reproductions in facsimile of the paper by Feletti & Grassi published first in December 1889 as a preprint (see paragraph 78), and a fortnight later (in January 1890) in the *Riforma medica* which forms the basis of a large part of the historical background of the nomenclature of the human malaria parasites. I feel that

the reproduction of this paper forms a necessary part of a comprehensive review of the nomenclature of these parasites, not only because of its intrinsic importance but also because, owing to its extreme rarity, it has been seen by very few living malariologists, a fact which has, no doubt, been responsible for a large part of the misconceptions which have gathered around this paper. The paper consists of two portions, which are reproduced in Appendix 2 as Document No. 1 and Document No. 2 respectively. Document No. 1 consists of a reproduction of pages 62 to 64 of Issue No. 11 of volume 6 of the *Riforma medica* which appeared on 15th January 1890. This Document contains the paper entitled "*Sui parassiti della malaria*" in which Feletti & Grassi gave the name *Haemamoeba malariae* to the Quartan Malaria Parasite, which, though recognised as distinct from the Malignant Tertian Malaria Parasite by Golgi some five years earlier (see Appendix 1), had till then remained without a scientific name. In the same paper Feletti & Grassi established the nominal genera *Laverania* and *Haemamoeba* for the Malignant Tertian Malaria Parasite and the Quartan Malaria Parasite respectively. This is the paper which, as explained in paragraph 84(1), and (2)(a) below, was republished in a French translation four months later (in May 1890). It is this French version, in which the foregoing names again appeared as new names, which, owing to the rarity of the Italian original, has been relied upon almost exclusively by subsequent workers. Document No. 2 in Appendix 2 consists of a reproduction of pages 296 and 298 of Issue No. 50 of the same volume of the *Riforma medica* which appeared on 1st March 1890. These pages contain a further paper by Feletti & Grassi entitled "*Sui parassiti della malaria. Aggiunta alla nota preliminare*" which, as its title indicates, is a supplement to the paper of 15th January 1890, reproduced as Document No. 1 referred to above. This second paper, like the first, was republished in a French version in May 1890, and it is from this latter version that this paper is generally known (see paragraph 84(2)(b) below).

28. One of the great difficulties encountered in the preparation of the present paper has been the extreme rarity of many of the books and papers in which new names were published for the human malaria parasites, and the conflicting accounts of the contents of those papers given by subsequent authors. It is therefore worth recording that, with the help of the Institutions

and individual specialists enumerated in the immediately following Section, I have been able to examine personally every one of source books and source papers discussed in the present paper, with the single exception of the pre-print issued in December 1889 of the paper in which Feletti & Grassi first established the nominal genus *Haemamoeba* and gave the name *Haemamoeba malariae* to the Quartan Malaria Parasite. The issue of the *Riforma medica* of 15th January 1890 in which this paper was issued in identical form is, however, reproduced in facsimile in Appendix 2 to the present paper. Thus, subject to the foregoing qualification, all the discussions of earlier publications given in the present paper are based upon a first-hand examination of the original sources.

(g) Acknowledgments and Thanks

29. Having now completed my review of the literature of the human malaria parasites, I wish to record my grateful thanks to all the institutions and individual specialists who have assisted me in this task and without whose help it would have been impossible to compile the present paper. First, I owe an altogether special debt of gratitude to Colonel Sir Rickard Christophers, C.I.E., O.B.E., F.R.S. (late *Indian Army Medical Service*, and now of the *Department of Zoology, Cambridge University*). Not only does the paper written by Sir Rickard jointly with Brigadier J. A. Sinton, V.C., M.D., D.Sc. in 1938 (paragraph 6 above) form the essential foundation and starting point for any study of the nomenclature of the human malaria parasites, but in addition I am personally peculiarly indebted to Sir Rickard for the unsparing pains which he has been kind enough to take in tracing obscure publications and in unravelling obscure synonymies and also for the immediate response which he has always made to requests for advice on many different problems encountered in the preparation of the present paper. The wide range and scope of the assistance so rendered will be seen from the numerous extracts which I give from letters which I received from Sir Rickard at various stages of the investigation².

² Some of the conclusions which emerged from this correspondence have since been published by Sir Rickard Christophers in a paper entitled "Some Remarks on the Nomenclature of the Malaria Parasites of Man" (Christophers, 1945, *Rev. Inst. Salubridad y Enfermedades trop.* 6(4) : 213—227).

30. I desire also to express my thanks to the following specialists and bibliographers, each of whom has given the most valuable assistance, either in the form of advice on particular questions or by furnishing additional data on individual points on which further elucidation was essential or by supplying photostat copies of rare papers: Miss I. M. Bellis (formerly Librarian to the *Wellcome Bureau of Scientific Research, London*); Dr. G. Robert Coatney (*United States Public Health Service, National Institute of Health, Bethesda, Maryland, U.S.A.*); Dr. Edward Hindle, Sc.D., F.R.S. (*Zoological Society of London*); Dr. C. A. Hoare D.Sc., F.R.S. (*Wellcome Laboratories of Tropical Medicine, London*); Dr. C. F. W. Muesebeck (*United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, D.C., U.S.A.*); Brigadier J. A. Sinton, V.C., M.D., D.Sc. (*War Office, London*); Professor Robert L. Usinger (*University of California, Division of Entomology and Parasitology, Berkeley, California, U.S.A.*); Dr. C. M. Wenyon, C.M.G., C.B.E., F.R.S. (*The Wellcome Foundation, London*).

31. I have also to express my grateful thanks to the following Institutions for the grant of facilities to study rare works in their libraries and to the Librarians of these Institutions for assistance granted when using these libraries: British Museum (Natural History); London School of Hygiene and Tropical Diseases; Royal College of Surgeons; Royal Entomological Society of London; Royal Society of Medicine; University College, London University; Zoological Society of London. I wish also to take the present opportunity to thank Mrs. Cornelia Rosner for locating rare works in the foregoing libraries, for making transcripts from those works and generally for the help given by her in this field.

32. Finally, I wish to thank my old friend and colleague Dr. Karl Jordan, Ph. D., F.R.S. (*British Museum (Natural History), Zoological Museum, Tring, Herts., England*), President of the International Commission on Zoological Nomenclature, for the encouragement which he has at all times given in the present investigation and for the interest which he has shown at every stage of its course.

**PART 1 THE SPECIFIC TRIVIAL NAMES BESTOWED
(OR ALLEGED TO HAVE BEEN BESTOWED)
UPON THE HUMAN MALARIA PARASITES IN
THE PERIOD 1881-1897**

33. In the revision of any group it is necessary, after having determined on taxonomic genus how many species are involved, firmly to establish the identity of each of the nominal species concerned (that is, the identity of each unit which has been treated by any author either as a distinct species to which a new specific name (binominal combination) has been given) or as a new nominal subspecies to which a new subspecific name (trinominal combination) has been given, before it is possible to determine the identity of the type species of the genera which have been established for species of the group concerned. It is for this reason that in the present paper the discussion of the specific trivial names bestowed (or alleged to have been bestowed) upon human malaria parasites precedes the discussion of the generic names similarly bestowed.

(1) The specific trivial name "malariae" as published in combination with the generic name "Oscillaria" by Laveran in 1881 for the Malignant Tertian Malaria Parasite

34. In 1880 Laveran reported for the first time the discovery in the blood of human patients suffering from malaria of elements which he thought to be parasitic (paper entitled "Un nouveau parasite trouvé dans le sang des malades atteints de fièvre palustre. Origine parasitaire des accidents de l'impaludisme," 24th December 1880, *Bull. Soc. med. Hôp., Paris*, (2) 17 : 158—164). In this preliminary report Laveran described three forms of the organism which he had discovered, namely (1) crescentic or ovoid bodies which were transparent or colourless, except for certain rounded pigment granules near the centre, (2) bodies which in repose were spherical, transparent and contained a ring of rounded pigment granules of about the same size, but which, when in movement, were surrounded by three or four fine filaments which had an active worm-like movement, (3) spherical bodies, slightly granular, and non-motile, which Laveran believed were cadaveric forms of body (2). Laveran did not in this paper give a scientific name to the parasite which he had discovered.

35. In May 1881 Laveran followed up this preliminary report in a monograph of 104 pages published by J. B. Baillièrè et fils, Paris, under the title "Nature parasitaire des Accidents de l'Impaludisme." In this monograph Laveran gave a fuller description of the parasite which he had discovered. He gave particulars of the three types of body which he had described in his paper the previous year and again came to the conclusion that all three were referable to a single species. On the relationship of that species to other species, Laveran expressed himself as being in doubt, but he finally decided to treat it as a new species and to give it a scientific name. The passage concerned, which is on pages 86 and 87 of his monograph, reads as follows:—

[86]

A quelle espèce appartient ce nouvel hématozoaire? Ici j'avoue mon embarras et je fais appel aux naturalistes. J'avais d'abord pensé qu'il s'agissait d'un amibe, qui, à l'état de développement complète, était muni de filaments mobiles; nous avons vu en effet, que les corps no. 2, en dehors des mouvements oscillatoires qui leur sont imprimés par les filaments mobiles, présentent assez souvent des mouvements lents, analogues à ceux des amibes; mais j'ai dû abandonner cette idée lorsque j'ai eu constaté que les filaments mobiles pouvaient se détacher des corps no. 2 et vivre à l'état de liberté dans le sang.

Je suppose aujourd'hui que les filaments mobiles renflés légèrement à une de leurs extrémités représentent l'état parfait du parasite du sang, et que les corps no. 1, no. 2 et no. 3 ne sont que des espèces de poches dans lesquelles ces parasites vivent pendant un certain temps à l'état d'agglomération, d'enkystement.

[87]

Les corpuscules brillants, arrondis, mobiles que l'on trouve presque toujours dans les préparations de sang provenant des malades atteints de fièvre palustre, représentent peut-être la première phase de développement des éléments parasitaires. Ces corpuscules n'ont pas, du reste, de caractère spécifique.

Les filaments mobiles des corps no. 2 ont une grande analogie avec des oscillariés. Il est à noter, que plusieurs observateurs, qui ne soupçonnaient pas l'existence de ces animalcules dans le sang des malades atteints de fièvre palustre, ont attribué déjà un grand rôle aux oscillariées dans la pathogénie de l'impaludisme. Hallier, le premier je crois, a émis cette opinion, toute théorique d'ailleurs.

Le Dr. Schurtz de (Zwickau) cite le fait d'un homme pris de fièvre intermittente dans des conditions de salubrité très bonnes en apparence; ce malade se livrait à l'étude des cryptogrammes et il

avait dans sa chambre à coucher vingt-quatre soucoupes renfermant des oscillariées (*Arch. d. Heilk.* 1868, p. 69). S'il était démontré que les filaments mobiles des corps no. 2 sont bien réellement de l'espèce des oscillariées le nom d'*Oscillaria malariae* conviendrait bien au nouvel hématozoaire.

36. Before we consider the question of the identity of the species to which Laveran applied the name *Oscillaria malariae*, there is a preliminary point of a purely nomenclatorial character which we must pause to examine. In this connection, it will be noted that the name *Oscillaria malariae* was not given in an unequivocal manner to the parasite which Laveran had discovered but was bestowed conditionally, Laveran not going further than noting that, if it were to be established that the mobile filaments seen in "Body No. 2" (i.e. in the second of the three forms described in his paper) were really a species of "oscillarian," then the name *Oscillaria malariae* would be a suitable name for the new Haematozoon. The question which we have to ask ourselves is whether the name *Oscillaria malariae* is invalidated by reason of having been given in this conditional manner or whether, notwithstanding the method by which this name was bestowed, it possesses rights under the Law of Priority (Article 25). If we had only the *Règles* to guide us, this question might be one of considerable difficulty, but fortunately the International Commission on Zoological Nomenclature has given a definite Ruling in an exactly similar case.

37. The Ruling given by the International Commission on this question is embodied in its *Opinion* 49 (1912, *Smithson. Publ.* 2060: 112—113). In the case dealt with in this *Opinion*, an author (Thomas) had described a species which he doubtfully identified with a previously established nominal species (*Aphis asclepiadis* Fitch) but added that, should the species which he so described prove distinct from Fitch's species (*asclepiadis*), "it may be named *Siphonophora asclepiadifolii*." The question put to the Commission was whether the specific trivial name *asclepiadifolii* Thomas was an available name or whether it was invalidated by the conditional manner in which it had been bestowed. In the latter event, the next oldest specific trivial name for Thomas's species was, it was stated in the application, "*asclepiadis* Cowen, 1895" (that name not being a homonym because originally

described in a different genus and Thomas's species and Fitch's species not being regarded as congeneric). The answer to this question, as given by the Commission in the "summary" to *Opinion* 49 reads: "On basis of the data submitted, *asclepiadifolii* Thomas, 1879, stands in preference to *asclepiadis* Cowen, 1895." This *Opinion*, therefore, lays down the general principle that the availability of a scientific name is not impaired if that name is bestowed conditionally, provided that in other respects the name in question is an available name. We may conclude, therefore, that the name *Oscillaria malariae* Laveran, 1881, is not invalidated by reason of having been bestowed conditionally³.

38. When we turn to the question of the identity of the parasite to which in May 1881 Laveran applied the specific name *Oscillaria malariae*, we come up against the first of the main sources of confusion in the nomenclature of the human malaria parasites. Laveran himself was attempting to determine the cause of malaria fever in Man and believed that he had succeeded in so doing, when, as he thought, he established the presence in the blood of malaria subjects of the parasite to which he gave the name *Oscillaria malariae* (in the passage quoted in paragraph 35 above). He described three forms of the parasite but he considered that these were all referable to a single species. Further, he certainly did not envisage the possibility that the various forms of malaria might be due to the existence of more than one species of parasite. In view of the fact that since 1881 malariologists have established the existence of a number of distinct species of parasite, each responsible for a particular form of malaria, it is necessary to determine which of these species it was that Laveran in 1881 described under the name *Oscillaria malariae*. It is necessary also to examine the possibility that what are now regarded as two or more species were included by Laveran in his single nominal species *Oscillaria malariae* at the time when he published that name in 1881.

39. Until the publication of Christophers' and Sinton's paper in 1938 (paragraph 6 above) the specific trivial name *malariae*

³ In 1948 the Thirteenth International Congress of Zoology, on the recommendation of the International Commission on Zoological Nomenclature, inserted in the *Règles* a provision embodying the Ruling given in *Opinion* 49 (1950, *Bull. zool. Nomencl.* 4: 144—145).

Laveran, 1881, as published in the combination *Oscillaria malariae*, had for more than a generation been universally accepted as applying to the Quartan Malaria Parasite. This view was based upon what were thought to be authoritative determinations by earlier malariologists and was not supported by any re-examination of Laveran's original description. A critical review was, however, undertaken by Christophers and Sinton who reported (1938 : 1131) as follows: "After a careful examination of the original publications we have convinced ourselves that Laveran's description, given at the time of naming, relates with absolute certainty to the sexual forms of the malignant tertian parasites and to these only." An exactly similar conclusion was reached by Sabrosky & Usinger as the result of an independent study carried out by them during the war, when serving in the Malaria Control in War Areas Unit of the United States Public Health Service, these authors summing up their conclusions in the following words: "Malariologists are now agreed that Laveran had the sexual forms of this species [i.e. "the parasite of malignant tertian malaria"], only, in his first paper cited above" (Sabrosky & Usinger, 1944 : 190).

40. These authorities are thus agreed not only that, when the name *Oscillaria malariae* was first published, it was applied by Laveran to the Malignant Tertian Malaria Parasite, but also that the whole of the material on which this name was based consisted of this parasite and of no other. This latter conclusion is of importance from the nomenclatorial standpoint, for, if it could be shown that, as originally published, the nominal species *Oscillaria malariae* Laveran, 1881, was a composite species which, though based largely (or almost exclusively) upon the Malignant Tertian Malaria Parasite, was based in part also upon the Quartan Malaria Parasite, an entirely different situation would arise. In that event, it would be possible legitimately to attach the name *Oscillaria malariae* Laveran, 1881, to the Quartan Malaria Parasite (notwithstanding the fact that Laveran clearly based his description mainly upon the Malignant Tertian Malaria Parasite), if it could be shown that the first author to note that *Oscillaria malariae* Laveran, 1881, was a composite species, had, in his capacity as "first reviser" (under Article 31), selected the Quartan Malaria Parasite as the species to which the specific trivial name *malariae* Laveran, 1881, should adhere. It will be convenient

here briefly to summarise the evidence on this subject which leaves no loophole for the belief that, as originally published, the nominal species *Oscillaria malariae* was a composite species.

41. It is interesting in this connection to compare Laveran's treatment of the subject in his "Nature parasitaire des Accidents de l'Impadudisme" in which in 1881 he first published the specific name *Oscillaria malariae*, with his treatment of the subject in his book "Du Paludisme et de son Hématozaire" which was published ten years later (1891) and in which he reviewed the whole subject in the light of the knowledge gained during the intervening period. In the first of these works he recognised, as we have seen (paragraphs 34-35 above), three types of body, all of which he regarded as referable to his *Oscillaria malariae*. In the second of these books he recognised four types of body. The three types of body recognised in 1881 which are the same as bodies Nos. 1 to 3 recognised in 1891 are, it is now agreed, all forms of the Malignant Tertian Malaria Parasite.

42. It is only in regard to Body No. 4 that any question can arise. Here we have to consider (1) to what species does this type of body belong and (2) was Laveran aware of the existence of this type of body when he wrote his "Nature parasitaire des Accidents de l'Impaludisme" in the early part of 1881.

43. In their paper of 1938, Christophers and Sinton stated (1938 : 1132, footnote) that the descriptions and figures relating to Body No. 4 given by Laveran in 1891 (in his "Du Paludisme et de son Hématozaire") "strongly suggest segmenting forms" of the Quartan Malaria Parasite. More recently, however, Sir Rickard Christophers has somewhat modified this view (*in litt.*, 24th March 1944):—

Even in his later treatises it would be very difficult to say that Laveran had definitely singled out any form as quartan. In fact his forms *en rosace* might from his figures fit much more with segmenting forms of the malignant tertian parasite. This is all the more probable from the fact, noted by Sinton and myself, that Laveran was dealing largely with the parasite as seen in the organs in post-mortem material.

44. But, whatever the nature of these No. 4 Bodies which Laveran in 1891 regarded as referable to the species described by him in 1881 as *Oscillaria malariae*, they can have no relevance to the identity of that nominal species itself, since there is no evidence whatever that Laveran had before him, or indeed had ever seen, any bodies of this type when he published the name *Oscillaria malariae* in 1881. It is true, as Christophers and Sinton have pointed out (1938 : 1132, footnote) that Laveran himself stated in 1891 (*loc. cit.*) that he had seen these No. 4 Bodies in the blood of a case examined in September 1881. This observation was immediately reported in a paper entitled "De la Nature parasitaire de l'Accident de l'Impaludisme," which was published in the following month (October 1881, *C. R. Acad. Sci., Paris* 93 : 627—630). Thus, we have Laveran's own word that he saw these No. 4 Bodies in September 1881 and we have also his paper reporting this observation in October. But Laveran's book "Nature parasitaire des Accidents de l'Impaludisme" (in which the name *Oscillaria malariae* first appeared) was actually published in 1881 as early as the month of May, for we know (Christophers & Sinton, 1938 : 1132, footnote) that on 3rd May 1881 Laveran presented this book to the Academie de Médecine. In that book Laveran set out to describe the whole of the results so far achieved by him in his investigations of the causes of malaria in Man; he described fully the three types of body which he had found and it is inconceivable that, if he had been aware of a fourth type of body, he would have omitted to record its existence. From the evidence summarised above, we may conclude (1) that, when Laveran wrote the book in which he first published the name *Oscillaria malariae*, he had never seen the type of body which he later called Body No. 4, (2) that it was not until September 1881 that he observed these No. 4 Bodies for the first time, and, therefore (3) that Laveran's discovery of the No. 4 Bodies took place five months subsequent to the publication (in May 1881) of the book containing the name *Oscillaria malariae*. We may also conclude that the paper referred to above which appeared in the issue of October 1881 of the *Comptes rendus des Séances de l'Academie des Sciences* of Paris was the first occasion on which Laveran recorded the existence of these No. 4 Bodies.

45. It is perfectly clear from the foregoing evidence that these No. 4 bodies were unknown to Laveran at the time when he wrote his original description of *Oscillaria malariae* (which must have been on some date prior to May 1881, by which time the book containing that name is known to have been actually published) and that the only forms of malaria parasite which were known to Laveran in the early part of 1881 were the three forms described in his book as forms of *Oscillaria malariae*. All these forms, it is now agreed, were forms of the Malignant Tertian Malaria Parasite. Accordingly, this is the species to which the specific trivial name *malariae* Laveran, 1881 as published in the combination *Oscillaria malariae*, applies. Being both a nomenclatorially available name (i.e. not a homonym of any previously published name) and at the same time the first specific trivial name to be bestowed upon the Malignant Tertian Malaria Parasite, the name *malariae* Laveran, 1881, is under the *Règles*, the valid specific trivial name for this species. For reasons which, apart from the extraordinary events described in paragraphs 46-51 below, would be quite inexplicable, the name *malariae* Laveran, 1881, although the oldest available name for the Malignant Tertian Malaria Parasite and, indeed, for any of the human malaria parasites, has completely dropped out of use. Its resuscitation at this late date for the Malignant Tertian Malaria Parasite would, however, lead to the most serious confusion and there is the strongest possible case for the use by the International Commission of its Plenary Powers to prevent this from happening.

Note on the misuse at the beginning of the twentieth century of the specific trivial name "malariae" Laveran, 1881, as published in the combination "Oscillaria malariae", followed by the total eclipse of that name

46. Before we leave the name *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, we must pause to examine the causes of the extraordinary misuse to which this name was put some twenty years after it was published and to note how, after this misuse had served its turn, this name was quietly allowed to drop out of use altogether. For this episode is not

only of interest by reason of its unique character in the history of nomenclature but in addition an understanding of it is necessary in order to follow the history of the other names for the human malaria parasites.

47. In approaching this problem, we have first to note that the specific trivial name *malariae* was given independently to two different human malaria parasites: first by Laveran in 1881 in the combination *Oscillaria malariae* to the Malignant Tertian Malaria Parasite (paragraph 45) and, second, by Feletti & Grassi in 1889 in the combination *Haemamoeba malariae* to the Quartan Malaria Parasite (paragraphs 53-77 below), following the discovery by Golgi in 1885 of the existence of this second species. For reasons on which no light is thrown by the literature the name *malariae* (as published by Feletti & Grassi) quickly won acceptance for the Quartan Malaria Parasite, while there was a correspondingly rapid decline in the use of the name *malariae* (as published by Laveran) for the Malignant Tertian Malaria Parasite, a variety of later names being applied to that species, e.g. *praecox* Grassi & Feletti, 1890, *immaculata* Grassi, 1891, *laverani* Labbé, 1894, and, finally to the exclusion of these names, the name *falciparum* Welch, 1897. During the same decade the name *Laverania* Feletti & Grassi, 1889 (usually attributed to Grassi & Feletti and dated 1890) came into general use as the generic name for the Malignant Tertian Malaria Parasite by those malariologists—at that time numerous—who accepted the view advanced by Feletti & Grassi in 1889 that this species was generically distinct from the Quartan Malaria Parasite. A serious problem remained for those specialists who regarded both the foregoing species as belonging to a single genus, for it was generally agreed by this time that the name *Oscillaria* used by Laveran in 1881 (paragraphs 187-198) was not appropriate and therefore that the name to be used must be *Plasmodium* Marchiafava & Celli, 1885. The difficulty which arose here was that this name was published four years before Golgi first detected the Quartan Malaria Parasite as being distinct from the Malignant Tertian Malaria Parasite and it would therefore clearly be difficult to sustain an argument that the name *Plasmodium* could be used for the Quartan Malaria Parasite. Nevertheless, if no such argument could be devised, the commonly accepted name *Laverania* Feletti & Grassi, 1889,

would fall as a junior synonym of *Plasmodium* Marchiafava & Celli, 1885, which would thus become the generic name for the Malignant Tertian Malaria Parasite, while it would be necessary to use for the Quartan Malaria Parasite the name *Haemamoeba* Feletti & Grassi, 1889. The present *Règles* were not in existence at the time that we are considering but the unwritten code by which zoologists of that day guided themselves provided that the relative status both of generic names and of specific trivial names should be regulated in accordance with the Law of Priority. Thus, malariologists who desired to retain (a) the word "malariae" as the specific trivial name for the Quartan Malaria Parasite and (b) the generic name *Laverania* Feletti & Grassi, 1889, for the Malignant Tertian Malaria Parasite were confronted with insuperable nomenclatorial difficulties.

48. In these circumstances we have to inquire how it was that within a few years of the opening of the present century malariologists had come to believe (1) that the name *malariae* Feletti & Grassi, 1889, could properly be used for the Quartan Malaria Parasite by workers who accepted only one genus for the human malaria parasites, notwithstanding the fact that the word *malariae* (as from Laveran, 1881) was the oldest available name for another species (the Malignant Tertian Malaria Parasite) in the same genus (*Plasmodium*) and (2) that the generic name *Laverania* Feletti & Grassi, 1889, could be used, in preference to the name *Plasmodium* Marchiafava & Celli, 1885, for the Malignant Tertian Malaria Parasite by those specialists who regarded that species as generically distinct from the Quartan Malaria Parasite. Christophers & Sinton (1938 : 1132-1133) have shown that this change of attitude took place in about the year 1900, in which year Lühe published his work *Ergebnisse der neuen Sporozoenforschung* and also two papers on this subject in the *Zentralblatt für Bakteriologie* (1900, *Zbl. Bakt.* 27 : 367 and 28 : 205), in which he cut the Gordian Knot by boldly asserting that the type species of the genus *Plasmodium* Marchiafava & Celli, 1885, was "*Plasmodium malariae* Lav., s. str." and that this species was the Quartan Malaria Parasite. Two years later (1902, *Arb. Gesundhampt. Berl.* 19 : 169) this erroneous identification was reinforced by its adoption by the great authority Schaudinn.

49. It is quite impossible to believe that two such eminent authorities as Lühe and Schaudinn could possibly have fallen into such gross errors as those described above. There must therefore be some entirely different explanation of their action in this matter. Nor is it difficult to guess what is the true explanation of their action. In the serious dilemma in which they found themselves they were faced with the choice between on the one hand applying the international rules of zoological nomenclature, thereby losing both the generic name *Plasmodium* as the generic name for the Quartan Malaria Parasite and also the specific trivial name *malariae* for that species and on the other hand disregarding the rules of nomenclature. In this serious situation they must have asked themselves the question: Is there no way out of these difficulties? Clearly there was one way and one way only. This was to claim that Laveran in 1881, like Feletti & Grassi in 1889, had applied the specific trivial name *malariae* to the Quartan Malaria Parasite, for, if acceptance for such a claim could be secured, that species would then retain its specific trivial name *malariae*, although in future it would be necessary to attribute that name to Laveran, 1881, instead of to Feletti & Grassi 1889 (or 1890). The only possible means by which such a transformation of the scene could be effected was either (1) to claim that Laveran's original description of *Oscillaria malariae* in 1881 showed that that species was a composite species which, in addition to the Malignant Tertian Malaria Parasite, had included also the Quartan Malaria Parasite, which, therefore, any subsequent author, acting as the "first reviser," would be entitled to select as the species to which the name *malariae* Laveran, 1881, should attach, or (2) to claim that, in publishing the name *Oscillaria malariae*, Laveran had published not a description of a particular species of malaria parasite but a general description of "the parasite" responsible for malaria in Man, in which case also it could be claimed (though not with any real validity) that a later author, acting as "first reviser," could restrict the specific trivial name *malariae* Laveran, 1881, to some one of the known malaria parasites, say, the Quartan Malaria Parasite.

50. When we turn back to the papers published by Lühe in 1900, we find that, without a word of explanation, he stated that the species which he called "*Plasmodium malariae* Lav., s. str." was the Quartan Malaria Parasite. This was the statement which

was endorsed (again without comment) by Schaudinn in 1902. This action by these two authors is undoubtedly the root cause of the misappropriation for the Quartan Malaria Parasite of the name properly belonging to the Malignant Tertian Malaria Parasite which was to persist unchallenged for the next forty years. The only conclusion which can be drawn from this episode is that first Lühe and later Schaudinn were more impressed by the need for (as they thought) stabilising the nomenclature of the human malaria parasites on the basis of current practice than by the need for the strict application of the international rules of zoological nomenclature.

51. The bold plan conceived and carried out by Lühe and Schaudinn was completely successful. The immense prestige of these authorities at once secured an uncritical acceptance from other malariologists, who were, it may be assumed, only too glad to adopt without question such highly acceptable conclusions backed, as they were, with the sanction of the two greatest experts of the day. In one small respect only did the solution devised by Lühe and Schaudinn fail to secure an apparently valid basis for the then-existing nomenclatorial practice; this was that under that solution it was necessary to attribute the trivial name *malariae*, as applied to the Quartan Malaria Parasite, to Laveran, 1881, instead of to Feletti & Grassi, 1889. It was not long however, before even this disadvantage was overcome, for, once the attribution to Laveran of the name *malariae* as the name for the foregoing species had served its turn, it was quietly dropped, Feletti & Grassi (or rather—though incorrectly—Grassi & Feletti) were restored to their position as the authors of the name *malariae* as applied to the Quartan Malaria Parasite, and the name *malariae* Laveran, 1881, though a valid name and, indeed, the oldest name for any of the human malaria parasites, disappeared altogether from current use.

52. It is interesting to reflect that this conflict between the requirements of stability in nomenclature and strict adherence to the rules of zoological nomenclature (in regard to the elimination of secondary homonyms) could only be resolved at that time by an almost certainly deliberate misidentification of one of the nominal species concerned. It was to meet such embarrassing

dilemmas (and, incidentally, to eliminate dangerous temptations of this kind) that at its meeting held at Monaco in 1913 the Ninth International Congress of Zoology conferred upon the International Commission on Zoological Nomenclature Plenary Powers to suspend the *Règles* (which had been adopted at Berlin in 1901) in any case where, in the judgment of the Commission, the strict application of the *Règles* would clearly result in greater confusion than uniformity. Had these Powers existed in 1900, the difficulty which then confronted Lühe and Schaudinn could have been met by the Commission using these Powers⁴ in such a way as would have legitimately secured the objective sought by those authors, namely the validation for the Quartan Malaria Parasite of the specific trivial name *malariae*, which could then have continued to be attributed to Feletti & Grassi, its rightful authors.

(2) The specific trivial name "malariae" as published in combination with the generic name "Plasmodium" by Marchiafava and Celli in 1885 for the Malignant Tertian Malaria Parasite

53. It was only when I was in course of preparing the present paper that I came across for the first time the hitherto entirely overlooked publication of a new specific trivial name as applied to a human malaria parasite, namely *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*. This appeared in the paper entitled "Weitere Untersuchungen über die Malariainfektion" in which Marchiafava & Celli first published the name *Plasmodium* (1885, *Fortschr. Med.*, 3(24) : 791).

⁴ At its meeting held in Paris in 1948, the Thirteenth International Congress of Zoology, on the recommendation of the International Commission on Zoology, decided to insert a provision in the *Règles* incorporating the Resolution adopted by the Ninth International Congress, Monaco, 1913, granting Plenary Powers to the International Commission to suspend the normal operation of the *Règles* in cases where it was satisfied that "the strict application of the *Règles* would clearly result in greater confusion than uniformity" (1950, *Bull. zool. Nomencl.* 4 : 64—66). At Copenhagen in 1953 the Fourteenth International Congress of Zoology, on the recommendation of the International Commission, deleted the restrictive phrase quoted above and in its place inserted a provision prescribing that the Plenary Powers had been granted "for the purpose of preventing confusion and of promoting a stable and universally accepted nomenclature" (1953, *Copenhagen Decisions zool. Nomencl.* : 23).

54. I was led indirectly to this discovery by following up the important contribution by Drs. Sabrosky & Usinger (in the paper submitted by them to the International Commission on Zoological Nomenclature in August 1944) on the question of the identity of the species on which in 1885 Marchiafava & Celli had based their genus *Plasmodium*. Whereas Christophers & Sinton in their paper in 1938 had accepted the view universally held at that time—a view which resulted from the misidentification by Lühe and Schaudinn referred to in paragraphs 46-51 above—that the Quartan Malaria Parasite was the type species of the genus *Plasmodium* Marchiafava & Celli, Sabrosky & Usinger had reached the conclusion that the type species of that genus was not the Quartan Malaria Parasite but the Malignant Tertian Malaria Parasite.

55. While, as I realised, the taxonomic interpretation of whatever Marchiafava & Celli might have written about the unit which they placed in their new genus *Plasmodium* was a matter upon which only malariologists could pronounce, I considered it desirable, as a first step, myself to examine the passage in the foregoing authors' paper of 1885, in order that I might satisfy myself on any purely nomenclatorial issues which I might find to be involved. The results of this examination were so unexpected that I quote in full the passage in which Marchiafava & Celli introduced the generic name *Plasmodium*:—

*Extract from page 791 of the paper published in 1885
in which Marchiafava & Celli established the
nominal genus " Plasmodium "*

Aus dem gesagten geht hervor, dass die beschriebenen Körperchen nicht verwechselt werden dürfen mit irgendwelchen zufälligen oder pathologischen Dingen die man bisher in den roten Blutscheiben bemerkt hat. Hier handelt es sich um Körperchen, welche frei im Protoplasma der roten Blutscheibe befindlich sind, die sie, wie wir unten näher sehen werden, verlassen können, um Körperchen welche aus Teilchen des Protoplasmas ohne ausgesprochene Structur bestehen, und die mit lebhafter amöboider Bewegung begabt sind. Und wenn wir diese Constitution, diese Lebensäusserungen bedenken, wenn wir an den innigen Zusammenhang denken, welcher zwischen ihren Wirkungen und der Pathologie der Malaria-infection (Melanaemie, Oligaemie, etc.) besteht und an ihre ausschliessliche und constante Gegenwart im

Malariablut, welches unzweifelhaft die Fähigkeit besitzt, die Krankheit zu übertragen, so scheint es uns nicht fernliegend, sie als parasitäre Organismen anzusprechen und ihnen den Namen *Plasmodium Malariae* zu geben. Wir glauben nicht, dass dieser Name vollkommen geeignet wäre, und keiner Kritik unterworfen werden könnte, aber wir haben, wie wir gestehen müssen, keinen besseren dafür finden können.

Es ist gesagt worden dass diese einfachsten Organismen keine ausgeprägte Structur besitzen, wir müssen noch hinzufügen dass dieselben in gewissen Phasen ihrer Bewegungen und wenn sie unbeweglich sind, eine periphere dicke und glänzende Partie zeigen und eine innere weniger glänzende, welche bisweilen feinkörnig erscheint. Die periphere glänzende Partie ist die, von der die Fortsätze oder Pseudofüsse ausgehen; die letzteren erscheinen in der Tat stets sehr glänzend und färben sich intensiver, während die centrale Partie entweder so dünn ist, dass sie das Protoplasma der roten Blutscheibe durchscheinen lässt, oder den Eindruck eines hellen oder leichtgefärbten Kernes von deutlicher Begrenzung darbietet.

56. The above passage brought to light an entirely new fact, hitherto overlooked by malariologists, namely that, when Marchiafava & Celli originally described their new genus *Plasmodium*, they at the same time applied a new scientific name, *Plasmodium malariae*, to the taxonomic unit which they placed in that genus. It had always been assumed by malariologists that, in establishing the new genus *Plasmodium*, Marchiafava & Celli had not used a scientific name for the species which they placed in it. Since, prior to Sabrosky & Usinger's paper of 1944, the genus *Plasmodium* Marchiafava & Celli, 1885, was assumed to be a monotypical genus based upon the Quartan Malaria Parasite, its type species had commonly been cited either as *Oscillaria malariae* Laveran, 1881, or as *Haemamoeba malariae* Feletti & Grassi, 1889. Sabrosky & Usinger, who treated the species concerned as being the Malignant Tertian Malaria Parasite and not the Quartan Malaria Parasite, also assumed that no scientific name had been used by Marchiafava & Celli for the sole species included by them in *Plasmodium* and referred to that species as *Oscillaria malariae* Laveran, 1881, citing this, the oldest name for the Malignant Tertian Malaria Parasite, as the name of the type species of the genus *Plasmodium*. Later on, however, this question was re-examined by these authors, and in another paper of October 1946 (*Science* **104** (No. 2704) : 401—2), Dr. Sabrosky

himself drew attention to the publication by Marchiafava & Celli of the specific name *Plasmodium malariae* Marchiafava & Celli, 1885. He quoted an extract from the passage (reproduced in paragraph 55 of the present paper), in which Marchiafava & Celli introduced the name *Plasmodium malariae*, and added: "The name was italicised and unquestionably intended as a formal scientific name. The proposal of *Plasmodium* as a new generic name has been accepted, but the new specific name has apparently been quite generally overlooked."

57. It was important to discover that, contrary to the universally held belief, Marchiafava & Celli actually applied a scientific name to the species on which their new genus *Plasmodium* was based. We have, however, still to consider the question whether the specific trivial name *malariae* in the combination *Plasmodium malariae* was regarded by Marchiafava & Celli as a new specific trivial name appropriated to an entirely new nominal species, or whether they were using the trivial name *malariae* Laveran, 1881, because they regarded themselves as describing the same species as that which Laveran had named *Oscillaria malariae* in 1881, and were merely transferring it to their new genus *Plasmodium*. In the first case the specific name *Plasmodium malariae* as used by Marchiafava & Celli would be *Plasmodium malariae* Marchiafava & Celli, 1885, whereas in the second it would be *Plasmodium malariae* (Laveran, 1881).

58. This is not an easy question to answer because we know (a) that Marchiafava & Celli, like Laveran, never considered that there might be more than one human malaria parasite, and, like him, also thought that they were describing *the* sole organism responsible for malaria in Man, (b) that the great bulk of the material on which Marchiafava & Celli based their description of *Plasmodium malariae* was, in fact, referable to the same species as that previously described by Laveran, namely the Malignant Tertian Malaria Parasite (paragraph 45 above), and (c) that Marchiafava & Celli were certainly familiar with the paper in which Laveran had described this species and had given it the name *Oscillaria malariae*.

59. On the other hand, as Sir Rickard Christophers has pointed out to me (*in litt.*, 6th October 1944), the bodies described by Marchiafava and Celli in 1885 as *Plasmodium malariae* were the small amoeboid intracellular asexual forms of the Malignant Tertian Malaria Parasite and were therefore very different from the large flagellating sexual forms of the same species, to which Laveran in 1881 had given the name *Oscillaria malariae*. It would have been natural therefore from this point of view if Marchiafava & Celli had regarded the new organism which they had discovered as representing an entity specifically distinct from that previously described by Laveran. Moreover, no one, of course, at this time had any idea of the existence of distinct sexual and asexual cycles in this species.

60. It seems clear, therefore, that Marchiafava & Celli must have thought that they were describing an entirely new species. They knew that Laveran thought that he had discovered *the* parasite responsible for human malaria. They themselves described what seemed to them to be quite another organism, which they, in their turn, regarded as *the* organism responsible for malaria. In other words, they must have thought that Laveran was in error in believing that the organism described by him was *the* organism responsible for malaria.

61. For the new species which they regarded as *the* organism responsible for malaria, Marchiafava & Celli selected the new specific name *Plasmodium malariae*. For that new name, they adopted, as the generic name, the word "*Plasmodium*," which appeared to them to be suitable in view of the amoeboid character of the organism in question; for the specific trivial name of this organism, they selected the word "*malariae*," believing, as they did, that they had at last discovered the organism really responsible for the disease malaria. It is no matter for surprise in such circumstances that the obvious appropriateness of this name outweighed any objections arising on grounds of nomenclatorial priority (if, in fact, such questions as this were ever considered by them at all).

62. The conclusion that Marchiafava & Celli, in using the name *Plasmodium malariae* for the species placed by them in their genus *Plasmodium*, were definitely introducing a new specific name as well as a new generic name, has been reached independently both by Sir Rickard Christophers and by Dr. Sabrosky as well as by myself. In a letter dated 16th October 1944, Sir Rickard Christophers wrote: "I think that *Plasmodium malariae* M. & C. must be regarded as probably a new name and not merely the identification by these authors of *Oscillaria malariae* Laveran"; and Dr. Sabrosky in his paper of 1946 concluded: "Careful reading of Marchiafava & Celli (*Fortschr. Med.*, 1885, 3, 791—797) shows that they too were proposing what they regarded as a distinct new form, quite unlike any previously described."

63. We may take it as established, therefore, that, in introducing the name *Plasmodium malariae*, Marchiafava & Celli definitely intended this to be regarded as a new specific name and not as a specific name, of which the trivial component (*malariae*) was the trivial name *malariae* Laveran, 1881, brought over into the genus *Plasmodium*, consequent upon the decision taken by Marchiafava & Celli on taxonomic grounds that this species should be transferred to that genus from the genus *Oscillaria*, in which it had originally been described by Laveran.

64. We must now revert to the question from which we started the investigation which led to the discovery of the new specific name *Plasmodium malariae* Marchiafava & Celli, 1885, namely that of the identity of the species on which the new genus *Plasmodium* had been based. As explained in paragraph 54 above, until 1944 it had been generally assumed that the species in question was the Quartan Malaria Parasite. When I received in August 1944 the paper by Drs. Sabrosky & Usinger, in which they expressed the view that the type species of the genus *Plasmodium* Marchiafava & Celli was the Malignant Tertian Malaria Parasite, I immediately wrote to Sir Rickard Christophers (who, in his paper written jointly with Brigadier Sinton in 1938 had treated the Quartan Malaria Parasite as the type species of this genus), and asked him to re-examine Marchiafava & Celli's original description of *Plasmodium* in the light of the views expressed by Drs. Sabrosky & Usinger.

65. In a letter dated 14th September 1944 Sir Rickard Christophers stated that in the paper in which Marchiafava & Celli had established the genus *Plasmodium*: "They were describing especially certain small amoeboid rings, some without pigment, and from the plate these might well be Malignant Tertian rings. Also they were describing parasite finds in some 40 cases seen by them in the Pontine Marshes, some of which were cerebral pernicious cases." Sir Rickard added: "Altogether the impression left with me is that Marchiafava in this paper was mainly dealing with Malignant Tertian."

66. The use of the word "mainly" by Sir Rickard Christophers in this context suggested the idea that, although Marchiafava & Celli themselves were unaware of the existence of more than one human malaria parasite, it was possible that, in fact, they had more than one species before them when they were establishing their new genus *Plasmodium*; in other words, that the genus *Plasmodium* was not monotypical and the nominal species *Plasmodium malariae* Marchiafava & Celli was a composite species.

67. This point was brought out specifically by Dr. Sabrosky in his paper of 1946⁵. He there quotes an analysis by Dr. Martin Young (*United States Public Health Service, National Institute of Health, Bethesda, Maryland*) of Marchiafava & Celli's detailed descriptions and figures, in which Dr. Young says: "It seems to me definitely that most of the infections that they saw were *falciparum*. However, they seem occasionally to have run across a *vivax* infection. Some of the descriptions are definitely of *vivax* segmenters, while others of the descriptions, especially where they mention the finding of crescents, are definitely *falciparum*." Dr. Sabrosky himself concludes: "There seems little doubt, therefore, that *Plasmodium malariae* M. & C. was based mainly on the malignant tertian parasite (*falciparum*). The benign tertian parasite (*vivax*) was seen, but there is no evidence of quartan."

⁵ See paragraph 56.

68. It appears therefore that the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, must be regarded as a composite species made up mainly of the Malignant Tertian Malaria Parasite but composed in part also of the Benign Tertian Malaria Parasite. Because the specific name has for so long been overlooked, this nominal species has up till now not been restricted to one or other of the two species of which it is composed (the Malignant Tertian Malaria Parasite and the Benign Tertian Malaria Parasite), despite the fact these two species have long been clearly distinguished from one another.

69. In order that the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, shall become determinate, one of the two species of which it was originally composed must be selected in accordance with the provisions of Article 31 of the *Règles*⁶, to be the sole species to which the specific name *malariae* Marchiafava & Celli shall adhere. We may now consider what would happen in case the species so selected was (a) the Malignant Tertian Malaria Parasite or (b) the Benign Tertian Malaria Parasite respectively.

70. Taking the first of these possibilities, we find that, if the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, were to be restricted to the Malignant Tertian Malaria Parasite, the specific trivial name *malariae* Marchiafava & Celli, 1885, would fall as a junior synonym, and as a junior secondary homonym, of the specific trivial name *malariae* Laveran, 1881,

⁶ At the time when this passage was written, the provisions in the *Règles* for the selection of a lectotype for a nominal species, the type material of which was considered by later authors to consist of examples of more than one taxonomic species were inadequate in the extreme, the Article concerned (Article 31) reading (in the then currently accepted English translation of the substantive French text) as follows: "The division of a species into two or more restricted species is subject to the same rules as the division of a genus." A first step towards the improvement of this Article was taken by the Thirteenth International Congress of Zoology, Paris, 1948, when it substituted for the provisions quoted above a new Article setting out in a form appropriate to the designation and indication of holotypes and to the selection of lectotypes for species the Rules given in Article 30 for the designation, indication and selection of type species of genera given in Article 30 (1950, *Bull. zool. Nomencl.* 4: 74—76). The revision of Article 31 was completed by the Fourteenth International Congress of Zoology, Copenhagen, 1953, when it recast the form of this Article and amended its provisions in certain minor respects (1953, *Copenhagen Decisions zool. Nomencl.* : 72—78).

as published in the combination *Oscillaria malariae* Laveran, 1881, since the taxonomic units to which these names were respectively applied by their original authors have been identified as being referable to the same species, namely the Malignant Tertian Malaria Parasite.

71. When we come to the second possibility, namely that there might be made a selection under Article 31, by which the name *Plasmodium malariae* Marchiafava & Celli, 1885, would apply exclusively to the Benign Tertian Malaria Parasite, we are confronted with a difficulty arising from the doubts which exist at the present time as to the meaning of Articles 35 and 36 relating to the rejection of junior secondary homonyms and the fact that these Articles are due to be reviewed by the next International Congress of Zoology⁷. The main question at issue is whether under those Articles the rejection of a specific name on the ground that it is a junior secondary homonym is in all circumstances permanent—as it certainly is in the case of a rejected junior primary homonym—or whether such rejection is permanent only for so long as the condition of secondary homonymy endures, that is, only for so long as two species bearing identical trivial names are judged on taxonomic grounds to belong to the same genus. If the latter view is the correct one or if these Articles were to be so amended by the next International Congress as to make that view the correct one, the availability of the name *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*, would, if restricted to apply only to the Benign Tertian Malaria Parasite, depend on the question of whether the Benign Tertian Malaria Parasite and the Malignant Tertian Malaria Parasite are regarded on taxonomic grounds as being congeneric with one another. In fact, most malariologists today place these two species in the same genus, but we have to consider the nomenclatorial situation also for any malariologists, present or future, who might prefer to treat these two species as belonging to separate genera.

⁷ The doubts as to the meaning to be attached to Articles 35 and 36 in relation to the rejection of secondary homonyms here referred to were completely removed by the series of decisions in relation to the Law of Homonymy taken by the Thirteenth International Congress of Zoology, Paris, 1948, when, after defining the conditions in which any pair of specific names are to be regarded as secondary homonyms of one another, it expressly provided that, once the junior of two secondary homonyms has been rejected on the ground of that homonymy, the rejection so made shall be permanent (1950, *Bull. zool. Nomencl.* 4: 118—125).

72. For the majority of malariologists who do regard the Benign Tertian Malaria Parasite as congeneric with the Malignant Tertian Malaria Parasite, the restriction of the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, to the Benign Tertian Malaria Parasite would lead to no change in current practice, for, although the name *malariae* Marchiafava & Celli, 1885, would then become the oldest specific trivial name for the Benign Tertian Malaria Parasite, it would fall as a junior secondary homonym of *malariae* Laveran, 1881, the oldest available, and, therefore the valid specific trivial name of the Malignant Tertian Malaria Parasite. In consequence, the Benign Tertian Malaria Parasite would retain its currently accepted specific trivial name, *vivax* Grassi & Feletti, 1890 (see paragraphs 94-95 below).

73. When we turn to consider the effect of restricting the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, to the Benign Tertian Malaria Parasite for any malariologist, present or future, who does not accept the taxonomic judgment under which the Benign Tertian Malaria Parasite has been transferred to the same genus as the Malignant Tertian Malaria Parasite, we at once find ourselves confronted by the doubts which exist as to the interpretation of Articles 35 and 36 of the *Règles* to which reference has already been made (paragraph 71)⁸. Accordingly, in existing conditions it is not possible to be sure what would be the nomenclatorial effect of the selection, under Article 31, of the Benign Tertian Malaria Parasite to be the species to which alone the name *Plasmodium malariae* Marchiafava & Celli, 1885, shall refer. This is rendered all the more doubtful by reason of the fact that this nominal species has been so completely overlooked that it cannot be said as yet that it has been formally rejected as a junior secondary homonym of the name *Oscillaria malariae* Laveran, 1881, consequent upon the species bearing this latter name having been transferred on taxonomic grounds to the genus *Plasmodium*. All that has happened so far is that Sabrosky (1944) has expressed the view that the nominal species bearing these names represent the same taxonomic species, an opinion which, as explained in paragraph 67 above, he has

⁸ As explained in Footnote 7 the doubts here referred to were completely dispelled by the action taken in 1948 by the Thirteenth International Congress of Zoology.

since (1946) modified, in the light of the detailed review of the paper by Marchiafava & Celli, carried out by Dr. Martin Young, to the extent of agreeing that, while *Plasmodium malariae* Marchiafava & Celli was based primarily upon asexual forms of the Malignant Tertian Malaria Parasite, it was also—at least to some small extent—based upon specimens of the Benign Tertian Malaria Parasite.

74. It is necessary therefore to take note that, if under any amendment or clarification of the provisions in the *Règles* relating to the rejection of junior secondary homonyms, the name *malariae* Marchiafava & Celli, 1885, if restricted to the Benign Tertian Malaria Parasite, were to become an available name for that species for any malariologist who did not regard that species as congeneric with the Malignant Tertian Malaria Parasite, the situation so created would be open to very strong objection⁹. For alone of the specific trivial names for the human malaria parasites, the name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*, as applied to the Benign Tertian Malaria Parasite, has succeeded in maintaining itself in continuous use for nearly sixty years and its supercession at this late stage for purely nomenclatorial reasons, while comprehensible to the small number of specialists who have made a study of the nomenclature of the human malaria parasites, would be incomprehensible to, and strongly resented by, the great body of malariologists for whom the names applied to these species are of interest only in so far as they are not subject to change and provide therefore a reliable means by which to refer to these species and to distinguish one from another. The objections to the supercession of the name *vivax* Grassi & Feletti, 1890, as the trivial name for the Benign Tertian Malaria Parasite would be a thousand times reinforced, if, as would be the case, the name which replaced *vivax* consisted of the word *malariae* (*malariae* Marchiafava & Celli, 1885), for it is the indiscriminate use of this ill-starred name in the past for both the Malignant Tertian Malaria Parasite and for the Quartan Malaria Parasite that has been the chief of the causes which has led to the present state of confusion in the names of the human malaria parasites.

⁹ For the reasons explained in Footnote 7 the contingency here discussed is one which since 1948 could no longer arise.

75. It should, further, be noted that, if, as the result of the restriction of the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, to the Benign Tertian Malaria Parasite, the name *malariae* (*malariae* Marchiafava & Celli, 1885) became the oldest available specific trivial name for that species for malariologists who do not regard it as congeneric with the Malignant Tertian Malaria Parasite, a new cycle of confusion would certainly open. For not only would the Benign Tertian Malaria Parasite have to be known by the name *malariae* (*malariae* Marchiafava & Celli, 1885) but in addition the name *malariae* (*malariae* Feletti & Grassi, 1890) for the Quartan Malaria Parasite would fall as a junior secondary homonym for the entire body of malariologists who regard that species and the Benign Tertian Malaria Parasite as congeneric with one another.

76. In order to avoid the risk, however remote, of such catastrophic results, I hereby myself, acting as first reviser in accordance with the provisions of Article 31 of the *Règles*, restrict the name *Plasmodium malariae* Marchiafava & Celli, 1885, bestowed a composite species consisting of the Malignant Tertian Malaria Parasite and the Benign Tertian Malaria Parasite, to apply solely to the former of these species, namely the Malignant Tertian Malaria Parasite. By this selection under Article 31, the specimens of the Malignant Tertian Malaria Parasite described and figured by Marchiafava & Celli, 1885, under the name *Plasmodium malariae* Marchiafava & Celli, 1885, as noted by Dr. Martin Young (paragraph 67 above) become the sole syntypes of the nominal species so named.

77. In view of the above selection under Article 31, the specific name *Plasmodium malariae* Marchiafava & Celli, 1885, applies exclusively to the Malignant Tertian Malaria Parasite and the specific trivial name *malariae* Marchiafava & Celli, 1885, becomes a junior subjective synonym of *malariae* Laveran, 1881 (originally published as *Oscillaria malariae*), which is the oldest available specific trivial name for this species.

- (3) The specific trivial name "malariae" as published in combination with the generic name "Haemamoeba" by Feletti and Grassi in December 1889 for the Quartan Malaria Parasite

78. The specific trivial name *malariae* was published as a new name in the combination *Haemamoeba malariae* in a paper by Feletti & Grassi which appeared under the title "Sui parassiti della malaria" on page 63 in Part 11 of volume 6 of the *Riforma medica* of Naples. This issue of the *Riforma medica* is dated 15th January 1890. The above is the place where the name *Haemamoeba malariae* (and also the generic names *Haemamoeba* and *Laverania*) are usually treated as having been first published but it appears that, in fact, the paper by Feletti & Grassi containing these names was published in pamphlet form in December 1889, i.e. about a fortnight before it appeared in the *Riforma medica*. This pamphlet is clearly very rare, for in spite of the most careful search Christophers and Sinton (1938 : 1133 note) had to report that they had been unable to locate a copy. Existing information in regard to this pamphlet is derived solely from the statements regarding it made by Blanchard (1905, *Les Moustiques* : 443, 449 note). In this work Blanchard gave the following note regarding the first publication of the generic name *Laverania*, one of the names first published in the foregoing pamphlet by Feletti & Grassi: "R. Feletti et B. Grassi. *Sui parassiti della malaria*; 8° de 11 p., 22 dec. 1889.—La brochure est datée du 22 décembre, mais n'a été remise à la poste que le 30 décembre." Elsewhere Blanchard spoke of this pamphlet as having been "distribuée le 30 décembre." The specific name *Haemamoeba malariae* Feletti & Grassi thus ranks for priority as from 30th December 1889.

79. The publication of separates of papers in advance of the appearance of the serial publication in which those papers are destined to be published (as was done by Feletti & Grassi in the present case) is liable to cause serious and unnecessary bibliographical difficulties at a later date. For this reason the practice has been severely condemned by the International Commission on Zoological Nomenclature in *Declaration 2* (1943, *Opinions and*

Declarations rendered by the International Commission on Zoological Nomenclature, 1 : 7—14)¹⁰. In the present case the fact that no copy of the original issue is available makes it impossible to quote a page reference for the original publication of the name *Haemamoeba malariae* (and the generic names *Haemamoeba* and *Laverania*) but otherwise no harm has been done, for the exact date of publication of the original pamphlet is known, thanks to the careful note published by Blanchard.

80. In the present case the position is complicated, however, by the fact that the early volumes of the *Riforma medica* are also extremely scarce (there being no copy in the United Kingdom) and most workers have had to content themselves with a French translation published by Feletti & Grassi in volume 13 of the *Archives italiennes de Biologie*. This translation appeared on 26th May, 1890. Fortunately, through the kindness of Dr. G. Robert Coatney in furnishing me with a photostat copy, I have been able in the following paragraphs to rely upon the original text as published in Italian in the *Riforma medica* on 15th January 1890 and therefore (as explained above) as originally published in pamphlet form in December 1889. In view of the great importance of this paper and the fact that (for the reasons given) it is so little known, I attach a facsimile copy of it as Document 1 in Appendix 2 to the present paper.

81. In this paper Feletti & Grassi reviewed the work of Laveran, Marchiafava, Celli, Golgi, Guarneri and other contemporary workers and in the light of this review reached the conclusion that the pigmented bodies characteristic of cases of what are known to be Benign Tertian Malaria and Quartan Malaria (referred to by Feletti & Grassi as “terzana” and “quartana” respectively) differed from the crescentic (“semiluna”) type to an extent which required the establishment for the former of a

¹⁰ At its Session held in Paris in 1948 the International Commission on Zoological Nomenclature obtained the approval of the Thirteenth International Congress of Zoology for the insertion in the *Règles* of a *Recommendation* deprecating the distribution of pre-prints of papers printed for publication in serial publications (1950, *Bull. zool. Nomencl.* 4 : 168).

new genus to which they applied the name *Haemamoeba* (*loc. cit.*: 63, column 2). Having thus formed the view that two species were involved and not one only (as hitherto supposed) and having established a new nominal genus for the newly separated species, it was necessary for Feletti & Grassi to find a specific trivial name for that species. This they did in the concluding paragraph of their paper, which appears on pages 63 and 64 and reads as follows¹¹:—

[63, column 3]

In conclusione, sono certamente paras-

[64, column 1]

siti della malaria le forme descritte da Laveran, Marchiafava, Celli ecc.; secondo ogni verosimiglianza appartengono ai *Rizopodi* e particolarmente agli *Amoebiformes*, e ne esistono *per lo meno* due specie: la *Haemamoeba malariae* (delle febbri regolari) e la *Laverania malariae* (delle febbri irregolari).

82. It will be seen from the foregoing passage that Feletti & Grassi regarded their genus *Haemamoeba* as containing but a single species, to which they applied the new name *Haemamoeba malariae*. From their standpoint, therefore, the genus *Haemamoeba* Feletti & Grassi is monotypical with the above nominal species as type species.

83. It is equally clear, however, from the passage in which Feletti & Grassi established the genus *Haemamoeba* (quoted in paragraph 81 above) that their species *Haemamoeba malariae* was a composite species consisting partly of the Benign Tertian Malaria Parasite ("terzana") and partly of the Quartan Malaria Parasite ("quartana").

84. It is necessary next to examine the circumstances in which the specific trivial name *malariae* Feletti & Grassi, December 1889, came to be restricted to one of the two species included in it at the time of its first publication. This restriction was effected in the year 1890 in a paper by the same authors published in volume 13 of the *Archives italiennes de Biologie*. There has been so

¹¹ For a facsimile of the paper here quoted see Appendix 2, Document 1.

much misconception regarding the date of publication of this paper, its authorship and its contents that it requires particularly careful study. The following are the points which require to be noted:—

- (1) The paper which begins on page 287 and ends on page 300 of volume 13 of the *Arch. ital. Biol.* has as its title: “ Sur les parasites de la malaria. Notes préliminaires des Prof. R. Feletti et B. Grassi.” This paper appeared in Part 2 of the volume cited above and was published on 26th May 1890, the wrapper to this Part bearing the words: “ Paru le 26 mai 1890.”
- (2) The foregoing paper consists of four parts, namely:—

(a) *a portion headed “ Première Note ”* (: 287—293).

The “ Première Note ” is described as “ Extrait de la *Riforma medica*, No. 11, 15 janvier 1890.” This is a translation into French of the paper originally published in Italian by Feletti & Grassi, which (as explained in paragraphs 78 and 79 above) is identical with the pamphlet published in December 1889 in which those authors first published the specific name *Haemamoeba malariae*. The Italian original of this paper is reproduced as Document No. 1 in Appendix 2.

(b) *a portion headed “ Deuxième Note ”* (: 293—296).

The “ Deuxième Note ” is described as “ Extrait de la *Riforma medica*, No. 50, 1er mars 1890.” This paper, of which, like the paper published in January 1890, I possess a photostat copy through the kindness of Dr. Robert Coatney, was published on pages 296 and 297 of Part 50 of Volume 6 of the *Riforma medica*. This paper is reproduced in facsimile as Document 2 in Appendix 2 to the present paper. It was published in Italian under the title “ Sui parassiti della malaria. Aggiunta alla nota preliminare.” The authors were cited as “ Prof. R. Feletti e B.

Grassi." In this paper Feletti & Grassi continued the discussion of the characters which they looked upon as distinguishing the genera *Laverania* and *Haemamoeba* from one another but did not name any new forms.

- (c) *a portion bearing the title "Parasites malariques chez les oiseaux. Note préliminaire des Prof. B. Grassi et R. Feletti" (: 297—300).*

Attached to the title of this portion is a reference to a footnote, which reads as follows: "Bollettino mensile dell'Accademia Gioenia di scienze naturali in Catania. Fasc. XIII. séance du 23 mars 1890." This portion also is thus seen to be a translation into French of a paper previously published in Italian by these authors. It must be noted that, unlike the two previous papers, of which the authors were cited as "Feletti & Grassi," the authors of this third paper were cited as "Grassi & Feletti."

- (d) *a single paragraph headed by the letters "N.B." but without any title or attribution of authorship (:300).*

This paragraph, which is quoted in full in paragraph 85 below, is essentially concerned to record a new observation ("Dans ces derniers jours") made by the authors concerning the reproduction of crescent forms even in birds. Since bird parasites are discussed only in the paper entitled (in the French translation) "Parasites malariques chez les oiseaux" reproduced as the third portion (portion (c) above) of the composite paper published in the *Arch. ital. Biol.*, it may be concluded that this paragraph, which was here published for the first time, is in the nature of a postscript to the paper, the French translation of which immediately precedes it. It follows, therefore, that the authorship of this paragraph should

be attributed to Grassi & Feletti, that being the order in which the names of these authors were cited in the paper "Parasites malariques chez les oiseaux."

85. It was in the postscript by Grassi & Feletti discussed in sub-paragraph (2)(d) of the preceding paragraph that those authors restricted the specific trivial name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, to the Quartan Malaria Parasite by distinguishing as a separate species, and giving the name *Haemamoeba vivax* to, the second (taxonomic) species which earlier (in December 1889) they had confounded with the Quartan Malaria Parasite and had included with that species under the name *Haemamoeba malariae*. The paragraph by Grassi & Feletti containing this restriction reads as follows:—

N.B.—Dans ces derniers jours nous avons constaté que les corps en croissant se reproduisent même chez les oiseaux, et que les amibes, ci-dessus décrites, n'ont rien de commun avec les corps croissant; elles appartiennent au genre *Haemamoeba* et nous les appelons *Haemamoeba praecox* n.sp. A cette espèce se rapportent très vraisemblablement les *Haemamoeba* de la fièvre quotidienne avec courtes intermittences. C'est pour cela que nous distinguons dans le genre *Haemamoeba*, trois espèces (*Haemamoeba malariae* de la fièvre quarte, *Haemamoeba vivax* de la fièvre tierce et *Haemamoeba praecox* de la fièvre quotidienne avec courtes intermittences, etc.).

86. The present *Règles* were not in existence at the time when Grassi & Feletti published the foregoing note, but in taking this action as the "first reviser" of the nominal species *Haemamoeba malariae* Feletti & Grassi, 1889, these authors proceeded in strict accordance with the procedure laid down in Article 31 of the present *Règles*. The restriction by Grassi & Feletti of *Haemamoeba malariae* Feletti & Grassi, 1889, to the Quartan Malaria Parasite is therefore perfectly valid under the *Règles*.

87. It should be noted that, although Feletti & Grassi were the first authors to publish a scientific name for the Quartan Malaria Parasite, this parasite had already been described and figured by Golgi. This important discovery is usually dated from 1889, the year in which Golgi published a paper (1889, *Arch. Sci. med.* **13** : 173), in which he described in detail the characters which distinguish the Quartan Malaria Parasite from the Malignant Tertian Malaria Parasite. In fact, however (as pointed out by Sir Rickard Christophers *in litt.*, 24th March 1944) the first paper in which Golgi established the characters of the Quartan Malaria Parasite was published four years earlier (in 1885, *G. Accad. Med. Torino* **33** : 734). A note on the rather complicated bibliographical problems raised by these early papers by Golgi, which has been kindly prepared for the present paper by Sir Rickard Christophers, is given in Appendix 1.

88. In none of his papers did Golgi give a scientific name to the Quartan Malaria Parasite. The first authors to give this species such a name were Feletti & Grassi in their pamphlet published in December 1889 (see paragraph 81 above). The specific trivial name so given, *malariae* Feletti & Grassi, December 1889, as restricted in 1890 by Grassi & Feletti (see paragraph 86 above) is thus the oldest specific trivial name for the Quartan Malaria Parasite.

89. At the time when the specific trivial name *malariae* Feletti & Grassi, December 1889, was published for the Quartan Malaria Parasite, it was the valid specific trivial name for that species for not only had that species itself not previously been named but the name then given to it (*Haemamoeba malariae*) was not a homonym of any previously published name. When, however, at a later date the Quartan Malaria Parasite was transferred on taxonomic grounds to the same genus as the Malignant Tertian Malaria Parasite (originally described as *Oscillaria malariae* Laveran, 1881), the specific trivial name *malariae* Feletti & Grassi, December 1889, ceased to be available for the Quartan Malaria Parasite, for it became a junior secondary homonym of the specific trivial name *malariae* Laveran, 1881 (the Malignant Tertian Malaria Parasite) from the point of view of those authors who

accepted the taxonomic judgment that these two species were congeneric. When, however, we turn to consider the position of those malariologists, present or future, who do not accept that judgment and for whom in consequence the specific trivial name *malariae* Feletti & Grassi, 1889, is not a junior secondary homonym of the name *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, we find ourselves confronted with the same problem as that which met us when we had to consider what would be the relationship between the names *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*, and *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, if an author, acting as a "First Reviser" under Article 31 were to select the Benign Tertian Malaria Parasite to be the species to which alone the name *malariae* Marchiafava & Celli, 1885, should apply (paragraphs 71-73 above). The question so raised was the interpretation to be placed on Articles 35 and 36 of the *Règles* in relation to the rejection of names on the ground of secondary homonymy. On that occasion it was not necessary to express a view on this admittedly controversial question, for, by then myself acting as a "First Reviser" and selecting—under Article 31—those parts of the material described and figured by Marchiafava & Celli which were undoubtedly referable to the Malignant Tertian Malaria Parasite to be the sole specimens by which the name *Plasmodium malariae* Marchiafava & Celli, 1885, shall be interpreted, that name became a subjective junior synonym of *Oscillaria malariae* Laveran, 1881. In consequence, in that particular case the difficulties arising from the uncertainty as to the proper interpretation of Articles 35 and 36 ceased to be relevant and it was unnecessary therefore to adopt a working hypothesis on this subject. In the present case, the adoption of such a hypothesis cannot be avoided,¹² for, in order to determine the status of the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, as the name for the Quartan Malaria Parasite, it is essential to take a view on the question whether under the *Règles* the rejection of that name as a

¹² The doubts here discussed regarding the meaning to be attached to Articles 35 and 36 of the *Règles* in relation to the rejection of names on the ground of secondary homonymy were, as has been explained in Footnote 7, completely set at rest in 1948, by the revision of these Articles by the Thirteenth International Congress of Zoology. Under that revision, a junior secondary homonym, when once rejected and replaced, can never again validly be used for the species in question.

junior secondary homonym of *malariae* Laveran, 1881, by those specialists who regard these two species as congeneric with one another and who place them both in the genus *Plasmodium* is permanent in the sense that it is binding also upon other specialists who regard these species as being referable to separate genera or whether, on the contrary, the name *malariae* Feletti & Grassi, 1889, can properly be used for the Quartan Malaria Parasite by those specialists who regard that Parasite and the Malignant Tertian Malaria Parasite as being generically distinct from one another. While, pending an authoritative clarification of Articles 35 and 36, no view can be held to be correct to the exclusion of every other view, I have myself always been of the opinion that the unqualified nature of the provision in Article 36, coupled with the total absence in Article 35 of any reference to a distinction between primary and secondary homonyms, is such that on any natural construction of the wording of these Articles, the only conclusion to be drawn is that any junior specific homonym, whether primary or secondary, is rendered permanently unavailable, once it has been rejected and replaced. Owing to the extraordinary misidentification of the nominal species *Oscillaria malariae* Laveran, 1881, with the Quartan Malaria Parasite (paragraphs 46-51 above), the name *malariae* Feletti & Grassi, 1889, has customarily been rejected not as a junior secondary homonym of *malariae* Laveran, 1881, but as a junior subjective synonym of that name. It is likely therefore that the name *malariae* Feletti & Grassi, 1998 has never as yet been formally rejected as a junior secondary homonym and in consequence, replaced by some other name. Certainly the only authors who in recent times have recognised that the name *malariae* Laveran, 1881, applies to the Malignant Tertian Parasite and not to the Quartan Malaria Parasite (Christophers & Sinton (1938); Usinger & Sabrosky (1944)), while recognising the existence of a condition of secondary homonymy in the genus *Plasmodium* between the names *malariae* Laveran, 1881 (for the Malignant Tertian Malaria Parasite) and *malariae* Feletti & Grassi, 1889 (for the Quartan Malaria Parasite) have refrained from formally rejecting the latter as an invalid junior secondary homonym of the former, the

reason in each case being the same, namely a reluctance to take any action which would lead to still further confusion in the literature of human malariology. Such action has its value as a temporary measure, pending the use by the International Commission of its Plenary Powers for the purpose of preserving existing nomenclatorial practice. It cannot however alter in any way the fact that under the *Règles* the name *malariae* Feletti & Grassi, 1889, will cease to be an available name for the Quartan Malaria Parasite for any specialist who regards that species as congeneric with the Malignant Tertian Malaria Parasite, immediately any author (a) accepts the name *malariae* Laveran, 1881, as the name of the Malignant Tertian Parasite, (b) regards that species and the Quartan Malaria Parasite as congeneric and (c) in consequence rejects the name *malariae* Feletti & Grassi, 1889, as a junior secondary homonym of *malariae* Laveran, 1881, and replaces it with the next available name for the Quartan Parasite. Whether or not this rejection would render this name permanently unavailable for use even by specialists who do not regard these two species as being congeneric with one another, is, as we have seen, at present a matter of dispute, though for the reasons which I have explained, I hold that such action would have this effect.¹³

90. To sum up, the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, cannot be used by any specialist who regards the species so named (the Quartan Malaria Parasite) as congeneric with the Malignant Tertian Malaria Parasite by reason of the fact that, if this name were to be used in this way, it would immediately become a junior secondary homonym of the name *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, and in consequence would need to be rejected and replaced by some other name. The position of the name *malariae* Feletti & Grassi, 1889, for those specialists who do not regard the species so named (the Quartan Malaria Parasite) as congeneric with the Malignant Tertian Malaria Parasite is not clear owing to the doubts which

¹³ The assumption here adopted later proved to have been justified, for in Paris in 1948 the Thirteenth International Congress of Zoology when revising Articles 35 and 36 of the *Règles*, definitely prescribed that a name, once rejected as a secondary homonym and replaced by another name, is to be treated as being permanently rejected and therefore incapable of being validly brought into use again by any later author. See Footnote 7.

exist as to the proper interpretation of Articles 35 and 36 relating to the rejection of secondary homonyms. It is necessary for the purposes of the present study to adopt some working hypothesis on this subject and the conclusion which I have reached—which coincides with the view which I have always held on the question of interpretation referred to above—is that the rejection and replacement of the name *malariae* Feletti & Grassi, 1889, as a junior secondary homonym in the genus *Plasmodium* renders that name permanently invalid, not only for those specialists who regard the Quartan Malaria Parasite and the Malignant Tertian Malaria Parasite as congeneric with one another but also for those who do not hold this view¹⁴. For the remainder of the present paper I therefore treat the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, as a permanently invalid name. On this view it is necessary under the *Règles* to find some later name for the Quartan Malaria Parasite. It must be noted at this point, however, that the name *malariae* Feletti & Grassi, 1889, has been used continuously for the Quartan Malaria Parasite for over fifty years and that its displacement at this date on purely nomenclatorial grounds would be open to the strongest possible objection.

(4) The specific trivial name “ malariae ” erroneously alleged to have been published as a new name in combination with the generic name “ Laverania ” by Feletti and Grassi in 1889 for the Malignant Tertian Malaria Parasite

91. As we have seen in paragraph 81 above, Feletti & Grassi in their paper “ *Sui parassiti della malaria* ” (published, first, as a pamphlet on 30th December 1889 and, second, as a paper, in the issue of the *Riforma medica* of 15th January 1890) recognised two species of human malaria parasite, one of which they referred to as *Haemamoeba malariae* and the other as *Laverania malariae*.

92. The generic names *Haemamoeba* and *Laverania* were both published in this paper for the first time. So also was the specific

¹⁴ As will be seen from Footnote 12, the decision taken by the Thirteenth International Congress of Zoology, Paris, 1948, gave the seal of approval to the working hypothesis here adopted.

trivial name *malariae* as placed by Feletti & Grassi in their new genus *Haemamoeba*. On the other hand the choice of the word "Laverania" for the name of their new genus makes it clear that the purpose of Feletti & Grassi was to give honour to Laveran, the discoverer of the first of the human malaria parasites to be detected (the Malignant Tertian Malaria Parasite). Further, their use for that species of the trivial name (*malariae*) published for that species by Laveran at the time of his discovery, establishes beyond doubt that the trivial name *malariae*, as used by Feletti & Grassi in 1889 in combination with the generic name *Laverania* was not a new name of their own but on the contrary was the name *malariae* as published by Laveran himself in 1881 in the combination *Oscillaria malariae*.

93. In a number of synonymies of the names of the human malaria parasites (of which the most recent instance is afforded by Christophers, 1945, *Rev. Inst. Salubridad y Enfermedades trop.*, 6(4) : 220) the specific name (binominal combination) *Laverania malariae* has been cited as though it were a new name published by Feletti & Grassi for the Malignant Tertian Malaria Parasite in 1889, i.e. as though the specific trivial name *malariae* as there used is attributable to Feletti & Grassi, 1889, whereas it is in fact attributable (as shown above) to Laveran, 1881. In this way there has grown up the erroneous belief that in 1889 (or in 1890, in the case of those authors who believed that the paper "*Sui parassiti della malaria*" was not published until that year) Feletti & Grassi published the specific trivial name *malariae* as a new name in combination with the generic name *Laverania*.

(5) The specific trivial name "vivax" as published in combination with the generic name "Haemamoeba" by Grassi and Feletti in 1890 for the Benign Tertian Malaria Parasite

94. The specific trivial name *vivax* was first published by Grassi & Feletti (in the combination *Haemamoeba vivax*) on 26th May 1890 (see paragraph 84(1) above) (*Arch. ital. Biol.* 13 : 300) in the short note quoted in paragraph 85 above. This was the place where those authors first recognised that the Benign Tertian Malaria Parasite and the Quartan Malaria Parasite were distinct species and gave a specific trivial name (*vivax*) to the first of these species. As explained in paragraph 83 above, these authors had

previously (1889, *Sui parassiti della malaria* and 15th January 1890, *Riforma medica* 6(11) : 64) included both these species in their (at that time) composite species *Haemamoeba malariae* Feletti & Grassi, 1889.

95. The specific trivial name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*, is the first such name to have bestowed upon the Benign Tertian Malaria Parasite and, as it is a nomenclatorially available name, it is the valid specific trivial name for that species.

(6) The specific trivial name "praecox" as published in combination with the generic name "Haemamoeba" by Grassi and Feletti in 1890, the name of a parasite of birds which has been erroneously applied to the Malignant Tertian Malaria Parasite

96. The specific trivial name *praecox* was published by Grassi & Feletti in 1890 in the combination *Haemamoeba praecox*. This name appeared in a brief postscript (written in French) attached by Grassi & Feletti to a translation into French (with the title "Parasites malariques chez les oiseaux") of a paper (written in Italian) which those authors had presented to the "Accademia Gioenia di scienze naturali in Catania" at the meeting of that body held on 23rd March 1890 and which had just appeared in Fascicule 13 of its *Bollettino mensile*. The French translation of this paper, together with the brief postscript then published for the first time (on page 300), appeared in Part 2 of volume 13 of the *Archives italiennes de Biologie*. The exact date of publication is known, for fortunately the wrapper of this Part bears the legend "Paru le 26 mai 1890." The original reference for the nominal species *Haemamoeba praecox* Grassi & Feletti is thus "May 1890, *Arch. ital. Biol.* 13(2) : 300."

97. The text of the passage containing the original publication of the name *Haemamoeba praecox* Grassi & Feletti, 1890, is reproduced in full in paragraph 85 of the present paper. In order to understand the description given by Grassi & Feletti for this species, it is necessary to be aware of the substance of the paper to which (as already explained) the passage containing the original

description of *Haemamoeba praecox* was a postscript. The description there given leaves no room for doubt that the foregoing name was introduced for the express purpose of denoting certain parasites found in the blood of birds which had been described in the paper entitled "Parasites malariques chez les oiseaux," to which the note containing the description of *Haemamoeba praecox* was, as has been explained, added as a postscript to the French version of the foregoing paper. It was only after the name *Haemamoeba praecox* had been given in this way to the bird parasite that in the following sentence Grassi & Feletti added, by way of, what they regarded as an important, comment, their view that the bird parasite to which they had given the foregoing name was the same as that which in Man was responsible for "la fièvre quotidienne avec courtes intermittences." The human parasites identified in this way by Grassi & Feletti were, it is now generally agreed, asexual forms of the Malignant Tertian Malaria Parasite. As has been pointed out by Christophers & Sinton (1938 : 1132), Grassi & Feletti, when they wrote the paper now under discussion, were unaware that these asexual forms of the human parasite were referable to the same species (the Malignant Tertian Malaria Parasite) as were the sexual forms to which nine years earlier Laveran had (in 1881) given the name *Oscillaria malariae*. Grassi & Feletti were familiar with these asexual forms in human cases and it was, no doubt, because they recognised the resemblance between these forms and the bird parasite which they had just named *Haemamoeba praecox* that, as we have seen, they added the comment that, in their view these asexual forms, found in human cases belonged to the same species as the bird parasite to which they given the name *Haemamoeba praecox*.

98. The specific trivial name *praecox* Grassi & Feletti was later extensively used as the specific trivial name of the Malignant Tertian Malaria Parasite by French workers who uncritically followed the erroneous determination by Lühe (1900) (discussed in paragraph 49 above) of *Oscillaria malariae* Laveran, 1881, as the Quartan Malaria Parasite. Workers in France who accepted Lühe's determination of Laveran's species, being thus forced to find a specific trivial name in place of *malariae* for the Malignant Tertian Malaria Parasite, adopted for this species the specific trivial name *praecox* Grassi & Feletti, 1890. The French workers

who adopted this course argued, first, that the nominal species *Haemamoeba praecox*, as established by Grassi & Feletti in 1890, was a composite species, made up partly of a new bird parasite and partly of asexual forms of the Malignant Tertian Malaria Parasite of Man. Second, it was argued that this nominal species had ceased to be a composite species in 1891 when Grassi & Feletti had removed the bird parasite from it, on renaming the bird parasite *Haemamoeba relicta* (Grassi & Feletti, 1891, *Bull. mens. Accad. Gioenia Sci. nat. Catania* (n.s.) 1 (No. 16) : 19). Accordingly, under this argument, the Malignant Tertian Malaria Parasite had been left in undisputed possession of the trivial name *praecox* Grassi & Feletti, 1890. This argument would have been valid only (i) if, in fact, examples of the Malignant Tertian Malaria Parasite had been included among the syntypes of the nominal species *Haemamoeba praecox* Grassi & Feletti, 1890, and (ii) if in 1891 Grassi & Feletti had effectively selected the foregoing syntypes to form the basis for the nominal species *Haemamoeba praecox* to the total exclusion of the syntypes of the bird parasite by removing the latter to the new nominal species *Haemamoeba relicta*.

99. We may conveniently examine first the second of these claims. On this subject, I applied for assistance to Dr. C. A. Hoare, F.R.S. (*The Wellcome Laboratories of Tropical Medicine, London*). After examining the whole of the papers concerned, Dr. Hoare replied as follows:—

I shall now deal with the points raised by you in chronological order.

(a) Grassi, B. & Feletti, F. “Parassiti malarici negli uccelli. Nota preliminare.” *Bulletino mensile della Accademia Gioenia di Scienze naturali in Catania*. Marzo 1890, (N.S.), Fascicolo XIII : 3—6.

Here they give the name *Laverania danilewsky* [sic] n.sp. (: 4) for the crescentic parasite of sparrows; they also found an amoeboid parasite, which they left un-named, but suggested it was a *Haemamoeba*.

(b) IID. “Ancora sui parassiti malarici degli uccelli. Seconda nota preliminare.” Aprile 1890, *ibid.* Fasc. XIV : 2—7.

In this paper the amoeboid parasite of sparrows, mentioned in (a) is named *Haemamoeba praecox* (: 2).

(c) IID. "Nuova contribuzione allo studio della malaria. Nota preliminare." *Ibid.* Dicembre 1890 e Gennaio 1891, Fasc. XVI : 16—20.

The year at the foot of the title page is 1891.

In this paper they record the findings in sparrows of a *new* form of *Haemamoeba*, which they name *Haemamoeba relictæ* n.sp. (: 19). It is evident from the text that they regard this as a *distinct* species, not merely a new name for *H. praecox*. This is also obvious from the next paper (paper (d) below).

(d) IID. "Inoculazione dei parassiti malarici da uccello ad uccello.—Parassiti dei globuli rossi delle rane." *Ibid.*, Marzo, Aprile 1891, Fasc. XVIII—XIX : 6—12.

Here it is stated that the authors recognise in sparrows three species of malaria parasites: *Haemamoeba praecox*, *H. relictæ* and *Laverania danilewsky* [sic]. This confirms the view of the authors as to the independence of the two *Haemamoeba*.

Subsequently, some authors (but not Grassi & Feletti: at least not up to 1891 inclusive) regarded *Plasmodium relictum* as a synonym of *P. praecox*, while others retained it as a distinct species.

I think it is clear from the above excerpts that Grassi & Feletti *did not* rename *H. praecox* but recognised two species, namely: *H. praecox* and *H. relictæ* (in addition to *Laverania danilewsky*).

100. From the information quoted above, we see at once that there is no substance in the claim that the name *Haemamoeba relictæ* Grassi & Feletti, 1891, was published as a substitute name (*nom. nov.*) for the name *Haemamoeba praecox* Grassi & Feletti, 1890, as applied by those authors to the bird parasite which they then so named. It is perfectly clear indeed that the foregoing authors regarded the name *praecox* as applying to one bird parasite and the name *relictæ* as applying to another bird parasite. Thus, the main part of the argument used by the French authors who sought to justify the use of the name *praecox* Grassi & Feletti for the Malignant Tertian Malaria Parasite is seen to be without any foundation. We have already seen (paragraph 97 above) that the other part of the French workers' argument, namely that the nominal species *Haemamoeba praecox* Grassi & Feletti, 1890, contained among its syntypes examples not only of the bird

parasite then so named but also of the Human Malignant Tertian Malaria Parasite is also completely devoid of foundation. Accordingly, under the *Règles* the specific name *praecox* Grassi & Feletti adheres exclusively to the bird parasite and has, moreover, done so from the moment at which it was first published.

101. The contention that the trivial name *praecox* Grassi & Feletti applied to the Malignant Tertian Malaria Parasite and was the oldest available such name for that species and therefore its valid name never won any general acceptance, and, in particular, was vigorously rejected by Schaudinn (1902, *Arb. kaiserl. Ges. Berlin*, 19 : 169), by Blanchard (1905, *Les Moustiques, Paris*) and by Stiles (1929, in Sergent Ed.) *et. al.* in *Arch. Inst. Pasteur Alger.* 7 : 232). These authors all took the view that the text of the original description of *Haemamoeba praecox* Grassi & Feletti showed beyond question that this name was definitely bestowed by its authors upon the bird parasite there described and that it must therefore adhere only to that species. In the most recent of the papers cited above (Stiles, etc. 1929) Sergent (Ed.) and others re-examined this question and, while formally adhering to the traditional French view that under the *Règles* the trivial name *praecox* Grassi & Feletti was the correct specific trivial name for the Malignant Tertian Malaria Parasite, agreed that in existing conditions it was neither practicable nor desirable to apply the name *praecox* to that species. We may, therefore, now leave this subject, contenting ourselves with noting that, for the reasons explained above, the specific trivial name *praecox* Grassi & Feletti, 1890, has no place in any list of the names bestowed upon the human malaria parasites. At most, this name can be included in such a list only as a name which has been erroneously applied to a human malaria parasite (the Malignant Tertian Malaria Parasite) through a misreading by subsequent authors of the description published by Grassi & Feletti.

- (7) The specific trivial name "falciforme" as published in combination with the generic name "Ematozoo" by Antolisei and Angelini in 1890 for the Malignant Tertian Malaria Parasite

102. When the bibliographical reference to *Haematozoon falciparum* Welch, 1897 (in Loomis's *Syst. pract. Med.* 1 : 36) was being checked in the course of the preparation of the present paper, the following footnote given by Welch immediately after his description of the above species suggested the existance of a hitherto ignored specific name for the Malignant Tertian Malaria Parasite, namely *Haematozoon falciforme* Antolisei & Angelini:—

The name *Haematozoon falciforme* suggested by Antolisei & Angelini is objectionable, as it implies that the shape is always falciform, and is applicable only to the crescentic forms. The adjective "falciparum" (*falx*, "sickle," *parire*, "to bring forth," "to produce"), on the other hand, indicates that the property of forming crescents is a distinctive character of the organism, and it is therefore applicable to the variety of the parasite which possesses exclusively this property.

103. Welch did not give a reference to the place where Antolisei & Angelini published the name *Haematozoon falciforme* but he did state that a full bibliography of works on malaria was given by Thayer (W. S.) and Hewetson (J). in their "Malarial Fevers of Baltimore" published in 1895.

104. Thayer & Hewetson's paper, which occupies the whole of one volume of the "Johns Hopkins Hospital Reports" (Thayer & Hewetson, 1895, *Johns Hopkins Hosp. Rep.* 5 : 1—218, 2 pls.) contains a detailed survey of the previous literature of malariology. This survey includes copious references to the annexed bibliography (: 189—208) which includes 359 titles. In their survey, Thayer & Hewetson described at length (: 25—27) the paper "Sulle febbri malariche predominanti nell'estate e autunno a Roma" (1890, *Atti. Accad. Med. Roma* 16) in which

Marchiafava & Celli had recorded their observations on “ ‘aestivo-autumnal’ Roman fever.” After noting (: 27) that these observations had been confirmed in their main features by a large number of observers, among the first of whom being Gualdi & Antolisei (who demonstrated the existence of this type of organism by inoculation experiments), Thayer & Hewetson proceeded as follows:—

Antolisei & Angelini (119, 131) refer to this variety as the “ haematozoon falciforme.”

105. The following are the entries given by Thayer & Hewetson in respect of the papers by Antolisei & Angelini to which they had referred under the numbers “ 119 ” and “ 131 ”:—

(119). ANTOLISEI & ANGELINI. Osservazioni sopra alcuni casi d'infezione malarica con forme semilunari. *Arch. Ital. di clinica medica*, 1890, 1.

(131). ANTOLISEI & ANGELINI. Nota sul ciclo biologico dell' ematozoa falciforme. *Riforma medica*, 1890, nos. 54, 55, 56, March 6, 7, 8, pp. 320; 326; 332.

106. It is clear from the way in which Thayer & Hewetson cited these references that it was upon one or other or both of these papers that they relied for their statement that Antolisei & Angelini had given the specific name (binominal combination) *Haematozoon falciforme* to the aestivo-autumnal Roman fever. It was necessary therefore to examine each of these papers carefully. The results are given in the immediately following paragraphs.

107. The first of these papers (i.e. that numbered (119) by Thayer & Hewetson), which was published on some date in 1890, in the *Archivio italiano de clinica Medica*, Milan, Naples, Turin **29**: 1—23, has been kindly examined for me by Sir Rickard

Christophers who has been good enough to furnish the following report on it (*in litt.*, dated 26th April 1944):—

It does not apparently give the first naming but refers several times to "*l'ematozoo falciforme*" in each case in italics. I give the passages below. Whether this naming is above all suspicion as to its being a correct zoological designation is, I think, just doubtful. Even supposing the genus name were accepted as *Haematozoon* it seems doubtful whether the name *ematozoo falciforme* is quite the zoologist's idea of a correct binominal designation. However one cannot say what validity there may be until one has seen the passage giving the name. That others have accepted "*falciforme*" as a specific name definitely given meantime carries considerable weight.

The passages giving the name "*l'ematozoo falciforme*" are:—

- :2 Avvertiamo che tanto i casi, che pubblichiamo quanto le osservazioni, che seguono, provengono soltanto da studii fatti dacche, abbiamo acquistato la convinzione, che *l'ematozoo falciforme* sia un parassita a se, nettamente diverso dagli altri, e dacche abbiamo imparato a distinguere le diverse fasi della sua vita da quelle degli altri.
- :8 Dalla lettura dei casi riferiti ognuno si sarà persuaso quanto sia vero, che non basta l'esame del sangue di un solo malarico per conoscere la biologia dell '*ematozoo falciforme*.
- :9 Dicevamo che dall'esame di alcuni dei nostri casi si deume che nell'inizio delle infezioni malariche provocati dall'*ematozoo falciforme*, nel sangue circolante non si mostrano che le amebe.

Of course all this applies to the crescentic gametocytes of *falciparum* which puzzled the authors because they could get no life cycle such as they now expected in any parasite on the analogy of the quartan and tertian parasites. They were not merely out, so to speak, to describe some definite zoological form.

108. There is no copy in the United Kingdom of the second of the two papers by Antolisei & Angelini cited by Thayer & Hewatson (i.e. the paper numbered (131) in their bibliography). I accordingly applied to Dr. Robert L. Usinger in the hope that it might be possible to trace a copy of this paper in some library in the United States. Dr. Usinger very kindly consulted Dr. G. Robert Coatney, who (on 13th September 1945) was so kind as to furnish the following very interesting report:—

I find that Antolisei, E. & Angelini 1889, "Due altri casi di febbre malarica sperimental," *La Riforma medica* 2 : 1352—1353,

1358—1359, do, on page 1359, name *falciforme* but only as a type of fever, like quartan fever, and, therefore, the name is not a zoological synonym of *falciparum*. In 1890 the same authors in "Nota sul ciclo biologico dell'ematozoo falciforme," *La Riforma medica* 6 : 320—321, 326—327, 332—334, on the last page (: 334) name *falciforme* n.sp., preceding the name *falciforme* with *ematozoo* in italics. This does not, in my opinion, constitute a generic name but rather a *lapsus calami*.

109. Leaving aside for the moment the question whether a specific term consisting of the words *Ematozoo falciforme* (i.e. the name published by Antolisei & Angelini, but with the first letter of the generic name written with a capital letter) constitutes a name which complies with the requirements of the *Règles* and is therefore, other things being equal, an available name, we have to note:—

- (1) that in each of the two papers cited by Thayer & Hewetson, Antolisei & Angelini did publish a new specific trivial name *falciforme* but that in each of these papers the generic name was spelt "*ematozoo*" and not "*haematozoon*" as stated by Thayer & Hewetson; and, therefore, that it must be assumed that the latter spelling is a deliberate emendation by Thayer & Hewetson of the original spelling "*ematozoo*";
- (2) that, as no particulars are available to show the date in 1890 on which was published the Part of volume 29 of the *Arch. ital. clin. Med.*, containing Antolisei & Angelini's paper "Osservazioni sopra alcuni casi d'infezione malarica con forme semilunari," whereas the Parts of volume 6 of the *Riforma medica* containing those authors' paper "Nota sul ciclo biologico dell'ematozoo falciforme" are known to have been published on the 6th, 7th and 8th March 1890, it must be concluded (at least until further information is available) that the last-named paper was the first to be published and therefore that it was in this paper that the name *ematozoo falciforme* was first published (Antolisei & Angelini, 8th March 1890, *Riforma medica* 6(56) : 334) as a name for the malaria parasite of semilunar form. (The question

as to which of these papers was the first to be published is of theoretical importance only, for in both papers the specific trivial name *falciforme* was published by Antolisei & Angelini in the same genus (*ematozoo*) and applied to the same species of parasite.)

110. We must turn now to consider whether the term "*ematozoo falciforme*" as published by Antolisei & Angelini constitutes a name which can be regarded as complying with the requirements of the *Règles*. Two problems are involved: (i) Does this name comply with the requirements of Article 3, which relates to the form of scientific names for animals? (ii) Apart from any answer which may be given to the foregoing question, is the name published by Antolisei & Angelini invalidated either wholly as a specific name (binominal combination) or as regards the first of its component elements (the generic name) by reason of the fact that, when this specific name was published, the generic name was printed with a small, instead of a capital, initial letter, i.e. as *ematozoo* and not as *Ematozoo*? For the first of these questions, the relevant Article in the *Règles* is Article 3. For the second of these questions the relevant Article is Article 8 (form of generic names). In the present context this latter Article should be read in conjunction with the parallel Article (Article 13), which relates to the form of specific trivial names.

111. The following is the substantive French text of Article 3 of the *Règles*:—

3. Les noms scientifiques des animaux sont des mots latins ou latinisés, ou considérés et traités comme tels, au cas où ils ne seraient pas d'origine classique.

112. The generic name *Ematozoo* is certainly not a "mot latin" nor can it be claimed that it is a "mot latinisé" except in so far as the fact that it was printed in italics suggests that in the opinion of Antolisei & Angelini, it was a Latinised word and therefore one which, on being printed, should be distinguished in this way from the Italian words which formed the remainder of the sentence in which it occurred. The word *Ematozoo* is not a "mot d'origine classique." Article 3 provides that a word not of classical origin

is to be accepted if it was considered and treated as a Latin or Latinised word by its author. The fact that Antolisei & Angelini gave to the parasite in question a binominal name and printed that name in italics to distinguish it from the adjoining Italian words does, in my view, create a presumption that they were considering and treating this non-classical word *Ematozoo* as a Latin or Latinised word. This presumption is greatly strengthened by the fact that the second part of the specific name introduced by Antolisei & Angelini, namely the specific trivial name *falciforme* is undoubtedly a Latin word. I conclude therefore that the form in which Antolisei & Angelini published the name *Ematozoo falciforme* satisfies the requirements of Article 3 of the *Règles*.

113. On turning to the second of the questions raised in paragraph 110 above, we have to consider the substantive French texts of Articles 8 and 13. These read as follows:—

8. Le nom générique consiste en un mot unique, simple ou composé, écrit par un première lettre capitale et employé comme substantif au nominatif singulier.

13. Les noms de personnes employés comme noms spécifiques peuvent être écrits par une première lettre capitale; tous les autres noms spécifiques s'écrivent par une petite lettre initiale.

114. It is perfectly clear that the form in which Antolisei & Angelini published the specific name here under consideration (*ematozoo falciforme*) does not comply with all the provisions of Article 8 (since the generic name was not written with a capital initial letter) but that it does comply with those of Article 13 (since the specific trivial name was written with a small initial letter, as is required by that Article in all cases except where the word chosen for a specific trivial name is the name of a person, in which case the author is left to choose between the use of a small initial letter and the use of a capital initial letter).¹⁵

¹⁵ At its Session held in Paris in 1948 the International Commission on Zoological Nomenclature obtained the approval of the Thirteenth International Congress of Zoology for the redrafting of Article 13 so as to require that every specific name shall be written with a small initial letter (1950, *Bull. zool. Nomencl.* 4 : 173).

115. The question now arises as to whether non-compliance with Article 8 in the original publication of a new generic name should be regarded as invalidating that name. No authoritative ruling has been given by the International Commission on Zoological Nomenclature on this matter, but practical considerations militate strongly against any such interpretation. If Article 8 were to be read in this sense, Article 13 would similarly have to be regarded as invalidating any specific trivial name (other than that consisting of the name of a person) originally published with a capital initial letter. Now every systematist knows that countless thousands of specific trivial names were originally published in this way, particularly a very large number already in common use at the time when the present *Règles* were adopted in 1901. It is inconceivable that those responsible for the introduction of these *Règles* contemplated the inclusion of a provision which would have had the effect of immediately invalidating a large proportion of the specific trivial names in common use at that time. My conclusion therefore is that Articles 8 and 13 should be read in another sense, namely: as indicating the correct forms in which generic and specific trivial names should be published, implying that any departure from those forms should call for automatic correction but should not be regarded as rendering the names invalid.

116. My interpretation of Article 8 is therefore that where a generic name is first published with a small initial letter, that form of printing the generic name, although constituting a contravention of Article 8, does not invalidate the generic name in question for the purposes of Article 25 (Law of Priority)¹⁶. At the same time, however, where a generic name is first published in this defective manner, that defect does call for an automatic correction of the name by the substitution by later authors of a capital initial letter for the small initial letter (erroneously) used in the original publication.

¹⁶ In 1948 at its meeting held in Paris the Thirteenth International Congress of Zoology inserted in the *Règles* a provision that infringements of Article 14 (and of certain other Articles) should be subject to automatic correction (1950, *Bull. zool. Nomencl.*, 4 : 67—68) and this provision was expressly extended to similar infringements of Article 8 by the Fourteenth International Congress of Zoology, Copenhagen 1953 (1953, *Copenhagen Decisions zool. Nomencl.*, : 47—48). In the light of this clarification of the *Règles*, the assumption here made as to the status of the generic name *ematozoo*, as published with a small, instead of with a capital, initial letter is seen to have been correct.

117. Applying these conclusions to the case of the generic name published by Antolisei & Angelini in 1890 for the Malignant Tertian Malaria Parasites, we may conclude that the fact that that name was originally printed with a small initial letter (as *ematozoo*) instead of with a capital initial letter (*Ematozoo*) constituted a defective method of publication, but that the defect involved does not invalidate this generic name, though it does call automatically for the substitution by later writers of a capital initial letter for the small initial letter (incorrectly) used in the original publication, the name thus becoming *Ematozoo* in place of *ematozoo*.

118. In the light of the foregoing considerations I conclude that the specific name *Ematozoo* (correction of *ematozoo*) *falciforme* Antolisei & Angelini satisfies the requirements of the *Règles* and accordingly possesses rights under the Law of Priority (Article 25) as from 8th March 1890, the date of publication of the portion of Antolisei & Angelini's paper in which this name was first published.

119. The species described by Antolisei & Angelini in 1890 as *Ematozoo falciforme* is the Malignant Tertian Malaria Parasite (paragraph 104), for which, as shown in paragraph 45 above, the oldest available specific trivial name, and accordingly the valid name, is *malariae* Laveran, 1881, of which therefore the specific trivial name *falciforme* Antolisei & Angelini, 1890, as published in the combination *Ematozoo* (correction of *ematozoo*) *falciforme*, is a junior subjective synonym.

(8) The specific trivial name "immaculata" as published in combination with the generic name "Haemamoeba" by Grassi in 1891, the name of a parasite of birds which has been erroneously applied to the Malignant Tertian Malaria Parasite

120. In 1891 a paper entitled "Weiteres zur Malariafrage" by Grassi & Feletti was published in the *Centralblatt für Bakteriologie und Parasitenkunde* (Grassi & Feletti, 1891, *Zbl. Bakt.* 10: 449—454, 481—488, 517—521). This paper was divided into three Sections, of which the first (: 449—454, 481—488) and the

third (: 519—521) were written jointly by Grassi & Feletti. The second Section (: 517—519), however, was written by Grassi alone. In this Section, to which was applied the sub-title “*Verschiedene Untersuchungen,*” Grassi first published (: 517) the specific trivial name *immaculata* (in the binominal combination *Haemamoeba immaculata*).

121. Grassi began by referring to a paper in which Celli & Guarnieri had recorded the occurrence in Man of parasites which segmented at a very early stage, that is to say, even before pigmentation had occurred; those authors had associated this parasite with another parasite which also segmented at an early stage, though not before pigmentation had occurred. Grassi had suspected that this second parasite might be a separate species, distinct from *Haemamoeba praecox* Grassi & Feletti, 1890, but at that time he had not found this form in any bird which he had examined. Quite recently, however, he had found a parasite which he identified with this form in an immature specimen of the Kestrel (*Cherchneis tinnunculus*). The material so obtained was then described by Grassi and given the name *Haemamoeba immaculata*.

122. The following is the full text of the passage summarised in the immediately preceding paragraph:—

A. Schon in einer vorhergehenden Note findet man angedeutet, dass Celle und Guarnieri eine Parasitenform im Menschen beschrieben haben, welche sich sehr frühzeitig, bevor auch nur die geringste Spur von Pigment existirt, segmentirt. Während nun obige Verfasser diese Form mit einer anderen, welche sich ebenfalls frühzeitig, aber erst nachdem sie bereits Pigment erworben, zusammenwerfen, stieg in mir der Zweifel auf, ob sie nicht eine Art für sich, verschieden von der *Haemamoeba praecox*, repräsentiren könne. Ich hatte seiner Zeit bereits bemerkt, dass in den von mir bis dahin untersuchten Vögeln obige Form gewiss fehlte. Kürzlich nun ereignete es sich, dass ich eine gleiche Form in einem, sich noch im Dunenkleide befindlichen Thurmfalken (*Cherchneis tinnunculus*) vorfand. Die anderen drei kleinen Thurmfalken welche sich mit ihm zusammen im Nest befanden, waren nicht von dieser Parasitenform infizirt, während der erste es derartig war, dass man nur mit grosser Mühe ein freies rothes Blutkörperchen vorfinden konnte. Diese Falke lebte acht Tage und bot mir stets den gleichen Befund.

Stets, in jedem Augenblick, fand sich in den rothen Blutkörperchen des Blutes eine Haemamöbe, welche, wie die anderen Haemamöben der Vögel, durchaus keine amöboidische Bewegungen zeigte. Fast in jedem Präparat fand man zu jeder Stunde Segmentationsfiguren. Die Segmentation fand statt, wenn ein grosser Theil des Blutkörperchens noch unversehrt war und ohne einen *Nucleus de reliquat* zu hinterlassen. Auch diese Haemamöbe hat einen Kern, Keine kontraktile Vakuolen etc. Ich schlage vor, derselben den Namen *Haemamoeba immaculata* zu geben.

123. In view of the unfortunate subsequent history of this name, it is particularly necessary to establish beyond possibility of question the identity of the species to which it applies. It is for this reason that I have quoted in full the original description given by Grassi for his *Haemamoeba immaculata*. We must note, therefore, that the material to which Grassi applied the new name *Haemamoeba immaculata* consisted exclusively of material obtained from the blood of an immature Kestrel. The parasite to which this name was given was thus an avian parasite. It is true, however, that in the passage immediately preceding that in which he described this avian parasite Grassi subjectively identified the parasite which he had found in the blood of the Kestrel with a parasite with which he was not familiar in nature but which had been described in a paper published by Celli & Guarnieri as having been found in the blood of Man. The specific name *Haemamoeba immaculata*, being a name based solely upon material obtained from the Kestrel, applies objectively only to that material, for it was that material alone which was before Grassi when he drew up his description. Accordingly, the identification by Grassi of the bird parasite which he had before him (and to which he gave the new name *Haemamoeba immaculata*) with a published description of a parasite found in Man represents no more than a subjective taxonomic judgement which, whether correct or incorrect, can have no possible bearing on the status of the name *Haemamoeba immaculata*, which objectively was attached for all time to the bird parasite from which it was described and to no other.

124. On page 518 of his paper (the page following that on which the name *Haemamoeba immaculata* was first published and on which the species so named was described) Grassi turned to review the existing state of knowledge regarding the human malaria parasites. He summarised his views on this subject in a table in which he recognised five such parasites (four in the genus *Haemamoeba* and one in the genus *Laverania*). The fourth of the "species" recognised by Grassi as belonging to the genus *Haemamoeba* figured in his list as "*Haemamoeba immaculata*." The human malaria parasite so referred to (together with the parasite which immediately preceded it and to which Grassi applied the name *Haemamoeba praecox* Grassi & Feletti, 1890, erroneously as has been shown in paragraph 101 above) was characterised by Grassi as follows: "verursacht perniciöse, quotidiane, subkontinuirliche und kontinuirliche Fieber." A little lower down the same page, Grassi, clearly quoting from the observations published by Celli & Guarnieri, added the note: "Die *Haemamoeba immaculata* wurde im Menschen bis jetzt nur in Rom angetroffen." Thus in his survey of the human malaria parasites Grassi repeated and amplified his earlier subjective taxonomic judgment that the bird parasite *Haemamoeba immaculata* occurred also in the blood of Man and was responsible for one of the kinds of human malaria fever. For the reasons already explained, this subjective judgment on the part of Grassi is entirely irrelevant, so far as concerns the question of the identity of the species to which the name *Haemamoeba immaculata* applies, that being a question settled objectively once and for all by the fact that it was the bird material which alone was used by Grassi when he drew up his description of that species.

125. It is now generally agreed that Grassi was (taxonomically) in error when he subjectively identified the bird parasite *Haemamoeba immaculata* with a human malaria parasite. Malariologists are generally agreed also that the human malaria parasite which Grassi misidentified with his bird parasite and to which he therefore erroneously applied the specific name *Haemamoeba immaculata* was the Malignant Tertian Malaria Parasite.

126. So far as human malariology is concerned, the subsequent history of the specific trivial name *immaculata* Grassi, 1891, is very similar to that of the specific trivial name *praecox* Grassi & Feletti, 1890 (discussed in paragraphs 98-99 above). Both names have been used for the Malignant Tertian Malaria Parasite and both for the same reason. In each case the widespread acceptance of the erroneous determination by Lühe (1900) (discussed in paragraphs 46-51 above) of *Oscillaria malariae* Laveran, 1881, as the Quartan Malaria Parasite left (as it was believed) the Malignant Tertian Malaria Parasite without an available specific trivial name. The difference between the later development of these two cases lies in the fact that, while workers in France accepted (erroneously as is now seen) the specific trivial name *praecox* Grassi & Feletti, 1890, as the next available specific trivial name for the Malignant Tertian Malaria Parasite (paragraph 98 above), German workers such as Schaudinn (1902, *Arb. Gesundh. Amt.*, Berlin 19 : 169) rejected the name *praecox* (quite correctly) on the ground that it had been originally applied to a bird parasite and not to a human malaria parasite. These and later German authors accordingly adopted the specific trivial name *immaculata* Grassi, 1891, for the Malignant Tertian Malaria Parasite, overlooking the fact that the use of this name in this sense was open to precisely the same objection as that advanced against the use of the name *praecox* Grassi & Feletti.

127. The position is therefore that from a nomenclatorial point of view the specific trivial name *immaculata* Grassi, 1891, as published in the combination *Haemamoeba immaculata*, is a name published for a parasite of birds and not for a malaria parasite of Man and that it was only through the erroneous subjective identification of the bird parasite with a human malaria parasite that this trivial name ever found its way into the literature of human malariology. The specific trivial name *immaculata* Grassi, 1891, has, therefore no place in the synonymy of the names bestowed upon human malaria parasites, though (like *praecox* Grassi & Feletti, 1890), it must be included in any list of names at one time or another erroneously believed to have been so bestowed which may be drawn up in connection with such a synonymy.

(9—11) The terms “quartanae,” “tertiana” and “quotidiana” erroneously alleged to have been published by Celli and Sanfelice in 1891 as trivial names for the Quartan Malaria Parasite, the Benign Tertian Malaria Parasite and the Malignant Tertian Malaria Parasite respectively, treated by the above authors as varieties (subspecies) of the nominal species “*Plasmodium malariae*” Marchiafava and Celli, 1885

128. In 1891 Celli & Sanfelice published a long paper entitled “Sui Parassiti del Globulo Rosso nell’Uomo e negli Animali” (1891, *Ann. Ist. Igiene sper. Univ. Roma* (n.s.) 1 : 33—63, 3 pls.). This paper is divided into a number of Sections of which the third is entitled “Uomo malarico.” In this Section (: 54) human malaria fever was stated to consist of three forms, This passage reads as follows:—

. . . Secondo poi il tipo del febricitare si può svolgere sotto tre forme:—

- (a) quartana: ne sono combinazioni la quartana doppia, la quartana tripla o pseudoquotidiana;
- (b) tertiana: n’è una combinazione la tertiana doppia o pseudoquotidiana;
- (c) quotidiana: combinazioni ne sono le febbri ad accessi prolungati, le subentranti, le subcontinue, le perniciose.

129. Throughout the remainder of Section III of their paper Celli & Sanfelice discussed human malaria fever (not the human malaria parasites) under these names. Quartan Malaria was discussed under the title “Nella quartana” (: 54—55), Benign Tertian Malaria under the title “Nella tertiana” (: 55) and Malignant Tertian Malaria under the title “Nella quotidiana” (: 55—58). In a concluding Section (which is unnumbered and lacks a title), commencing on page 59 and ending on page 61, Celli & Sanfelice brought together the conclusions reached in the

earlier part of their paper and on page 61 they set out as shown in the following table (reproduced in facsimile in Plate I) the views which they had formed in regard to the parasites responsible for the types of fever discussed in their paper:—

Per distinguere le specie adottammo anche noi il criterio della sede, al quale va talora congiunto quello morfologico e sempre quello sperimentale, per cui finora da una specie all'altra un parassita non fu inoculabile. Alcune specie hanno della varietà, che distinguiamo secondo la rapidità di sviluppo, cioè: A) lento; B) accelerato; C) rapido.

Tenendo conto per ora soltanto delle specie meglio studiate, la loro classificazione sarebbe dunque come segue:

Generi	Species	Varietà
1° <i>Haemogregarina</i> (Danilewsky)	{ <i>H. ranarum</i> R. Lank <i>H. testudinis</i> Dan. <i>H. lacertae</i> Dan. <i>H. columbae</i> Gras. <i>H. Danilewsky</i> Kru. <i>H. aluci</i> n.sp. <i>H. bubonis</i> n.sp. <i>H. passeris</i> Gras.	
2° <i>Haemoproteus</i> (Kruse)	{ <i>H. noctuae</i> n.sp.	{ A C A C
3° <i>Plasmodium</i> (Marchiafava e Celli)	{ <i>Pl. malariae</i> M. e C.	{ A B C A— <i>quartanae</i> B— <i>tertiana</i> C— <i>quotidiana</i>

130. The serial publication in which the foregoing paper by Celli & Sanfelice was published is very scarce and it is doubtless for this reason that the nomenclature used in it for the human malaria parasites has not before now been critically examined. Even Christophers had not in 1945 (*Rev. Inst. Salubridad y Enfermedades trop.* 6(4) : 220—221) seen this paper and, misled by earlier copyists, fell into the error of stating that Celli &

Sanfelice had published "*quotidianae*" and "*tertiana*" as the "names" of varieties of a species to which they had applied the specific name "*Haemamoeba malariae*" but that they had published "*quartana*" as the name of a variety of a species to which they had applied the specific name "*Plasmodium malariae*." Actually, as can be seen from the table reproduced in the immediately preceding paragraph, all three of these so-called "names" were published by Celli & Sanfelice in connection with varieties attributed by those authors to *Plasmodium malariae* Marchiafava & Celli.

131. It will be seen from the table reproduced in paragraph 129 above that Celli & Sanfelice:—

- (1) treated all the then known forms of human malaria parasite as being referable to a single species which they placed in the genus *Plasmodium* Marchiafava & Celli, 1885, and to which they applied the specific trivial name *malariae* Marchiafava & Celli, 1885;
- (2) distinguished the three forms of human malaria parasite as varieties of *Plasmodium malariae* Marchiafava & Celli, 1885, under the letters "A," "B," and "C" in exactly the same way as, for the three preceding species, each placed in the genus *Haemoproteus* Kruse, 1890, they had recognised two forms (designated as varieties "A" and "B") of *H. passeris* Gras., two forms (similarly designated) of the new species *H. noctuae* Celli & Sanfelice, and three forms (designated as varieties "A," "B" and "C") of the new species *H. alaudae* Celli & Sanfelice;
- (3) added, in the case of *Plasmodium malariae* Marchiafava & Celli, the word "*quartanae*" against "Varietà A", the word "*tertiana*" against "Varietà B" and the word "*quotidianae*" against "Varietà C."

132. When we come to interpret the new terms introduced by Celli & Sanfelice in the paper under discussion, the first point which we have especially to observe is that it is only in the table (reproduced in paragraph 129 above) on page 61 of their paper that they used the Latin words “quartanae,” “tertianaes” and “quotidianae” respectively in connection with “the” human malaria parasite. It is only by reference back to the Italian words used for the types of fever concerned, namely “quartana,” “terzana” and “quotidiana,” used on pages 54 and 55 of Celli & Sanfelice’s paper that it is possible to identify “Varietà A—quartanae” with the Quartan Malaria Parasite, “Varietà B—tertianaes” with the Benign Tertian Malaria Parasite, and “Varietà C—quotidianae” with the Malignant Tertian Malaria Parasite. Article 25 of the *Règles* requires that a name, to acquire rights under the Law of Priority, must be accompanied by an indication, definition or description (“accompagné d’une indication, d’une définition ou d’une description”). The word selected as the trivial name for a taxonomic unit, even if (as in the present case) it conveys a clue to the identity of the organism so named, cannot be regarded as constituting an “indication,” unless it is accompanied by at least a few descriptive words. In the present case the three alleged names (*quartanae*, *tertianaes* and *quotidianae*) were not so accompanied in the only place where they appear in Celli & Sanfelice’s paper. We must conclude therefore that, even if those authors intended to use these words as scientific zoological names (a question which is discussed in paragraphs 134 to 137 below) they published them without even the minimum “indication” required by proviso (a) to Article 25 and therefore that these names (if they were names) possess no rights under the Law of Priority as from the date of the publication of Celli & Sanfelice’s paper.

133. We must note here, in passing, that, if Celli & Sanfelice had intended that the terms “quartanae,” “tertianaes” and “quotidianae” should be regarded as scientific zoological names and if each of those names had been duly accompanied by an indication, one of them would nevertheless automatically have been invalid. For under the *Règles* the nominotypical subgenus of a genus automatically bears the same name as the genus itself (Article 9), and by universal practice the same principle is observed

by zoologists in relation to the name to be used for the nominotypical subspecies of a species. It would be well however if the International Congress of Zoology were to take an early opportunity to insert in the portion of the *Règles* relating to the names of species and subspecies an express provision similar to that already prescribed by Article 9 in relation to the names of nominotypical subgenera, even though such a provision would do no more than give official sanction to the present practice of zoologists¹⁷. In the present case Celli & Sanfelice stated that they recognised only one species of human malaria parasite (*Plasmodium malariae* Marchiafava & Celli), which, in their view, comprised three varieties ("A," "B" and "C"). If, as we have assumed above for the purpose of the present argument, a name had been given by Celli & Sanfelice to each of these varieties, one of them would have been given to the nominotypical subspecies of *Plasmodium malariae* Marchiafava & Celli, 1885. Celli & Sanfelice themselves both clearly and correctly indicated (: 55) that, in their view, the name *Plasmodium malariae*, as published by Marchiafava & Celli in 1885, applied to the Malignant Tertian Malaria Parasite. The passage in which Celli & Sanfelice gave this indication reads as follows: "Nella quotidiana vera (fig. 20—38) la varietà parasitaria (Marchiafava & Celli) . . .". It is clear, therefore, that Celli & Sanfelice considered that their "Varietà C—quotidianae" (as so cited in the table given on page 61 of their paper) was the parasite responsible for the fever which (: 55) they had discussed under the Italian term "quotidiana" and which, being the Malignant Tertian Malaria Parasite, was the species to which Marchiafava & Celli had given the name *Plasmodium malariae*. Thus, if Celli & Sanfelice had intended that the Latin adjective

¹⁷ At Paris in 1948 the International Commission on Zoological Nomenclature remedied the deficiency in the *Règles* here referred to by securing the approval of the Thirteenth International Congress of Zoology to the insertion in the *Règles* of an Article providing that, where a nominal species has two or more nominal subspecies, the subspecific name for the subspecies on which the original description of the species itself was based shall have as its subspecific name the same name as that borne by the collective species itself, thereby giving valid force to the existing practice of systematists by introducing a provision at the specific and subspecific name level exactly parallel to the provision which had always existed in Article 9 of the *Règles* at the generic and subgeneric name level (1950, *Bull. zool. Nomencl.* 4 : 191). At the same time the Paris Congress decided that the subspecies on which a nominal species is based should be known as the "nominotypical" subspecies of the species concerned. At Copenhagen in 1953 the Fourteenth International Congress of Zoology substituted the expression "nominated" for the expression "nominotypical" (1953, *Copenhagen Decisions zool. Nomencl.* : 21).

quotidianae applied by them to their "Varietà C" should be regarded as a scientific zoological name for a "variety" of the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, the name *quotidianae* Celli & Sanfelice, 1891, would have been a subjective junior synonym of the name *malariae* Marchiafava & Celli, 1885, since, as is agreed, the former as well as the latter name applies to the Malignant Tertian Malaria Parasite. Since, as has been explained above, the giving of a separate subspecific trivial name to the nominotypical subspecies of a polytypic species contravenes the *Règles*, the name *quotidianae* Celli & Sanfelice, 1891, would have been invalid, even if (as we have seen was not the case) it had been duly published with an "indication" as required by proviso (a) to Article 25.

134. We have next to consider whether the Latin words "quartanae," "tertiana" and "quotidianae," as published by Celli & Sanfelice in the table on page 61 of their paper were intended to be scientific zoological names at all. For this purpose we have first to consider the status of these alleged names in relation to the provisions of paragraph (1) of Article 14 of the *Règles*, which specifies the various permissible types of specific trivial name. The position of such names, when adjectives, is dealt with in sub-paragraph (a) of paragraph (1), which provides that such names must agree in gender with the generic name. Attached to this sub-paragraph is the example "*Felis marmorata*." (The substantive French text of this portion of Article 14 reads: "Les noms spécifiques sont: (a) des adjectifs s'accordant en genre avec le nom générique; Exemple: *Felis marmorata*."") The generic name "*Felis*" (in the example cited) is in the nominative singular as required by Article 8. Accordingly, as the generic name *Felis* is a feminine noun, the adjectival specific trivial name is in the feminine gender and in the nominative singular case, appearing in the form "*marmorata*."

135. Applying these principles to the present case, we find that an adjectival trivial name of a subspecies (variety) of *Plasmodium malariae* Marchiafava & Celli would need to be (1) in the nominative singular and (2) in the neuter gender, that being the gender of the word *Plasmodium* (the generic name). Thus, if (to take,

as an example, the first of the Latin words used by Celli & Sanfelice) it were desired to use the adjective *quartanus*, -a, -um, as the trivial name of a subspecies of a species of *Plasmodium*, the subspecific trivial name would appear in the form "*quartanum*." When we turn to Celli & Sanfelice's paper, what do we find? Instead of being in the form "*quartanum*" (as required by the *Règles*) this word is in the form "*quartanae*." Thus this word was used by those authors in the genitive singular (instead of in the nominative singular) and in the feminine gender (instead of in the neuter gender). The other two Latin words used by Celli & Sanfelice, namely "*tertiana*" and "*quotidiana*," were published in exactly the same form.

136. Why was it that Celli & Sanfelice placed these three Latin words in the genitive singular case and treated them as applying to some feminine noun? No explanation can be found for their action, so long as it assumed that these authors, when using these Latin adjectives, were intending to give scientific zoological names to the three "varieties" of the single nominal species *Plasmodium malariae* Marchiafava & Celli, recognised by them in the paper under consideration. The action of Celli & Sanfelice is only explicable on the assumption that they never intended these adjectives to be treated as scientific zoological names and were quite content to leave unnamed the three "varieties" designated by them as varieties "A," "B" and "C," in the same way as they designated by letters, but did not give names to, the "varieties" which they recognised for the three species of the genus *Haemoproteus* Kruse enumerated in the same table (reproduced in paragraph 129 above). Once we discard the erroneous notion that these Latin adjectives were intended to be scientific names, it becomes apparent that the object of Celli & Sanfelice in using these words was to denote the type of malaria for which each of the so-called "varieties" of *Plasmodium malariae* Marchiafava & Celli was responsible. We may therefore conclude that Celli & Sanfelice employed these words as adjectives in agreement with the noun *malariae* (as used for the trivial name of the species), regarding them not as names but as descriptive epithets. To take, for example, their use of the word "*quartanae*" in connection with their "Varietà A," they may have used this word in agreement with the word "*malariae*" (the trivial name of

the species), which is a feminine noun and, in the way there used, is in the genitive singular case; the full phrase understood in that case would be "*Plasmodium malariae quartanae*" or, as one might say, the "*Plasmodium* of (or responsible for) Quartan Malaria." It is possible however, that the word understood but not expressed with which the adjective "*quartanae*," as used by Celli & Sanfelice was in grammatical agreement, was not the word "*malariae*" but the word "*febris*," in which case it would be even clearer that the word "*quartanae*" was used by these authors as a technical designation and not as a subspecific trivial name, the concept intended to be conveyed by this designation being "The Plasmodium of the Quartan Fever." That this is the true explanation of the use of these descriptive adjectives in the genitive case with no noun expressed is lent some colour by the fact that technical designations of this kind were certainly used by some malariologists at about this time. In this connection, we may refer to the cheironym *Haemamoeba febris irregularis* attributed to Sakharov (paragraphs 151—157 below) and the use by Koch of such expressions as *febris tropica* (paragraphs 178—185 below).

137. While, therefore, there may be some doubt as to the precise manner in which Celli & Sanfelice intended that their use of the terms "*quartanae*," "*tertiana*" and "*quotidiana*" should be interpreted, it seems clear that those authors did not look upon these terms as names in the sense understood in zoological nomenclature.

138. To sum up, if the terms "*quartanae*," "*tertiana*" and "*quotidiana*" had been published by Celli & Sanfelice as scientific zoological names, the names consisting of these adjectives would have been invalid, because they were published without an indication, definition or description (see paragraph 132 above). In fact, however, it was never the intention of Celli & Sanfelice that these adjectives should be regarded as scientific zoological names, for these words were employed by those authors not as subspecific trivial names for the parasites concerned but as Latin adjectives to designate types of the fever to which those parasites

give rise. The so-called varietal (i.e. subspecific) trivial names *quartanae*, *tertiana* and *quotidiana* of Celli & Sanfelice, 1891, are thus seen not to be names at all. It is likely, indeed, that these terms would never have found their way into the literature if Celli & Sanfelice's paper had been readily available to subsequent students.

139. While for the reasons which I have explained there appears no reasonable doubt that the interpretation of Article 14 suggested in the present Section is correct, it is admittedly a weakness in the *Règles* that they should contain no express provision relating to the status of terms such as *quartanae* as published by Celli & Sanfelice in 1891, and in a later portion of the present paper (paragraphs 279—280 below) I therefore submit a recommendation that words should be inserted in Article 14 clarifying its meaning in the sense suggested above¹⁸.

(12) The term "hominis" as published in combination with the generic name "Laverania" by Danilewsky in 1891

140. In 1891 (*Ann. Inst. Pasteur* 5(12) : 758—782), Danilewsky published a paper entitled "Contribution à l'étude de la Microbiose malarique," in which he discussed the relationship of the malaria parasites of Man and birds. Towards the close of his paper Danilewsky gave (: 780) the following schematic picture of his ideas of classification, although (it will be noted) he expressly stated that he reserved for another occasion the discussion of the place to be allotted in his scheme in the zoological system:—

Au point de vue de l'hypothèse unitaire de l'infection malarique on pourrait proposer le rapprochement suivant des diverses

¹⁸ The recommendation here referred to was approved by the International Commission on Zoological Nomenclature at its Session held at Paris in 1948, and on its recommendation, words clarifying the meaning of Article 14 in this matter were added to the *Règles* by the Thirteenth International Congress of Zoology (1950, *Bull. zool. Nomencl.* 4 : 624—625).

formes du parasite, sans entrer pour cela dans la discussion de sa place dans le système zoologique:—

<i>Cytozoon malariae</i>	<i>Cytozoon praecox</i>	(a) <i>Haemamoeba-Cytamoeba</i>
(α) <i>hominis</i>	s. <i>Cytosporon</i>	(b) <i>Cytosporon avium</i>
(β) <i>avium</i>	<i>Polymitus</i> (c)	(c) <i>Haemogregarina avium</i>
	<i>Laverania</i>	(e) <i>Laverania hominis</i>

141. The only specific trivial name first published in the above table in connection with the human malaria parasites is the word "hominis" which appears in the first column as a sub-unit of the comprehensive term "*Cytozoon malariae*" and in the third column in combination with the generic name *Laverania* (as *Laverania hominis*).

142. Later authors devoted a considerable amount of time and trouble in trying to elucidate the meaning to be attached to the new names first published in the foregoing table. These efforts were, however, completely fruitless owing to the hopeless overlapping and confusion which characterised the nomenclature employed by Danilewsky. Accordingly, in order to put an end to discussion of this question, Dr. Ernest Hartman (*School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Maryland, U.S.A.*), invited the International Commission on Zoological Nomenclature to give a definite ruling on the status (if any) of the names used by Danilewsky in his 1891 paper. The decision of the Commission is embodied in its *Opinion* 101 (published in 1928) (*Smithson. misc. Coll.* 73 (No. 5) : 13—15), the "summary" of which reads as follows: "The technical Latin designations used by Danilewsky, 1891, *Annales de l'Institut Pasteur*, Vol. 5 (12), pp. 758—782, are not in harmony with the International Rules of Zoological Nomenclature and are therefore not subject to citation or the Law of Priority on basis of said publication."

143. The so-called specific trivial name *hominis* as published in the combination *Laverania hominis* by Danilewsky in 1891 is thus seen to have no status in zoological nomenclature.

(13—15) The terms “quartanae,” “tertiana” and “irregularis” erroneously alleged to have been published by Kruse in 1892 as trivial names for the Quartan Malaria Parasite, the Benign Tertian Malaria Parasite and the Malignant Tertian Malaria Parasite respectively, treated by Kruse as varieties (subspecies) of the nominal species “*Plasmodium malariae*”

144. In 1892 (*Hyg. Rdsch.* 2: 357—380, 453—485) Walther Kruse published a paper entitled “Der gegenwärtige Stand unserer Kenntnisse von den Parasitären Protozoen,” in which he treated the three known forms of human malaria parasite as belonging to a single polytypic species to which he applied the name *Plasmodium malariae*. He gave descriptions of each of these parasites, referring to each by a term consisting of a combination of three Latin words, the first two being “*Plasmodium malariae*” and the third an adjective which, on first inspection, resembles a subspecific trivial name.

145. The following is an extract from Kruse’s paper showing how he used these names if that was what they were intended to be:—

[466]

Wir unterscheiden jetzt:

1. Das *Plasmodium malariae quartanae*. Dasselbe vollendet seinen Cyclus in drei Tagen, von dem jüngsten unpigmentirten bis zu dem das Blutkörperchen ganz ausfüllenden melaninhaltigen erwachsenen Stadium, das entweder in Form einer Margerite 8—12 Sporen entwickelt, oder ohne sol che zu bilden, degenerirt.
[Here follows detailed description.]

2. Das *Plasmodium malariae tertiana*, vollendet seinen Cyclus in zwei Tagen. Wenn es erwachsen ist, füllt es gleichfalls das Blutkörperchen völlig aus, bildet aber dann entweder 14—20 Sporen in Form einer Rosette, oder degenerirt, sei es nach Art der entsprechenden Quartanaparasiten, sei es unter Verwandlung in einen mit Geisseln versehenen Körper

[467]

— ein Prozess der beim *Haemoproteus* beschriebenen genau gleicht. [Here follows detailed description.]

3. Dar *Plasmodium malariae irregularis* erscheint in zwei Entwicklungsreihen, die sich schärfer wie bei den andern Varietäten von einander differenziren lassen. [Here follows detailed description.]

146. We have now to consider whether the words “ quartanae,” “ tertiana ” and “ irregularis ” were intended by Kruse to be varietal names in the sense in which names are given in zoological nomenclature. We have first to note that Kruse gave no indication whatever that, in using these words, he was introducing new scientific names for these parasites. If that was his intention, this is a curious and unusual way in which to publish new names. Second, we have to note that, if it was Kruse’s intention to introduce new subspecific names, he did so in correct trinomial form but in a manner which would nevertheless have been very strange at the date when he published his paper, for at that time the universal method of introducing a new “ varietal ” (i.e. subspecific) name was to insert the word “ var. ” [= varietas] or some equivalent expression between the specific trivial name (in this case the name “ malariae ”) and the new varietal (i.e. subspecific trivial) name. For both these reasons it must be admitted that, if Kruse intended to bestow new varietal (subspecific) trivial names on the three human malaria parasites known to him, he did so in a very peculiar manner.

147. We have further to note that, if the words “ quartanae,” “ tertiana ” and “ irregularis ” were intended to be names in the zoological sense:—

- (a) each of these “ names ” would have been incorrectly formed, for, contrary to the provisions of Article 14 (taken in conjunction with Article 8) of the *Règles* (of which the latter requires that a generic name shall be a noun substantive in the nominative singular and the former that a specific or subspecific trivial name, when consisting of an adjective, must agree in case and gender

with the generic name), the adjectives used by Kruse in the present context were placed by him in the genitive case and the feminine gender, although the generic name used (*Plasmodium*) was correctly cited in the nominative singular and is a neuter noun;

- (b) the specific name *Plasmodium malariae* would need to be looked upon as having been used by Kruse as a kind of collective name with no definite content, the taxonomic unit to which the specific trivial name *malariae* was first given (i.e. the Malignant Tertian Malaria Parasite) by Laveran in 1881 in the combination *Oscillaria malariae* (which is also the same species as that to which the same specific trivial name was given by Marchiafava & Celli in 1885 in the combination *Plasmodium malariae*), being given by Kruse a separate varietal (subspecific trivial) name, “*irregularis*,” contrary to the provisions of the *Règles* that, where it is necessary to refer to the nominotypical subspecies of a polytypic species having two or more subspecies, the trivial name of the species is to be applied to the nominotypical subspecies, no new subspecific trivial name being employed.

148. We are, therefore, confronted with the question: “Why, if Kruse intended the words “*quartanae*,” “*tertiana*” and “*irregularis*” to be subspecific trivial names, did he not write the first of these words as “*quartanum*,” the second as “*tertianum*” and the third as “*irregulare*,” as he would have done if he had formed those “names” in accordance with the practice which then and for many years previously had already been universally recognised as correct (and which has since been enshrined in Articles 8 and 14 of the *Règles*)?” The correct answer to this question is, I am convinced, that Kruse never intended these three adjectives to be regarded as subspecific trivial names in the scientific zoological sense.

149. The reasons which have led me to this conclusion are identical with those which led me to a similar conclusion, when considering the use by Celli & Sanfelice in 1891 of three adjectives

used also in the genitive singular and in the feminine gender (“*tertiana*,” “*quartana*” and “*quotidiana*”) in connection with the human malaria parasites which those authors (like Kruse a year later) regarded as belonging to a single polytypic species, to which they (again like Kruse) applied the specific name *Plasmodium malariae*. The interpretation which I have given of this use by Celli & Sanfelice of these three adjectives is (as will be seen from paragraphs 134—136 above) that those adjectives were deliberately placed by those authors in the genitive singular and in the feminine gender because they were using those adjectives not as names in the zoological sense but in their ordinary Latin sense as descriptive epithets applied to the specific trivial name *malariae* which is a noun substantive here cited in the genitive singular and is of the feminine gender. Exactly, the same answer should, in my view, be given to the questions raised by Kruse’s use of the three adjectives here under discussion.

150. If the terms “*quartana*,” “*tertiana*” and “*irregularis*” as published by Kruse in 1892 in combination with the specific name *Plasmodium malariae* had been acceptable as validly published zoological names, the first—as Kruse’s description shows—would have applied to the Quartan Malaria Parasite, the second, to the Benign Tertian Malaria Parasite, the third, to the Malignant Tertian Malaria Parasite. For the reasons explained in the immediately preceding paragraph it is clear however that the foregoing terms were not published by Kruse as scientific names and therefore that there are, in fact, no such names as the alleged names *quartana* Kruse, 1892, *tertiana* Kruse, 1892, and *irregularis* Kruse, 1892.

(16) The cheironym “*irregularis*” erroneously alleged to have been published in the combination “*Haemamoeba febris irregularis*” by Sakharov in 1892 as a name for the Malignant Tertian Malaria Parasite

151. Sir Rickard Christophers has informed me (*in litt.*, 14th September 1944) that he has a note that the name *irregularis* has been alleged to have been published by Sakharov (or Sakharoff) as a varietal (i.e. subspecific) name in 1892 in the trinominal combination *Haemamoeba febris irregularis* and to have been applied by Sakharov to the Malignant Tertian Malaria Parasite.

At the same time, Sir Rickard added: "I cannot find any definite naming by Sakharoff in proper form and unless there is some other paper than I have so far seen in which this is done, the name may, I think, be safely omitted."

152. In a later letter, dated 16th October 1944, Sir Rickard furnished the following supplementary report: "I have not succeeded in finding any definite zoological naming by Sakharoff of *irregularis*. I have looked up all the papers by him that I can find but without result. He refers to his parasite constantly as 'le parasite des fièvres paludéennes irrégulières' and as 'les parasites des fièvres irrégulières,' but nowhere have I found a name in proper zoological form."

153. Dr. C. M. Wenyon, writing on 18th December 1944, forwarded a note prepared by Miss I. M. Bellis in the light of a search of the literature which she had made both for this name and also for the cheironym *tropica*. Miss Bellis pointed out, by way of negative evidence, that, as observed by Ziemann (1906, in Mense's *Handb. Tropenkrankh.* 3 : 281), Lühe (1906, in Mense's *ibid.* 3. : 220) expressed the opinion that there was so much confusion in the nomenclature of the human malaria parasites that it was much better to refer to those species by their vernacular names. In spite of this, Lühe then proceeded to discuss all the scientific names which to his knowledge had been applied to these species. In this survey however he made no mention of a specific trivial name *irregularis*.

154. Miss Bellis drew attention also to the fact that Koch (1898, *Reise-Berichte über Rinderpest, Bubonenpest* : 95) mentioned "irreguläre Malaria" (and also "tropische Malaria") but did not introduce any new specific trivial name for the parasite that he was discussing (the Malignant Tertian Malaria Parasite).

155. Dr. G. Robert Coatney, in a letter dated 13th September 1945, reported as follows:—

I cannot verify *Haemamoeba febris irregularis* Sakharov, 1892. However, Sakharoff (same man but different spelling), 1891, “Recherches sur le parasite des fièvres paludéennes irrégulières” (*Ann. Inst. Pasteur* 5: 445—449) says that he thinks those malarias that exhibit irregular fevers are distinct species from those that do not but he *does not* name a n.sp. *irregularis*.

156. It seems to me possible that the explanation of this problem may be found in the (alleged) use (by Sakharov) of the term *irregularis* not as a specific trivial name in a binominal combination (as required for the scientific name of a species in zoological nomenclature) but as the third portion of a term consisting of a trinominal combination of Latin words, of which the second word was the word “*febris*.” For it is possible that, if not Sakharov himself, at least some later author referring to Sakharov’s papers, may have used a trinominal expression of this kind not as a subspecific name in the sense in which such names are used in zoological nomenclature but rather as a convenient technical designation of the “Haemamoeba of the Irregular Fever,” i.e. the Malignant Tertian Malaria Parasite. The use by one author of a technical designation of this kind might readily be misinterpreted by a later author as indicating that the author by whom this designation had first been used had thereby introduced the name *irregularis* as a new specific trivial name for the species of *Haemamoeba* responsible for irregular fevers.

157. Whether or not the above is the correct explanation of the origin in the literature of malaria of the alleged name *irregularis* Sakharov, the possibility that that name was ever published as a specific trivial name in conditions which satisfy Article 25 of the *Règles* may be regarded as being very remote. The chance that this name was duly published as a specific trivial name in proper zoological form cannot however be entirely ruled out, but in the circumstances the proper course is, I think, to treat this name as a cheironym. It is desirable however, that, when the International Commission on Zoological Nomenclature comes to deal with the problem of the human malaria parasites, it should take appropriate steps to guard against the contingency that the above name was ever validly published.

(17—19) The specific trivial name “laverani” as published in combination with the generic name “Haemamoeba” by Labbé in 1894 for the Malignant Tertian Malaria Parasite and the trivial names “quartana” and “tertiana” published at the same time by that author for the Quartan Malaria Parasite and the Benign Tertian Malaria Parasite respectively, then treated as subspecies of the Malignant Tertian Malaria Parasite

158. In 1894 (*Arch. Zool. expér. gén.* (3) 2 : 55—258, pls. 1—10) Labbé published a long paper entitled “Recherches zoologiques et biologiques sur les Parasites endoglobulaires du Sang des Vertèbrés.” In the fourth section of this paper, which was headed “Les Parasites endoglobulaires du Sang de l’Homme” (: 160—170) the author reviewed the work of Laveran and his successors. After rejecting (: 168) the conclusion of Grassi & Feletti that the crescent-formed parasites should be separated generically from the other human malaria parasites, Labbé posed a more radical question in the following words: “Le parasite de la malaria constitue-t-il une espèce unique, polymorphe ?” After observing that this important question was one which it was difficult to decide, Labbé proceeded to consider the position of the two varieties (“variétés”) separated by Golgi, namely the “Parasite de la quarte” (i.e. the Quartan Malaria Parasite) and the “Parasite de la tierce” (i.e. the Benign Tertian Malaria Parasite). Of these he observed that they seemed to be fairly well established (“assez bien établies”) by the characters which he proceeded to summarise. He added that they were accepted by practically every author, except Laveran who applied the expression “corps sphériques” alike to the parasite of the “tierce” and to the parasite of the “quarte.” A little later (: 169) after discussing the conclusions reached by Mannaberg, Labbé gave as his opinion that these two parasites constituted varieties of a single parasite (“Il semble donc à peu près établi que les parasites tierce et quarte constituent des *variétés d’un même parasite*, variétés qui ne sont peut-être pas *absolues* et *irréductibles*.”)

159. Having thus reached a taxonomic decision on the status of the Benign Tertian Malaria Parasite (the "parasite tierce") and the Quartan Malaria Parasite (the "parasite quarte"), Labbé turned his attention to the crescent-formed parasite ("les croisants"). As regards these latter, he considered that their claim to specific rank ("spécificité") was poorly established ("mal établie"), for he agreed with Laveran that the crescent-formed parasites "se confondent avec les corps amoeboïdes" and that small spherical elements gave birth to both these forms of parasite ("de petits éléments sphériques donnent naissance à ces deux formes parasitaires"). Labbé concluded, therefore, that the parasite in question, i.e. the Malignant Tertian Malaria Parasite, occurred in two forms, the one elongated and crescent-shaped, the other amoeboid. The passage in which Labbé gave this as his conclusion reads as follows:—

. . . Nous pensons donc que, de même que chez les *Proteosoma* et les *Halteridium* nous avons vu le parasite prendre soit une forme allongée, pseudo-grégarienne, soit une forme amoeboïde; ces deux formes aboutissant uniformément à une forme ronde, puis à la sporulation; de même, chez le parasite de malaria, que nous pouvons appeler *Haemamoeba Laverani*, nous pouvons voir deux formes parasitaires différentes: l'une allongée, semi-lunaire, l'autre amoeboïde.

160. Labbé summed up his views in regard to the taxonomy of the human malaria parasites in the following diagnosis (: 170):—

HAEMAMOEBEA Grassi

Syn. *Haematophyllum* Metschnikoff, *Oscillaria* Laveran, *Plasmodium* Marchiafava et Celli, *Haematomonas* Osler, *Haemamoeba* + *Laverania* Grassi et Feletti.

Parasites endoglobulaires du sang de l'homme caractérisées par un dimorphisme de structure:

- 1° Des formes amoeboïdes à mouvements assez vifs;
- 2° Des formes allongées, semi-lunaires, immobiles.

Ces deux formes, à protoplasme hyalin, à structure d'amibes, douées d'un noyau vésiculaire à nucléole excentrique, aboutissent à une forme ronde qui constitue une spore nue. Cette spore se divise en un petit nombre (quarte) ou en un grand nombre (tierce) de sporozoïtes nucléés groupés autour d'un reliquat et disposés en rosace ou en morula.

Il y a un stade de dégénérescence à flagella. Les parasites réduisent l'hémoglobine en mélanine et ont une action pathogène sur l'organisme. Le développement se fait en deux ou trois jours.

Une seule espèce: *Haemamoeba Laverani*, comprenant des variétés *H. L. var. quartana*, *H. L. var. tertiana*.

161. The following conclusions may be drawn from the extracts from Labbé's paper quoted above:—

- (1) Labbé considered that there was only one species of human malaria parasite. This species he placed in the genus *Haemamoeba* erroneously referred by him to Grassi instead of to Feletti & Grassi. He gave a new trivial name (*laverani*) to this species, clearly in honour of his compatriot Laveran, by whom the first of the human malaria parasites (the Malignant Tertian Malaria Parasite) had been originally described. Labbé did not indicate why he proposed to substitute this name for the name *malariae* Laveran, 1881 (published by Laveran in the combination *Oscillaria malariae*). Indeed at no point in his paper did Labbé refer to the trivial name *malariae* Laveran.
- (2) At the time when Labbé wrote his paper—and for some time thereafter—taxonomists commonly held the view that, if a racial or other variety was distinguished from a species previously regarded as made up of a single uniform population, it was appropriate to give a name to the newly distinguished racial or other variety but not necessary to distinguish by name the racial form to which the specific trivial name had originally been given. Accordingly, where an author stated that he recognised *two* varieties, his statement was equivalent, in the terms of the present *Règles*, to a statement that he recognised *three* subspecies, namely the nominotypical subspecies (which takes as its trivial name the name of the species itself) and two other subspecies. Labbé stated (: 169) that he recognised *two* varieties of the human malaria parasite, namely the “parasite quarte” (= the Quartan Malaria Parasite) and the “parasite tierce” (= the Benign Tertian Malaria Parasite). In the light of the

explanation given above, this should be understood to mean that Labbé recognised a single collective species, consisting of *three* subspecies, namely:—

- (a) the nominotypical subspecies of *Haemamoeba laverani* Labbé, that is to say, the taxonomic unit originally described as *Oscillaria malariae* by Laveran in 1881, after whom this taxonomic unit was re-named by Labbé (=the parasite responsible for malignant tertian malaria fever);
 - (b) the subspecies responsible for quartan malaria fever;
 - (c) the subspecies responsible for benign tertian malaria fever.
- (3) Labbé added, on page 170, that what, in accordance with the then current terminology (explained in (2) above), he called the “species” (i.e. the nominotypical subspecies) itself occurred in two “forms” (the word “forme” being used in this connection in contrast to the word “variété” employed by Labbé to denote the subspecies *quartana* Labbé and *tertiana* Labbé). The first of these forms was “amoëboïde, à mouvements assez vifs,” the second “allongée, semi-lunaire, immobile.”
- (4) The name *Haemamoeba laverani* var. *quartana* was given by Labbé to the “parasite quarte” (=the Quartan Malaria Parasite).
- (5) The name *Haemamoeba laverani* var. *tertiana* was given by Labbé to the “parasite tierce” (=the Benign Tertian Malaria Parasite.)

162. As will be seen from his diagnosis of the genus and its species (quoted in paragraph 160 above) Labbé referred to the Benign Tertian and Quartan Malaria Parasites (under their French names “tierce” and “quarte”) and immediately thereafter gave the new trivial names *tertiana* and *quartana* to these parasites. Thus Labbé did give, for each of these parasites, an “indication,” as required by proviso (a) to Article 25 of the *Règles*. The extreme brevity of the “indication” so given might have prompted

a doubt whether the data afforded were sufficient to enable a taxonomic judgment to be reached in regard to the identity of the taxonomic units to which the two foregoing names were applied, if it had not been for the fact that earlier in his paper (on page 168) Labbé gave a succinct definition both of the "parasite tierce" and of the "parasite quarte." The names *tertiana* Labbé and *quartana* Labbé may therefore both be accepted as having been duly published in the manner prescribed by the *Règles*. (It will be noted that, unlike the cheironyms *tertianae* and *quartanae* (discussed in paragraphs 134—136 above) commonly alleged to have been published as trivial names by Celli & Sanfelice in 1891, the trivial names *tertiana* Labbé, 1894, and *quartana* Labbé, 1894, were duly published in the nominative singular in agreement with the generic name and in the same gender as that name, as required by Articles 8 and 14 of the *Règles*.)

163. Having now established that the trivial names *laverani*, *quartana* and *tertiana* were duly published by Labbé in accordance with the provisions of the *Règles* and having identified the taxonomic units to which these names severally apply, we must turn to consider the status of each of these names in relation to other names given to the same taxonomic units.

164. *The trivial name "laverani" Labbé, 1894:* The taxonomic unit to which Labbé applied the specific trivial name, *laverani* (but not the taxonomic units which he regarded as "variétés" of it and to which he applied the varietal (subspecific) names *quartana* and *tertiana*) was (as has been shown above) the Malignant Tertian Malaria Parasite. The trivial name *laverani* Labbé, 1894, is thus a junior subjective synonym of the *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, which applies to the same parasite. Labbé quite clearly did not regard himself as describing a new species of parasite. What he was doing—and what he realised that he was doing—was to give a new specific trivial name to a species which had already been described and named. That species was undoubtedly the species which had first been named by Laveran, whom Labbé now associated with that species by using his name in the Latinised form "*laverani*" as its specific trivial name. Accordingly, the specific trivial name *laverani* Labbé 1894, as published in the combination *Haemamoeba laverani*, might reasonably be regarded as not only a subjective synonym,

but also as an objective synonym, of the specific trivial name *malariae* Laveran, 1881, originally bestowed upon the Malignant Tertian Malaria Parasite in the binominal combination *Oscillaria malariae*.

165. *The trivial name "quartana" Labbé, 1894:* The trivial name *quartana* was (as already shown) applied by Labbé as a varietal (subspecific) trivial name to distinguish the taxonomic unit so named from the Malignant Tertian Malaria Parasite (= *Oscillaria malariae* Laveran, 1881) (renamed *Haemamoeba laverani* by Labbé), of which he considered that his *quartana* was a variety. The taxonomic unit to which Labbé applied the name *quartana* was the "parasite quarte," i.e. the Quartan Malaria Parasite. The only name which, prior to the publication of the name *quartana* Labbé, 1894, had been published for the Quartan Malaria Parasite is the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*. As already observed (paragraph 90) this latter name cannot be used for the Quartan Malaria by those malariologists—the majority—who regard this species as congeneric with the Malignant Tertian Malaria Parasite, for to these specialists both species are referable to the genus *Plasmodium* Marchiafava & Celli, 1885, in which genus the name *malariae* Feletti & Grassi, 1889, for the Quartan Malaria Parasite is a junior secondary homonym of the name *malariae* Laveran, 1881, the oldest available name for the Malignant Tertian Malaria Parasite. Nor, in my view, can the name *malariae* Feletti & Grassi be used for the Quartan Malaria Parasite even by those malariologists who do not regard the species so named as congeneric with the Malignant Tertian Malaria Parasite. For the fact that this name is a junior secondary homonym and must be rejected and replaced by authors who put the species so named in the same genus (*Plasmodium*) as the species *malariae* Laveran, 1881, means—under Articles 35 and 36—that this name is permanently rejected and cannot be used by anyone¹⁹.

¹⁹ At the time when this passage was written, it was still a matter of argument whether a rejected secondary homonym (such as the name *malariae* Feletti & Grassi 1889, in the genus *Plasmodium*) was rejected permanently or whether it could be used by those authors who held a taxonomic view according to which the name in question was not a secondary homonym of some older name. As explained in Footnote 7, the Thirteenth International Congress of Zoology, Paris, 1948, decided that a name rejected and replaced for the foregoing reason can never be validly used again.

In these circumstances, under the *Règles*, the name *quartana* Labbé, 1894, as published in the combination *Haemamoeba laverani* var. *quartana*, is the oldest available trivial name for the Quartan Malaria Parasite.

166. *The trivial name "tertiana" Labbé, 1894:* The trivial name *tertiana* was (as already shown) applied by Labbé as a varietal (subspecific) trivial name to distinguish the taxonomic unit so named from the Malignant Tertian Malaria Parasite (= *Oscillaria malariae* Laveran, 1881) (renamed *Haemamoeba laverani* by Labbé), of which he considered his *tertiana* was a variety. The taxonomic unit to which Labbé applied the name *tertiana* was the "parasite tierce," i.e. the Benign Tertian Malaria Parasite. The oldest available trivial name for that parasite is *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*, of which, therefore, the trivial name *tertiana* Labbé, 1894, is a junior subjective synonym.

(20) The specific trivial name "falciforme" as published in combination with the generic name "Haematozoon" by Thayer and Hewetson in 1895 for the Malignant Tertian Malaria Parasite

167. As will be seen from paragraphs 107 above, Antolisei & Angelini in 1890 published a description of the Malignant Tertian Malaria Parasite, which they called *ematozoo falciforme*, which, for the reasons which I have explained, I consider is, on being corrected to *Ematozoo falciforme*, a name which must be regarded as an acceptable name under the *Règles*. In 1895 in the important work entitled "The Malarial Fevers of Baltimore" which occupies the whole of volume 5 of the *Johns Hopkins Hospital Reports*, Thayer & Hewetson, (: 27), without offering any explanation of what they were doing, introduced the name *Haematozoon falciforme* for the Malignant Tertian Malaria Parasite in a discussion of the paper by Antolisei and Angelini referred to above. In introducing this name, Thayer & Hewetson used a small letter instead of a capital for the first letter of the

generic name which appeared as *haematozoon*. It is likely, that Thayer & Hewetson, in taking this action, did not look upon themselves as publishing a new name, considering rather that they were correcting the defective name published five years earlier by Antolisei & Angelini. It is not possible, however, in a case of this kind to look behind the published words, in order to seek out the intention of the author concerned. For the reasons which I have explained fully when discussing the situation created by the publication of the generic name *Ematozoo* Antolisei & Angelini, 1890, with a small initial letter instead of with a capital letter (paragraphs 110 to 118 above), which is exactly parallel with the present case, I am of the opinion that the name *falciforme* as published by Thayer & Hewetson is not invalidated by reason of the fact the generic name was written with a small initial letter (as *haematozoon*) instead of with a capital (as *Haematozoon*). It might however be argued that the name *falciforme* so published was no more than a usage of the same name as previously published by Antolisei & Angelini, but on the whole it seems better to treat it as a new name attributable to Thayer & Hewetson themselves.²⁰

168. The name *falciforme* Thayer & Hewetson, 1895, applies, as has been explained above, to the Malignant Tertian Malaria Parasite which ever since 1881, had possessed the available name *malariae* Laveran, (paragraph 45). Accordingly, the name *falciforme* Thayer & Hewetson, 1895, as published in the combination *Haematozoon falciforme*, is a junior subjective synonym of the name *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*. Moreover, as the name *falciforme* Thayer & Hewetson, 1895, applies to the same species as *falciforme* Antolisei & Angelini, 1890, it is invalid by reason of being a junior secondary homonym of that name.

²⁰ When at Copenhagen in 1953 the Fourteenth International Congress of Zoology revised Article 19 of the *Règles* (the Article governing the emendation of names), it included in the revised Article a provision that an invalid emendation (such as Thayer & Hewetson's emendation to *Haematozoon* of the name previously published as *Ematozoo* by Antolisei & Angelini) is to be attributed to the authors by whom that emendation was made and is to bear priority as from the date on which it was published and not the earlier date on which the name in its unemended form was first published (1953, *Copenhagen Decisions zool. Nomencl.*, : 45, Decision 73(3)).

- (21—25) The terms “tertiana,” “quartana,” “undecimanae,” “sedecimanae” and “vigésimo-tertiana” published by Lewkowicz in 1897 in combination with the generic name “Haemosporidium” Lewkowicz, 1897, and erroneously alleged by later authors to have been published as specific trivial names for human malaria parasites

169. The issue of 6th February 1897 of the “Erste Abteilung” of the *Centralblatt für Bakteriologie, Parasitenkunde u. Infektionskrankheiten* (1897, *Zbl. Bakt.* (Erste Abt) 21(4) : 129—133) contains a short paper by Lewkowicz entitled “Ueber den Entwicklungsgang und die Einteilung der Malariaparasiten,” in which he introduced a new classification of the human malaria parasites, which he presented (: 132—133) schematically as follows:—

[132]

H a e m o s p o r i d i a

Entwicklungsdauer 2 und 3 Tage,

- I. Gruppe endoglobuläre Entwicklung,
erwachsene Formen sphärisch.
- a) *Haemosporidium tertiana*, Entwicklungsdauer 2 Tage,
b) : *quartana*, : 3 :

[133]

Entwicklungsdauer über 3 Tage,

- II. Gruppe extraglobuläre Entwicklung,
erwachsene Formen halbmondförmig.
- c) *Haemosporidium* ? Entwicklungsdauer unbestimmt (erwachsene Formen häufig cigarrenförmig, s.o.)
- d) : *undecimanae*, Entwicklungsdauer 10 Tage.
e) : *sedecimanae*, : 15 :
f) : *vigésimo-tertiana*, : 22 :

170. The parasites, it will be noted, were divided into two main groups. The first comprised the “Parasiten der Tertiana und Quartana” and the second the “Parasiten der sog. acyklischen Wechselfiebers” (: 130). The parasites of the first group were

characterised by Lewkowicz as having an endoglobular development, spherical shape in the adult forms, and a period of development of 2 to 3 days; those in the second group by extraglobular development, crescent shapes in the adult forms and a development period of more than 3 days. In the latter group Lewkowicz recognised four species. For the first of these species (a species in which the adult forms were stated to be frequently cigar-shaped) the period of development had not been determined but was considered to be probably somewhat shorter than that of the other species placed in the second group, this species thus forming a transition between the two groups (: 132). The periods of development of the three other species of the second group were given as 10, 15, and 22 days respectively.

171. The question now arises as to whether the terms “tertianae” and “quartanae” applied by Lewkowicz to the two species of his first group and the terms “undecimanae,” “sedecimanae” and “vigésimo-tertianae” applied to the second, third and fourth species of his second group should be regarded as new specific trivial names.

172. The parasites concerned are certainly distinguished by an indication, definition or description, as required by proviso (a) to Article 25 of the *Règles* and if the terms used were published as new names, they would undoubtedly possess rights under the Law of Priority as from the date of the publication of Lewkowicz's paper. But, as explained in the case of the terms “quartanae,” “tertianae” and “quotidianae” as used by Celli & Sanfelice in 1891 (see paragraphs 134—136 above), an adjective, when used as a specific trivial name, must be placed in the nominative singular and in the same gender as the word constituting the generic name. In the present case the generic name (*Haemospordium*) is a neuter noun and, in consequence, if Lewkowicz had intended that the Latin adjectives which he used in connection with these species should be regarded as specific or subspecific trivial names, he should have cited them as “quartanum,” “tertianum,” etc. In fact, as we have seen, he placed these adjectives in the genitive singular and cited them in the feminine gender.

173. In these circumstances, it must be concluded that Lewkowicz used these Latin adjectives not as specific or subspecific trivial names but as descriptive epithets. It must be noted however that, unlike the predecessors noted above, Lewkowicz used these adjectives in direct association with a generic name (*Haemosporidium*), without even the interposition of a noun acting as a specific trivial name. The use of these adjectives in the feminine singular in direct association with a generic name consisting of a neuter noun clearly shows that these adjectives were used by Lewkowicz as ordinary Latin adjectives applying to some noun, understood but not expressed, the noun in question being of the feminine gender and in the genitive case. The most probable explanation is that the noun in question was the word "malaria" and that the terms "quartanae", "undecimanae", etc., cited by Lewkowicz were regarded by him as being in grammatical agreement with the word "malariae" (i.e. the genitive singular of the word "malaria"). It is possible, however, that, as in the case of Celli & Sanfelice (paragraph 136), the word understood but not expressed was the word "febris". In this connection, it is important to note that, as shown in the table which he furnished, Lewkowicz was particularly concerned with the period of development ("Entwickelungsdauer") of the various types of fever. Thus against the term "quartanae," Lewkowicz made the entry "Entwickelungsdauer 3 Tage," thus indicating that in this case the period of development was three days and that the fever appeared on the fourth day. It is perfectly clear that all five of the Latin adjectives used by Lewkowicz were employed to denote the period of development of the form of *Haemosporidium* concerned, and that these terms were not used by that author as specific or subspecific trivial names. If any confirmation of this conclusion were needed, it is provided by Lewkowicz's treatment of the first form of *Haemosporidium* (lettered "a") in his "II. Gruppe." This is the only one of the *Haemosporidia* listed for which he did not know the period of development and it is also—no doubt, for this reason—the only one to which he did not apply a Latin adjective consisting of an ordinal number.

174. If the five foregoing terms as published by Lewkowicz in 1897 had been acceptable as trivial names for human malaria

parasites, the first ("tertiana") and second ("quartana") would have been names for the Benign Tertian Malaria Parasite and the Quartan Malaria Parasite respectively, while the third ("undecimana"), fourth ("sedecimana") and fifth ("vigésimo-tertiana") would all have been names for the Malignant Tertian Malaria Parasite. For the reasons explained in the immediately preceding paragraph, it is clear, however, that these five terms were not published by Lewkowicz as scientific names and therefore that there are, in fact, no such names as the alleged names *tertiana* Lewkowicz, 1897, *quartana* Lewkowicz, 1897, *undecimana* Lewkowicz, 1897, *sedecimana* Lewkowicz, 1897, or *vigésimo-tertiana* Lewkowicz, 1897.

(26) The specific trivial name "falciparum" Welch as published in combination with the generic name "Haematozoon" by Welch in 1897 for the Malignant Tertian Malaria Parasite

175. In 1897 (*in* Loomis's *Syst. Pract. Med.* 1 : 36) Welch published the specific trivial name *falciparum* in the combination *Haematozoon falciparum* for the Malignant Tertian Malaria Parasite. (No definite evidence is available regarding the date in 1897 in which Welch's book was published. It has accordingly here been treated as having been published after the paper by Lewkowicz discussed in the immediately preceding Section, as that paper is known to have been published as early as February 1897.)

176. In the passage referred to above Welch criticised the name *falciforme* Antolisei & Angelini, 1890, as published in the combination *Ematozoo* (=correction of *ematozoo*) *falciforme* (paragraph 102 above), on the ground that that name implied that the taxonomic unit so named was always falciform and that this carried with it the further implication that the name *falciforme* was applicable only to the crescentic forms. Welch accordingly proposed the name *falciparum* as being more appropriate, in that it indicated that "the property of forming crescents is a distinctive character of the organism." The present *Règles*, which were not

in existence at the time when Welch published the specific trivial name *falciparum*, provide (Article 32) that a scientific name, once published, cannot be rejected on the ground that it is inappropriate. Accordingly, as the *Règles* have retroactive effect, Welch's action in substituting the specific trivial name *falciparum* for the older name *falciforme* was incorrect.

177. For the reasons explained above, the trivial name *falciparum* Welch, 1897, being only a *nom. nov. pro* the name *falciforme* Antolisei & Angelini, 1890, is a junior objective synonym of that name (and, incidentally, also of the name *falciforme* Thayer & Hewetson, 1895, as published in the combination *Haematozoon falciforme*) (paragraph 102 above) and is therefore an objectively invalid name. Even if this were not so, the name *falciparum* Welch, 1897, would not be required, for it is a junior subjective synonym of the trivial name *malariae* Laveran, 1881 (paragraph 45 above), the oldest available trivial name for the species to which both these names apply (namely the Malignant Tertian Malaria Parasite).

**Supplementary note on the cheironym "tropica" erroneously
alleged to have been published in the combination
"Plasmodium tropica" by Koch in
1899 for the Malignant Tertian
Malaria Parasite**

178. In a letter dated 14th September 1944 Sir Rickard Christophers drew attention to the alleged existence of a specific trivial name *tropica* claimed to have been published by Koch in 1899 in the combination *Plasmodium tropica* as a name for the Malignant Tertian Malaria Parasite.

179. The date on which this alleged name is claimed to have been published is two years subsequent to the close of the period (1881—1897) covered by the present paper and, if that were the date on which this name had actually been published, the problem created by that name would have no bearing upon the issues now

to be submitted to the International Commission on Zoological Nomenclature. For in that event the specific trivial name *tropica* would have been ante-dated by two years by the specific trivial name *falciparum* Welch 1897 (published as *Haematozoon falciparum*), the specific trivial name now almost universally used for the Malignant Tertian Malaria Parasite and the name which for this reason it is desired should now be validated by the International Commission as the specific trivial name for that species. The name *tropica* has however a historical importance, for at one time it was widely used by German workers. For this reason and because, so long as the place (if any) in which this name was validly published remains undertermined, there is a risk that it may some day be found to have been published prior to the publication in 1897 of the specific trivial name *falciparum* Welch, I have felt it desirable to collect any information which might throw light on the question whether (and, if so, when), the name *tropica* was ever validly published as a specific trivial name.

180. Sir Rickard Christophers, writing on 14th September 1944, informed me that he had been unable to trace any paper in which the word *tropica* had been validly published by Koch as a specific trivial name, although later the word *tropica* attributed to Koch had been widely used in this sense for the Malignant Tertian Malaria Parasite by German authors. Koch had, however, used such expressions as "der tropischen Malariaparasiten" and "Parasiten der tropischen Malaria" in his paper "Ueber die Entwicklung der Malariaparasiten" published in 1899 (*Z. Hyg. InsectKr.* 32 : 1—24); it was possible that it was through the use of these expressions in this paper that later authors had incorrectly stated that in the same year (1899) Koch had published the specific name *Plasmodium tropica* (paragraph 178 above). In a later letter (dated 16th October 1944), Sir Rickard reported that he had looked up all the papers by Koch that he could find but in none of these had Koch published the word *tropica* as a name in proper zoological form. In addition to the examples quoted above from his 1899 paper Koch had elsewhere used such expressions as "Parasiten der Tropenfieber" and "Parasiten des febris tropica." Schaudinn (1902, *Arb. Gesundheitsamt. Berl.* 19 : 169) and later authors had frequently used the expression "Tropicparasit" but had not published the word *tropica* as a

specific trivial name in a binominal combination as required in zoological nomenclature. Sir Rickard reached the conclusion that at most the name *tropica* had been applied to the Malignant Malaria Parasite as "a semi-scientific name" by workers engaged in clinical work.

181. Miss I. M. Bellis (in the memorandum forwarded by Dr. C. M. Wenyon with his letter of 18th December 1944 to which reference had been made in paragraph 153 above in connection with the cheironym *irregularis* Sakharov, 1892) drew attention to the following statement by Ziemann (1906, in Mense's *Handbuch der Tropenkrankheiten* 3: 356): "Sacharoff nannte unser Perniciosa Febris meridiana. R. Koch nannte sie *Tropica*." This statement, as Miss Bellis points out, referred to the fever and not to the parasite. Miss Bellis drew attention also to the fact that in the same work under the heading "Einteilung der Malaria-parasiten" Ziemann mentions (: 279) "Tropicparasiten Koch's" as a synonym of "Perniciosaparasiten . . . der Italiener" and under "Die Perniciosaparasiten" says (: 292): "Robert Koch identifizierte dann die sämtliche tropischen Perniciosaparasiten direkt mit den italienischen malignen Tertian-Parasitenformen . . ." but that in neither of these passages did Ziemann give the scientific name *tropica* for this species of parasite. In this connection also Miss Bellis cited the statement by Lühe (1906: 220) (to which reference has been made in paragraph 153 above in the discussion of the cheironym *irregularis*) that, in his view, there was so much confusion in the nomenclature of the human malaria parasites that it was much better to use vernacular names when referring to those species. Miss Bellis then pointed to the fact that in spite of this statement Lühe had given as full a list as he could of the scientific names so far bestowed upon the human malaria parasites, but that this list contained no reference to any specific trivial name consisting of the word *tropica*.

182. In the same memorandum Miss Bellis reported the result of a special examination which she had made of Koch's malaria papers reprinted in Teil 1 of Band 2 of the "Gesammelte Werke von Robert Koch" published at Leipzig in 1912 and furnished the following extracts to illustrate the way in which Koch had

used the Latin adjective "tropica" and the German adjective "tropischen" in discussing Malignant Tertian Malaria:—

- (1) *Berichte des Geh. Medizinalrats Prof. Dr. R. Koch über die Ergebnisse seiner Forschungen in Deutsch Ost-Afrika, 1898*

The following statements occur:—

Die tropische Malaria unterscheidet sich von den anderen Arten der Malaria in vielfacher Beziehung, am deutlichsten aber durch den eigentümlichen Krankheitsverlauf und durch die besonderen Blutparasiten, welche regelmässig bei derselben angetroffen werden . . . (: 308).

Der Blutparasit des hiesigen Tropenfiebers entspricht im übrigen vollkommen der Beschreibung, welche von den Parasiten der angeblichen quotidianen Malaria in anderen tropischen Ländern von verschiedenen Forschern gegeben ist. (: 310).

(A description with several figures follows, but no scientific name is given.)

- (2) *Über die Entwicklung der Malariaparasiten, 1899 (Z. Hyg InsectKr. 32)*

The following passages occur:—

Zu den echten Malariaparasiten, welche den angegebenen Merkmalen entsprechen, sind bisjetzt folgende Arten zu rechnen:—

1. Der Parasit des quartanen Fiebers
2. Der Parasit des tertianen Fiebers
Beide sind durch die Untersuchungen von Golgi hinreichend charakterisiert.
3. Der Parasit des Tropenfiebers
. . . . Für diesen Parasit ist durch Marchiafava und seine Schüler nachgewiesen, dass es eine besondere Art bildet und einen analogen endogenen Entwicklungsgang besitzt, wie die Parasiten der quartanen und tertianen Fiebers.

(No scientific names were given by Koch in this passage.)

Von den drei Malariaparasiten des Menschen ist die endogene Entwicklung hinreichend bekannt und ich habe den Beschreibungen Golgis in bezug auf die Quartan- und Tertianparasiten und den Angaben Marchiafavas über die Tropenparasiten (identisch mit den sogenannten Astivo-Autumnalparasiten) eigentlich nichts hinzufügen.

(In this passage also no scientific names were given by Koch.)

(3) *Zusammenfassende Darstellung der Ergebnisse der Malaria-expedition, 1900 (Dtsch. med. Wschr., Nos. 49 u 50)*

Wir haben es somit nur noch mit den drei erwähnten Arten der Malaria zu tun. Aber wie sollen wir die dritte Art benennen. Ofters begegnet man die Bezeichnung "Estivoautumnalfieber," in neuerer Zeit wird der Name "maligne Tertiana" häufig gebraucht. Beide Namen scheinen mir nicht zweckmässig zu sein. Der Ausdruck "Estivoautumnalfieber" passt für die Tropen, wo doch diese Art von Malaria eigentlich zu Hause ist gar nicht; wollte man sie "maligne Tertiana" nennen dann musste man die Tertiana des gemässigten Klimas zum Unterschied von jener als "benigne Tertiana" bezeichnen und zweien Taufen vornehmen. Es scheint mir das richtigste zu sein, mit Rücksicht auf die eigentliche Heimat der Krankheit den von jeher gebrauchten Namen "Tropenfieber" beizubehalten und die späteren lokalen Eindrücken entsprechende Bezeichnungen fallen zu lassen.

(In this as in the previous passages quoted Koch did not give a scientific name.)

183. Finally, Dr. G. Robert Coatney (in a letter dated 13th September 1945) reported that he also had been unable to trace the use of the word *tropica* as part of a scientific name for a malaria parasite.

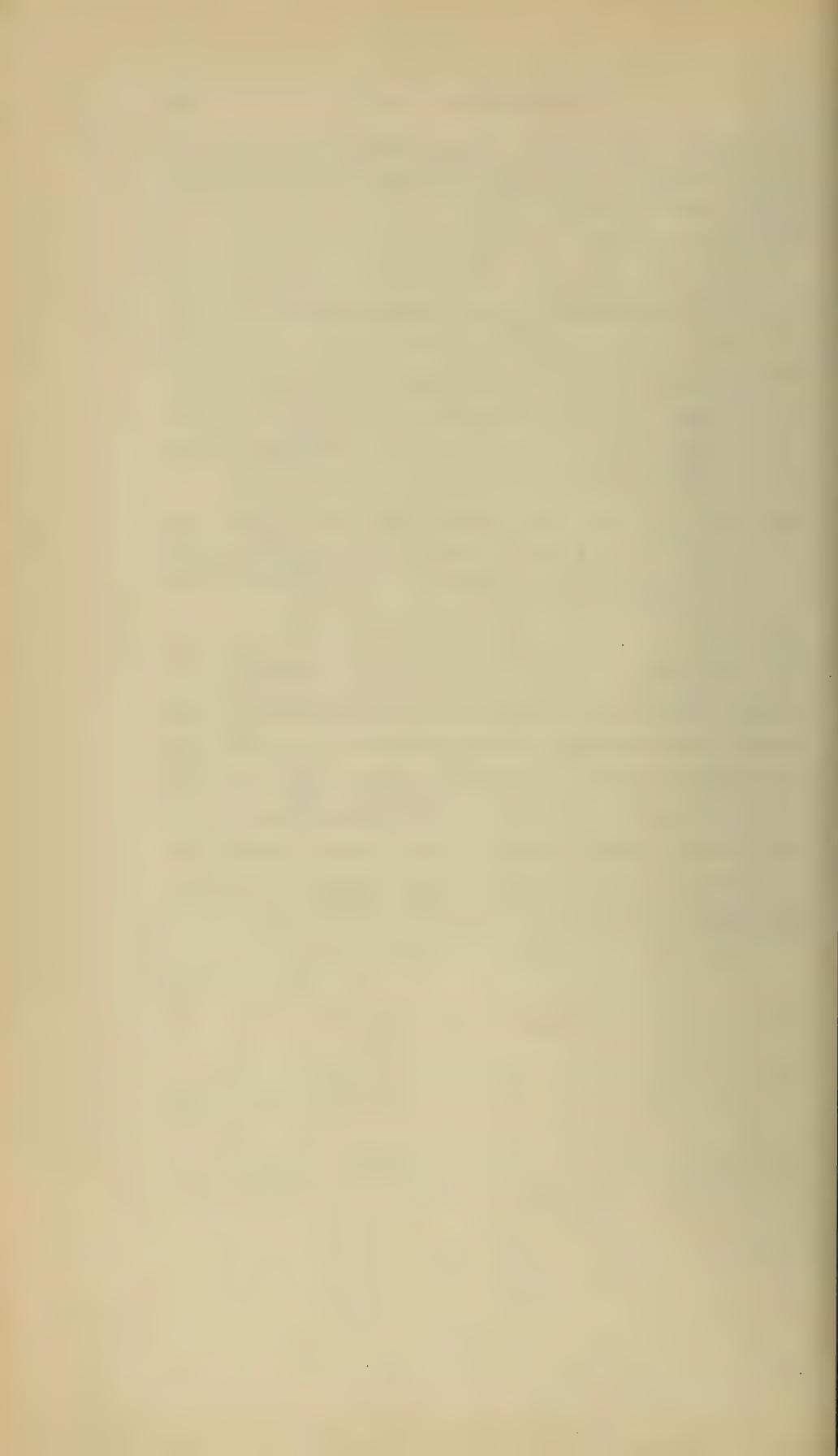
184. The conclusions which I draw from the evidence summarised above are:—

- (i) that Koch realised very clearly that the fever to which he applied the expression "tropische Malaria" was the

same as the aestivo-autumnal fever found in temperate climates, i.e. the fever due to the Malignant Tertian Malaria Parasite;

- (ii) that Koch never published the word "*tropica*" as a specific trivial name in a binominal combination formed for the Malignant Tertian Malaria Parasite, for, if he had done so, he would (according to his own view, as summarised in (i) above) have only thereby given a new scientific name to a species already recognised (as Koch himself stated) by Marchiafava, i.e. he would only have created a junior synonym for the Malignant Tertian Malaria Parasite;
- (iii) that, when Koch did use the Latin word "*tropica*" he used it not as a scientific name for the parasite but as a convenient technical designation for the fever to which the parasite gives rise.

185. The possibility that the name *tropica* was published by Koch in due zoological form may therefore be regarded as extremely remote. In the circumstances I think that the proper course is to treat the alleged name *tropica* Koch as a cheironym. Nevertheless, the possibility that this name was validly published in some paper which it has been impossible to trace cannot be entirely ruled out. This, as in the case of the cheironym *irregularis*, is a risk which should, therefore, be taken into account by the International Commission on Zoological Nomenclature, when it comes to formulate its decision on the complex of problems raised in the present paper.



PART 2 THE NAMES OF THE NOMINAL GENERA ESTABLISHED (OR ALLEGED TO HAVE BEEN ESTABLISHED) FOR THE HUMAN MALARIA PARASITES IN THE PERIOD 1881-1897

186. In Part 1 of the present paper we have firmly established in the case of each specific trivial name bestowed upon a human malaria parasite in the period 1881-1897, the identity of the species to which the name was applied. We can now turn to the generic names given to these parasites during the same period, and, having ascertained, for each generic name, whether it is valid in the sense that it is not a junior homonym of some other name and having determined what is the nominal species which is the type species of the nominal genus to named, we shall be able to determine which generic names are available nomenclatorially and which either are invalid as junior objective synonyms of older names or, although available, are not required because of being junior subjective synonyms of older names.

(1) The generic name "Oscillaria" Schrank, 1823, and the generic name "Oscillaria" erroneously alleged to have been published as a new name by Laveran in 1881

187. The first scientific name bestowed on any of the human malaria parasites was the name *Oscillaria malariae* given by Laveran in 1881 (*Nature parasit. Accid. Impaludisme*: 87) to the Malignant Tertian Malaria Parasite (paragraph 45 above).

188. *Oscillaria* was thus the first generic name used for a human malaria parasite, but a great deal of controversy has arisen as to its validity in view of the fact that at the time when Laveran first used this name for his malaria parasite (*Oscillaria malariae*, in 1881), there already existed a genus *Oscillaria* Schrank, 1823 (*Nova Acta Acad. Caes. Leopold. Carol.* **11** (No. 2) : 533), which had been established for certain species which are now recognised to be algae.

189. Two distinct questions arise in considering the validity of the generic name *Oscillaria* as used by Laveran in 1881:—

- (i) Had the generic name *Oscillaria* Schrank, 1823, ever been applied to a genus in the Animal Kingdom?
- (ii) When Laveran used the generic name *Oscillaria* in first describing the human malaria parasite to which he applied the specific trivial name *malariae*, did he consider that he was introducing a new generic name for this species or did he consider that he was referring that species to the existing genus *Oscillaria* Schrank, 1823?

190. The status of the name *Oscillaria* Schrank in zoological nomenclature depends on whether the nominal genus to which it was applied has ever been regarded as a genus in the Animal Kingdom. To determine the answer to this question it is necessary to examine closely the manner in which in 1823 Schrank introduced this generic name. It should be noted first that this name was published by Schrank in the serial publication cited in paragraph 188 above in a paper entitled “*Über die Oscillatorien.*” In this paper he included the following units in this group:—

- (i) *Bacillaria*. Schleichthieren.

Under this head Schrank included a number of species previously described with the generic name *Vibrio*.

- (ii) *Oscillaria*. Oscillarie.

Under this head Schrank included thirteen species previously described under the generic name *Oscillatoria* and four species previously described with the generic name *Vibrio*.

- (iii) *Vibrio*. Aelchen.

Schrank placed eight species in this genus.

191. Schrank discussed the question of whether the species belonging to the group (*Oscillatoria*) dealt with in his paper were properly referable to the Animal Kingdom. On the one hand, he pointed, first, to their method of reproduction ("durch Theilung") as suggestive of the Vegetable Kingdom, and second, to the fact that the organisms in question had been dealt with by Vaucher in a book on Freshwater Confervae (*Hist. Conferv.* : 172—178). On the other hand, he remarked with regard to the first point that reproduction "durch Theilung" is not peculiar to the Vegetable Kingdom but has been observed also among small animals ("Thierchen") and with regard to the second point that in dealing with the species in question Vaucher "sah sie niemals für Pflanzen an, spricht von ihnen, wie man von Thieren spricht, und nennt sie sogar ausdrücklich Thierchen."

192. At no point in his paper did Schrank express a definite view as to whether the organisms placed by him in the group *Oscillatoria* were to be referred to the Animal Kingdom or to the Vegetable Kingdom or possibly to some intermediate category. It seems to me, however, that the fact that Schrank himself in his original description of the genus consistently referred to the organisms concerned as "Thierchen" is sufficient to warrant the conclusion that the genus *Oscillaria* Schrank, 1823, was originally established as a genus of animals, for the foregoing expression would have been entirely inappropriate for species of a genus of plants.

193. We now come to the second of the two questions referred to in paragraph 189 above, namely that as to whether Laveran deliberately placed his malaria parasite in the genus *Oscillaria* Schrank, 1823, or whether by some accident he selected the word "Oscillaria" as the name for a new genus established by him, especially for the reception of his new species (the Malignant Tertian Malaria Parasite). We find in the first place that Laveran was certainly aware of Schrank's paper, and this fact alone makes it unlikely that he would have chosen the name *Oscillaria* if he had intended to establish a new nominal genus. Nor would it seem intrinsically unnatural for Laveran to have regarded his malaria parasite as sufficiently closely related to the minute

motile organisms placed by Schrank in his genus *Oscillaria* to justify him in assigning his new species to the same genus. This view is strongly reinforced by Laveran's own statement that the mobile filaments of what he called the "corps no. 2" often showed a great analogy with the "oscillariées" (see the penultimate paragraph of the passage quoted in paragraph 35 of the present paper). In the second place, the fact that Laveran himself later abandoned the use of the generic *Oscillaria* is more consistent with the thesis that he realised that Schrank's genus was unsuitable for the reception of his new malaria parasite (possibly because he had come to the view of other zoologists and botanists that it belonged to the Vegetable Kingdom and not to the Animal Kingdom) than with the alternative view that he deliberately abandoned a new name of which he was himself the author. On the whole, therefore, we can dismiss the possibility that, when in 1881 Laveran published the specific name *Oscillaria malariae* for the Malignant Tertian Malaria Parasite, he regarded himself as introducing a new generic name *Oscillaria*, for it may be concluded that he considered that he was describing his new species as a species of the genus *Oscillaria* Schrank, 1823.

194. In the light of the above considerations, we have now to consider the status under the *Règles* of the generic name *Oscillaria* as applied to the Malignant Tertian Malaria Parasite. The answer turns upon the interpretation to be placed upon Article 1 of the *Règles* when read in conjunction with Article 34. The point to be considered is the status in zoological nomenclature of a generic name applied to a genus originally regarded as belonging to the Animal Kingdom but subsequently transferred, on taxonomic grounds, to the Vegetable Kingdom.

195. Christophers & Sinton (1938: 1133), in considering the validity of the generic name *Oscillaria* as used by Laveran in 1881, concluded that "there could be no question that Laveran's name, being given to an animal, could not strictly be regarded as pre-occupied by a genus of the Vegetable Kingdom." This interpretation appears to have been based not upon the relevant portion of the substantive French text of Article 1 of the *Règles*

(or even upon the correct German translation) but upon the inaccurate English translation commonly in use. The substantive French texts of Article 1 (third paragraph) and Article 34 read as follows:—

*Article 1, paragraph (3)*²¹

Si un être est transporté du Règne animal dans le Règne végétal, ses noms zoologiques sont maintenus dans la nomenclature zoologique.

Article 34

Tout nom générique est rejeté comme homonyme, s'il a été employé précédemment pour quelque autre genre d'animaux.

196. It is perfectly clear from the substantive French text of Article 1 that, if a taxonomic unit originally described as belonging to the Animal Kingdom is later regarded as belonging to the Vegetable Kingdom, the names given to that unit when it was believed to belong to the Animal Kingdom are maintained in zoological nomenclature. Applying this provision to the particular case with which we are concerned, this means that, when the genus (supposedly of animals) named *Oscillaria* by Schrank in 1823, was later treated as belonging to the Vegetable Kingdom, the generic name *Oscillaria* Schrank, 1823, nevertheless retained its position in zoological nomenclature. Accordingly, Article 34 still applies to that name, and in consequence any generic name consisting of the word *Oscillaria* published subsequent to 1823 as the name of a new genus of animals is, under that Article, to be rejected as a junior homonym.

²¹ The inaccurate English translation of Article 1, which appears to have been responsible for the misunderstanding, reads as follows:—

Zoological nomenclature is independent of botanical nomenclature in the sense that the name of an animal is not to be rejected simply because it is identical with the name of a plant. If, however, an organism is transferred from the vegetable to the animal kingdom, its botanical names are to be accepted in zoological nomenclature with their original botanical status; and *if an organism is transferred from the animal to the vegetable kingdom, its names retain their zoological status.*

The italicised passage is supposed to be a translation of the substantive French text of the paragraph (3) of this Article quoted in paragraph 195 of the present paper.

197. The position as regards the validity of the generic name *Oscillaria* as applied by Laveran to the Malignant Tertian Malaria Parasite may thus be summarised as follows:—

- (i) If Laveran regarded himself as establishing in 1881 a new nominal genus named *Oscillaria* for the reception of the Malignant Tertian Malaria Parasite, the generic name *Oscillaria* Laveran, 1881, then published for the nominal genus so established, is invalid by reason of its being a junior homonym of the generic name *Oscillaria* Schrank, 1823, a generic name originally published for what was believed at that time to be a genus of animals but which was later recognised to be a genus of plants.
- (ii) If Laveran in 1881 deliberately placed the Malignant Tertian Malaria Parasite in the genus *Oscillaria* Schrank, 1823, he was simply using the latter name in a taxonomically incorrect sense.

198. The conclusion is, therefore, that the generic name *Oscillaria*, as applied to the Malignant Tertian Malaria Parasite, is either nomenclatorially invalid or taxonomically incorrect. For the reasons explained in the preceding paragraphs, I believe that the second of these alternatives represents what really happened. In consequence, I am of the opinion that Laveran never looked upon the name *Oscillaria* as the name of a new nominal genus established by himself. However, this is one of the many matters on which it is desirable that a definite ruling should be given by the International Commission on Zoological Nomenclature when it comes to stabilise the names of the human malaria parasites.

(2) The generic name “*Plasmodium*” Marchiafava and Celli, 1885

199. The generic name *Plasmodium* was first published by Marchiafava & Celli in 1885 (*Fortschr. Med.* 3 (24) : 791) as a generic name for what those authors regarded as *the* malaria parasite of Man. It is an available name in the sense that it is not a junior homonym of any previously published generic name.

200. Until the discovery described in paragraphs 55 to 56 of the present paper, it was always assumed (a) that Marchiafava & Celli placed no nominal species in their genus *Plasmodium*, and (b) that the single species which they did place in that genus was the species to which in 1881 Laveran had given the name *Oscillaria malariae*. As we shall see, both these assumptions were incorrect.

201. It has been shown earlier in the present paper (paragraph 55 above) that, when introducing the new generic name *Plasmodium* Marchiafava & Celli published also the new specific name *Plasmodium malariae* for the single species included by them in their new genus. This nominal species is therefore the type species of the genus *Plasmodium* Marchiafava & Celli by monotypy (Article 30, Rule (c)).

202. Up till the year 1946 it was universally assumed by malariologists that the species placed in the genus *Plasmodium* by Marchiafava & Celli was the Quartan Malaria Parasite, and that species has therefore been regarded by all authors as the type species of this genus. Sabrosky (1946), by going back to Marchiafava & Celli's paper of 1885, was the first author to establish that the material treated by those authors as constituting the species placed by them in the genus *Plasmodium* included no individuals at all of the Quartan Malaria Parasite. The evidence provided by Dr. Martin Young included in Sabrosky's paper showed that the greater part of this material consisted of the Malignant Tertian Malaria Parasite, though it included also some examples of the Benign Tertian Malaria Parasite. In order to give to the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, an entirely determinate character, I have in the present paper (paragraph 76) selected as a First Reviser (acting under Article 31) the examples of the Malignant Tertian Malaria Parasite to be the sole syntypes of the nominal species *Plasmodium malariae* Marchiafava & Celli. This action firmly attaches the foregoing name to the Malignant Tertian Malaria Parasite.

203. The only generic name applied to any human malaria parasite prior to the publication of the name *Plasmodium* Marchiafava & Celli, 1885, was the name *Oscillaria* as used by Laveran in the combination *Oscillaria malariae* when in 1881 he first named the Malignant Tertian Malaria Parasite (paragraph 45). I have shown, however in paragraphs 197 to 198 above, that the name *Oscillaria* as used by Laveran was not a new name but represented only a taxonomically erroneous use of the earlier name *Oscillaria* Schrank, 1823.

204. We may therefore sum up the position as follows: The generic name *Plasmodium* Marchiafava & Celli, 1885, is the oldest available generic name for any species of human malaria parasite, and its type species by monotypy is the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, a nominal species which represents the Malignant Tertian Malaria Parasite. The fact that this species and not the Quartan Malaria Parasite is the type species of this genus would, if not remedied by the International Commission on Zoological Nomenclature under its Plenary Powers, cause serious confusion in the literature. That the Quartan Malaria Parasite had for so long been accepted as the type species of the genus *Plasmodium* Marchiafava & Celli, is undoubtedly attributable to the uncritical acceptance by all subsequent workers (up to the time of Sabrosky (1946)) of the authoritative but totally incorrect action of Schaudinn (1902) in designating the Quartan Malaria Parasite (misidentified by him, following Lühe (1900), as *Oscillaria malariae* Laveran, 1881) as the type species of *Plasmodium* Marchiafava & Celli, 1885 (“*Plasmodium malariae* (Der Quartanparasit) als typus der Gattung”). A discussion of the probable origin of this erroneous determination will be found in paragraphs 46—51 above.

(3) The generic name “*Haematomonas*” Mitrophanow, 1883, and the generic name “*Haematomonas*” erroneously alleged to have been published as a new name by Osler in 1886

205. In 1886 in an “Address on the Haematozoa of Malaria” (1886, *Philad. med. Times* and 1887, *Brit. med. J.* 1887 (Vol. 1) : 556) Osler discussed the systematic position of “the” human malaria parasite and expressed the view that, pending the acquisition of a

better understanding of the affinities of this parasite, it should be referred to the genus *Haematomonas*. Osler stated that this view had been suggested by Mitrophanow but he did not cite a reference to any paper by that author on this point. The following is an extract of the relevant portion of the account of Osler's "Address" published in the issue of the *British Medical Journal* referred to above:—

There is sufficient evidence to show that the various forms are only phases in the life history of one of the flagellate protozoa belonging to the order Flagellata-Pantostomata. Mitrophanow suggests a new genus, *Haematomonas*, to include the monad haematozoa; but Crookshank, who has carefully worked out the affinities of the parasites of the rat, the fish and the surra disease, has referred them to the genus *Trichomonas*. The organism here described has not however, the characteristic marks of a *Trichomonas*; for it lacks the undulating fringe on one side and the caudal filament. Nor does it agree with the features of a *Cercomonas*; so that, meanwhile, until the true affinities are determined by an expert, its proper place seems to be the genus *Haematomonas* of Mitrophanow, which conveniently includes all monads parasitic in the blood. Thus: genus *Haematomonas*; species *Haematomonas malariae*. [no italics]. Definition: Body plastic, ovoid or globose, no differentiation of protoplasm, which contains pigment grains; flagella variable from one to four. Highly polymorphic, occurring in (1) amoeboid form, (2) crescents, encysted form; (3) sporocysts; (4) circular, free, pigmented bodies. The name designates the natural affinities of the parasite, its habitat and the conditions under which it occurs, on which grounds it seems preferable to that of *Plasmodium malariae*, suggested by Marchiafava & Celli.

206. Partly because Osler in his "Address" did not cite any bibliographical reference for the name *Haematomonas* and partly, it may be supposed, because he adopted *Haematomonas* as the generic name for "the" malaria parasite (all the forms known to him being treated as forms of a single polytypic species), it has been commonly assumed that at the time when Osler's "Address" was published, the name *Haematomonas* was no more than a manuscript name of Mitrophanow's and, therefore, that Osler himself, by publishing this name, had become its author. In 1894, for example, Labbé (1894, *Arch. Zool. expér. gén.* (3) 2 : 170) cited the generic name "*Haematomonas* Osler" among the

synonyms of *Haemamoeba* Grassi [*recte* Feletti & Grassi], the genus in which he placed the single species (*Haemamoeba laverani*) of human malaria parasite which he recognised. The alleged generic name *Haematomonas* Osler appeared again as recently as 1945 when it figured in a synonymy of the generic names of the human malaria parasites published by Christophers (1945, *Rev. Inst. Salubridad y Enfermedades trop.* 6 (4) : 216—219).

206. Actually, the name *Haematomonas* was published by Mitrophanow in a paper entitled "Beiträge zur Kenntniss der Hämatozoon" published in 1883 (*Biol. Zbl.* 3 : 41), i.e. three years before the appearance of Osler's "Address." In this paper Mitrophanow established the new genus *Haematomonas* for the reception of two new species of flagellate, the one *Haematomonas cobitis* found in the blood of a Mudfish ("Schlammpeizger"), the other *Haematomonas carassii* found in the blood of the carp ("Karauschkarp").

207. With this information at our disposal, we see that what happened was that Osler was aware that Mitrophanow was of the opinion that "the" human malaria parasite was congeneric with the flagellates which he had described from the blood of the fishes referred to above and therefore considered that the human malaria parasite should be referred to the genus *Haematomonas* Mitrophanow, 1883. This view was provisionally accepted by Osler.

208. The position is, therefore, that Osler never published the name *Haematomonas* as a new generic name and that there is in consequence no such name as "*Haematomonas* Osler." This alleged name owes its existence entirely to a misunderstanding by later authors of Osler's paper, due to their failure to read Mitrophanow's paper of 1883. In these circumstances, the alleged name *Haematomonas* Osler, 1883, should be deleted from the synonymy of the names of the genera established for the human malaria parasites, though it must be included in any list of generic names erroneously supposed to have bestowed upon those parasites.

(4) The generic name "Haematophyllum" Metschnikoff, 1887

209. The generic name *Hämatophyllum* was first published by Metschnikoff in a paper written in Russian and published in the Russian serial *Russkaja Medicina* (1887, *Russk. Med.* **12** : 207). It has not been possible to consult a copy of this paper, as there appears to be no copy of the above serial in Western Europe. Fortunately, however, Metschnikoff himself wrote an abstract of this paper which was published in the same year in the *Centralblatt für Bakteriologie und Parasitenkunde* (1887, *Zbl. Bakt.* **1** (21) : 624—625). According to this abstract, which, though signed by Metschnikoff, is written in the third person, the title of his paper (when translated into German), was "Zur Lehre von den Malaria Krankheiten." In this paper Metschnikoff described some pathological-anatomical material obtained from the Bacteriological Station at Odessa. Of the three sets of material examined the two first consisted of amoeboid forms similar to those observed by previous workers (e.g. Marchiafava, Celli, Golgi); the third appeared to him to represent a stage of development not previously noticed. He went on to say that the name previously suggested for the malaria parasite, namely *Plasmodium malariae* (i.e. *Plasmodium malariae* Marchiafava & Celli, 1885) was unsuitable and that he therefore proposed the new name *Hämatophyllum malariae*. The words used by Metschnikoff were: "Auf Grund seiner Befunde glaubt M. [=Metschnikoff], in dem Malaria-parasiten eine in die Nähe der Coccidien zu stellende Form erblicken zu können, welche er (wegen der Unbrauchbarkeit des vorgeschlagenen Namens: *Plasmodium malariae*) als *Hämatophyllum malariae* zu bezeichnen vorschlägt."

210. It is clear from the passage quoted above that the generic name *Hämatophyllum* was proposed by Metschnikoff as a *nom. nov. pro* the generic name *Plasmodium* Marchiafava & Celli, 1885, which he rejected solely on account of (as it seemed to him) the unsuitability of the word "Plasmodium" as the generic name for the malaria parasites of Man. According to Article 32 of the present *Règles* (which, however, it may be noted were not adopted until many years after Metschnikoff wrote his paper), a generic name, once published, may not be rejected on the ground of

inappropriateness, even by its own author (" Un nom générique . . . , une fois publié ne peut plus être rejeté pour cause d'impropriété, même par son auteur "). Accordingly, the name *Hämatophyllum* Metschnikoff, 1887, is no more than a substitute name for *Plasmodium* Marchiafava & Celli, 1885.

211. The orthography of this name has been expanded from " Hämatophyllum " to " Haematophyllum " by those later authors who have discussed Meschnikoff's paper (e.g. Labbé, 1894, *Arch. Zool. expér. gén.* (3) 2 : 170; Christophers, 1945, *Rev. Inst. Salubridad y Enfermedades trop.* 6 (4) : 216, 219). Strictly speaking, however, this procedure is incorrect under the existing *Règles* which require (Articles 19 and 20) that the exact original orthography of a name is to be retained.²²

212. Since the name *Hämatophyllum* Metschnikoff, 1887, is a mere substitute name (*nom. nov.*) for the name *Plasmodium* Marchiafava & Celli, 1885, it automatically takes, as its type species, whatever nominal species is the type species of the genus *Plasmodium*. That species, as shown in paragraph 201 above, is *Plasmodium malariae* Marchiafava & Celli, 1885. The nominal species so named represents the Malignant Tertian Malaria Parasite (paragraph 45 above).

213. Although not invalid as a junior homonym of some older name, the name *Hämatophyllum* Metschnikoff, 1887, is nevertheless an objectively invalid name, since it has, as its type species, a nominal species (*Plasmodium malariae* Marchiafava & Celli, 1885) which is also the type species of a nominal genus (*Plasmodium* Marchiafava & Celli, 1885), the name of which is an available name and one which possesses priority over *Hämatophyllum* Metschnikoff, 1887.

²² Article 20, jointly with Article 19, was completely revised by the Fourteenth International Congress of Zoology, Copenhagen, 1953. Under the revised provisions diacritic marks are not to be used in zoological names and, where such a mark was used on the first publication of a name, it is to be replaced by an appropriate combination of letters (1953, *Copenhagen Decisions on Zoological Nomenclature* : 57—58). Under this provision, the correct orthography for the name here under consideration is *Haematophyllum*.

(5) The generic name “*Haemamoeba*” Feletti and Grassi, 1889

214. The generic name *Haemamoeba* was first published by Feletti & Grassi in a paper entitled “Sui parassiti della malaria.” This paper was (as explained in paragraph 78 above) first published in the form of an eleven-page pamphlet on 30th December 1889 and just over a fortnight later (on 15th January 1890) it appeared in the *Riforma medica* of Naples (Feletti & Grassi, 1890, *Riforma med.* 6 (11) : 61—64). No copy of the pamphlet published in advance of the appearance of this paper in the *Riforma medica* has been traced and in consequence it is not possible to quote the page reference for the publication of the generic name *Haemamoeba*. The following notes are based upon an examination of the photostat copy of the issue of the *Riforma medica* containing this paper by Feletti & Grassi (which is reproduced in facsimile as Document No. 1, in Appendix 2 to the present paper).

215. In this paper Feletti & Grassi, after reviewing the work of their immediate predecessors, came to the conclusion that human malaria was due to two parasites, each referable to a distinct genus. For the species described by Laveran, Feletti & Grassi erected the new genus *Laverania*, while for the second species they erected the genus *Haemamoeba*. The passage in which these two generic names were thus published reads as follows (: 63):—

In ogni caso nessun zoologo, specialmente dopo le inoculazioni di Antolisei e Angelini, esiterà ad ammettere che il corpo pigmentato della terzana e della quartana è differente dalla semiluna. Noi proponiamo di riferire l'uno al nuovo gen. *Haemamoeba* e l'altro al nuovo gen. *Laverania*.

216. On the following page (: 64) Feletti & Grassi (in the passage quoted in paragraph 81 above) referred to their new species (that responsible for the “terzana” and “quartana” fevers) under the new specific name *Haemamoeba malariae*, at the same time referring Laveran's original species (*Oscillaria malariae* Laveran, 1881) to their new genus *Laverania*.

217. Two preliminary points must be noted: first, the name *Haemamoeba* was published by Feletti & Grassi with a brief "indication" (as required by proviso (a) to Article 25 of the *Règles*) and is thus a validly published name possessing rights under the Law of Priority; second, the name *Haemamoeba* Feletti & Grassi, 1889, is an available name in the sense that it is not a homonym of any previously published generic name (and is therefore not invalid under Article 34).

218. Since Feletti & Grassi included in this genus the single nominal species *Haemamoeba malariae* Feletti & Grassi, the genus *Haemamoeba* Feletti & Grassi was a monotypical genus from the standpoint of its authors. As shown in paragraphs 83—86 above, the species *Haemamoeba malariae* Feletti & Grassi, 1889, was, however, a composite species consisting partly of the Benign Tertian Malaria Parasite ("terzana") and partly of the Quartan Malaria Parasite ("quartana"). In May of the following year in a postscript (quoted in paragraph 85 above) to a paper by the same authors (in which, however, their names were placed in the reverse order and therefore appeared as "Grassi & Feletti") the Benign Tertian Malaria Parasite was recognised as a species distinct from the Quartan Malaria Parasite (and given the name *Haemamoeba vivax*), the earlier name *Haemamoeba malariae* Feletti & Grassi, 1889, being thus restricted to the Quartan Malaria Parasite.

219. The present *Règles* were not in existence when Grassi & Feletti thus restricted the specific name *Haemamoeba malariae* Feletti & Grassi, 1889, to the Quartan Malaria Parasite, but, in thus acting as the "first reviser" of the name, these authors proceeded in strict accordance with the provisions of Article 31 of the present *Règles*.

220. The nominal genus *Haemamoeba* Feletti & Grassi, 1889, is accordingly a monotypical genus with *Haemamoeba malariae* Feletti & Grassi, 1889 (=the Quartan Malaria Parasite) as its type species. This was the first occasion on which a nominal genus was established with the Quartan Malaria Parasite as type

species and, as the name *Haemamoeba* Feletti & Grassi, 1889, is a nomenclatorially available name, it is the valid generic name for the Quartan Malaria Parasite for all malariologists who consider that species as generically distinct from the Malignant Tertian Malaria Parasite. For those malariologists—the great majority—who consider that these two parasites should be referred to the same genus, the generic name *Haemamoeba* Feletti & Grassi, 1889, is a junior subjective synonym of *Plasmodium* Marchiafava & Celli, 1885, of which the Malignant Tertian Malaria Parasite (as *Plasmodium malariae* Marchiafava & Celli, 1885, a junior subjective synonym of *Oscillaria malariae* Laveran, 1881) is the type species (paragraph 204).

(6) The generic name “Laverania” Feletti and Grassi, 1889

221. The generic name *Laverania* was first published by Feletti & Grassi in the same paper as the generic name *Haemamoeba* (discussed in paragraph 214 above), that is to say in the pamphlet “*Sui parassiti della Malaria*” published on 30th December 1889 as an advance issue of the same paper which had been sent for publication to the *Riforma medica*, in which serial it appeared about a fortnight later (on 15th January 1890) (Feletti & Grassi, Jan. 1890, *Riforma medica* 6 (11) : 63). In view of the fact that it is not been possible to trace a copy of the pamphlet of 30th December 1889, it is not possible to quote a page reference for the original publication of the generic name *Laverania*. The following notes are based upon an examination of the photostat copy of the issue of the *Riforma medica* containing this paper by Feletti & Grassi, which is reproduced as Document No. 1 in Appendix 2 of the present paper.

222. Felletti & Grassi established their nominal genus *Laverania* jointly with the other nominal genus, *Haemamoeba*, which they then recognised. The passage containing their diagnoses for these two nominal genera has been quoted in paragraph 215 of the present paper, while the passage in which they cited by name the species which they referred to these genera has been quoted in paragraph 81. From the second of these passages it

will be seen that Feletti & Grassi included in their nominal genus *Laverania* a single species which they cited as *Laverania malariae*. It is clear from the passages quoted that Feletti & Grassi (while regarding the species *Haemamoeba malariae* as a new species) did not regard *Laverania malariae* as a new species and looked upon themselves as doing no more than transferring to the genus *Laverania* (established by themselves in honour of Laveran) the species of human malaria parasite responsible for the irregular fevers ("delle febbri irregolari") which Laveran had been the first to discover and to which in 1881 he had given the name *Oscillaria malariae*.

223. The nominal genus *Laverania* Feletti & Grassi, 1889, is thus a monotypical genus with *Oscillaria malariae* Laveran, 1881 (=the Malignant Tertian Malaria Parasite) as its type species. The generic name *Laverania* Feletti & Grassi, 1889, is a nomenclatorially available name in the sense (a) that it is not invalid under Article 34 of the *Règles* as a junior homonym of any previously published generic name and (b) that it has, as its type species, a nominal species which is not also the type species of a previously established nominal genus that possesses an available name.

224. We have to note, however, that *Oscillaria malariae* Laveran, 1881, the type species of *Laverania* Feletti & Grassi, 1889, is subjectively identified with *Plasmodium malariae* Marchiafava & Celli, 1885, both these nominal species being regarded as representing the Malignant Tertian Malaria Parasite (paragraphs 45 and 77 above respectively). We have further to recall (paragraph 204) that the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, is the type species of the nominal genus *Plasmodium* Marchiafava & Celli, 1885. Thus, through the subjective identification of the species represented by the nominal species which are respectively the type species of these two genera, the nominal genera *Laverania* Feletti & Grassi and *Plasmodium* Marchiafava & Celli are subjectively identified with one another. Accordingly, though an available name, the name *Laverania* Feletti & Grassi, 1889, is a junior subjective synonym of the name *Plasmodium* Marchiafava & Celli, 1885.

(7) The generic name "Ematozoo" Antolisei and Angelini, 1890

225. As explained in paragraphs 104-108 above the generic name *Ematozoo* was published by Antolisei & Angelini in two papers each of which appeared in 1890. The exact date of publication (8th March 1890) is known for one of the papers in which the name *Ematozoo* appeared (i.e. the paper in the *Riforma medica*) but, as regards the other paper nothing is known regarding the date of its publication except that it was some time in 1890. In these circumstances, it is necessary to treat the name *Ematozoo* as having been first published in the paper which appeared in the *Riforma medica*. The reference to the original publication of the name *Ematozoo* Antolisei & Angelini, is, therefore, 8th March 1890, *Riforma medica* 6 (56) : 334. (This point is of theoretical interest only, for this generic name was published in exactly the same way in each of the two papers concerned.)

226. We have pointed out (paragraph 107 above) that the generic name *Ematozoo* was originally published with a small initial letter (as "*ematozoo*") and in the same Section we have given our reasons (paragraphs 110—118) for considering that, although this method of publishing a new generic name was defective, in that it did not comply with the requirements of Articles 3 and 8 of the *Règles*, the infringement involved, though calling for automatic correction by later authors, is not such as to deprive either the generic name *Ematozoo* or the specific trivial name *falciforme*, published at the same time in the combination *ematozoo falciforme*, of rights under the Law of Priority (Article 25) as from the date in 1890, on which was published the paper by Antolisei & Angelini containing these names in the forms "*ematozoo*" and "*ematozoo falciforme*" respectively.

227. In each of the papers referred to above, the name *Ematozoo* Antolisei & Angelini, 1890, was published as the name of a monotypical genus with the new nominal species, *Ematozoo falciforme* Antolisei & Angelini, 1890, as type species. We have shown in paragraph 104 above that this name was applied in these papers to the parasite of semilunar form found in cases of the "aestivo-autumnal Roman fever." In other words, this name applies to a form of the Malignant Tertian Malaria Parasite.

228. We see, therefore, that *Ematozoo falciforme* Antolisei & Angelini, 1890, is a junior subjective synonym of *Oscillaria malariae* Laveran, 1881. At this point we have to recall (paragraph 204) that another junior subjective synonym of Laveran's species is *Plasmodium malariae* Marchiafava & Celli, 1885, the type species of *Plasmodium* Marchiafava & Celli, 1885. Thus, the nominal species which are the respective type species of *Ematozoo* Antolisei & Angelini, 1890, and *Plasmodium* Marchiafava & Celli, 1885, are both subjectively identified (on taxonomic grounds) with the same species. Accordingly the generic name *Ematozoo* Antolisei & Angelini, 1890, though an available name, is a junior subjective synonym of the name *Plasmodium* Marchiafava & Celli, 1885.

(8—11) The generic names “*Cytamoeba*,” “*Cytosporon*,” “*Haemocytosporon*” and “*Cytozoon*” published by Danilewsky in 1891

229. In the paper published in 1891 (*Ann. Inst. Pasteur* 5 (12) : 758—782) discussed in paragraph 140 above in connection with the alleged specific and subspecific trivial name *hominis*, Danilewsky introduced no less than four new generic names for the human malaria parasites:—

- (1) *Cytamoeba*. This name was proposed on page 762 of Danilewsky's paper as a substitute for the name *Haemamoeba* (“ . . . j'ai proposé de remplacer la dénomination du plasmodium malarique de l'homme, *Haemamoeba*, en celle de *Cytamoeba*.”)
- (2) *Cytosporon*. Later in the same paragraph on page 762 Danilewsky introduced the generic name *Cytosporon* for the human malaria parasite (“ Aussi, et surtout à cause de la propriété fondamentale du microbe de donner des spores, je l'appellerai *Cytosporon malariae*.”). In the schematic table which appears on page 780 of Danilewsky's paper (and which is reproduced in paragraph 140 of the present paper), the generic name *Cytosporon* is given in the second column (jointly with the name

Cytozoon) as the name for a group which Danilewsky appears to have regarded as being of generic value, for, in addition to *Cytosporon*, he placed in it the well-known and thoroughly recognised genus *Haemamoeba* with *Cytamoeba* cited as a synonym.

- (3) *Haemocytosporon*. This name was introduced in a footnote on page 762 of Danilewsky's paper with a statement that it was the full form of the name published in the main text on the same page in the abridged form "*Cytosporon*" ("On ne doit voir dans ce nom provisoire i.e. *Cytospron* (abrégé de *Haemocytosporon*) aucune allusion . . .").
- (4) *Cytozoon*. This name appears in the first column of the table on page 780 of Danilewsky's paper (reproduced in paragraph 140 above) as a generic name applicable to the parasites both of Man ("hominis") and birds ("avium"), which embraces (in some unexplained manner) all the generic names cited in the second and third columns of the table.

230. The task of interpreting Danilewsky's use of the foregoing names would present almost insuperable difficulties. Fortunately, however, it is not necessary to make this effort, for (as explained in paragraph 142 above) the International Commission on Zoological Nomenclature has ruled, in *Opinion* 101, that the Latin "technical designations" used by Danilewsky in this paper are not in harmony with the *Règles* and accordingly possess no rights under the Law of Priority (Article 25) as from the publication of that paper.

231. The four so-called generic names (*Cytamoeba*, *Cytosporon*, *Haemocytosporon*, *Cytozoon*) published in connection with the human malaria parasites by Danilewsky in 1891 have thus no status whatever in zoological nomenclature.

(12) The generic name "Haemamoeba" as used by Labbé in 1894

232. In the recent paper on the nomenclature of the human malaria parasites, to which reference has already been made, Christophers has included (1945, *Rev. Inst. Sabubridas y Enfermedads trop.* 6 (4) : 216, 220) on page 216 the generic name "*Haemamoeba* Labbé, 1894" in a list of the generic names published for the human malaria parasites. On the same page he stated that the type species of this genus was "*O. malariae* Laveran (1881) by designation." In a note on page 220, he again referred to the genus "*Haemamoeba* Labbé (1894)." On this occasion he added that this genus "includes *Haemamoeba* and *Laverania* of Feletti & Grassi." In the same note he implicitly withdrew the earlier statement (made on page 216) that *Oscillaria malariae* Laveran, 1881, was the type species of this (alleged) genus, for he stated: "He [i.e. Labbé] recognises only one species of malaria parasite, viz., *H. Laverani*, with varieties *quartana* and *tertiana*."

233. These entries in the synonymy referred to above are clearly due to some inadvertence, for (as shown in paragraph 160 above) in the paper in question ("Recherches zoologiques et biologiques sur les Parasites endoglobulaires du Sang des Vertèbrés," published in 1894, *Arch. Zool. expér. gén.* (3) 2 : 170) Labbé definitely attributed the generic name *Haemamoeba* to Grassi (actually he should have attributed it to Feletti & Grassi) and not to himself. Further, at no point in that paper did Labbé cite the name *Oscillaria malariae* Laveran, 1881, although at the beginning of the section of his paper dealing with human malaria parasites he referred in detail to Laveran's discovery of "the" parasite of human malaria and quoted at length (: 160—161) from the note of 24th December 1880 communicated by Laveran to the "Société médicale des Hôpitaux" (reproduced also in the "Notes à l'Académie de Médecine") in which that authority made known the discovery which he had made (paragraphs 34 and 35 above).

234. The position is therefore that Labbé never published the name *Haemamoeba* as a new generic name of his own: he merely used the generic name *Haemamoeba* Feletti & Grassi, 1890 (which

he incorrectly attributed to Grassi). The alleged generic name "*Haemamoeba* Labbé, 1894" is thus seen to be a non-existent name and therefore to have no place in the synonymy of the nominal genera established for the human malaria parasites.

(13) The generic name "Haematozoon" Thayer and Hewetson, 1895

235. We have seen (paragraphs 104—105 above) that in a paper entitled "The Malarial Fevers of Baltimore" (1895, *Johns Hopkins Hosp. Rep.* 5: 1—218, 2 pls.) Thayer & Hewetson stated (: 27) that in two papers (to which bibliographical references were given) Antolisei & Angelini had published a new name "*haematozoon falciforme*" for the parasite responsible for the "‘aestivo-autumnal’ Roman fever." We have seen also (paragraphs 107—108 above) that in the two papers cited Antolisei & Angelini did publish a new name for this parasite but that the new name so published consisted of the words "*ematozoo falciforme*." It follows, therefore, that it was Thayer & Hewetson themselves who were the first to publish the generic name *Haematozoon* (printed in their paper "*haematozoon*" with a small initial letter), which appears to have been a deliberate emendation by them of the generic name *Ematozoo* Antolisei & Angelini, 1890 (which, as will be seen from the extract quoted in paragraph 107 above, was originally published by those authors as "*ematozoo*" with a small initial letter).

236. In our discussion of the generic name *Ematozoo* Antolisei & Angelini, 1890 (paragraphs 110—118 above) we have given our grounds for the view that the failure on the part of these authors to write the first letter of the word "*ematozoo*" with a capital letter, though an infringement of Articles 3 and 8 of the *Règles*, which calls for automatic correction by later authors, does not constitute an infringement sufficiently serious to deprive the generic name *Ematozoo* Antolisei & Angelini, 1890, of rights under the Law of Priority. While noting that Thayer & Hewetson in their turn published the generic name *Haematozoon* without

a capital initial letter, we need not debate whether this omission on their part was sufficiently serious to invalidate this name, for the considerations in the opposite sense advanced in the case of the name *Ematozoo* Antolisei & Angelini, 1890, apply with equal vigour to the present case.

237. From the way in which Thayer & Hewetson introduced the name *Haematozoon* it is likely that they did not regard themselves as publishing a new name of their own but rather as correcting a name already published by Antolisei & Angelini, though (as explained in paragraph 235 above) it must be conceded also that, in introducing the spelling "*Haematozoon*" in place of the spelling "*Ematozoo*" used by Antolisei & Angelini, Thayer & Hewetson did accept a personal responsibility for the revised spelling "*Haematozoon*."

238. As will be seen from paragraph 235 above, the generic name *Haematozoon* Thayer & Hewetson, 1895, was published with a single included species, *Haematozoon falciforme*. That species is accordingly the type species of the genus *Haematozoon* Thayer & Hewetson by monotypy under Rule (c) in Article 30.

239. We have already seen (paragraph 119 above) that the species *Ematozoo falciforme* Antolisei & Angelini, 1890, is the parasite responsible for the aestivo-autumnal Roman fever, that is, the Malignant Tertian Malaria Parasite, *Oscillaria malariae* Laveran, 1881. Another nominal species which has also been subjectively identified with that species is *Plasmodium malariae* Marchiafava & Celli, 1885. The last-named species is the type species of *Plasmodium* Marchiafava & Celli, 1885. Since *Plasmodium* Marchiafava & Celli is a nomenclatorially available name, not being invalid as a homonym under Article 34, and the type species of this genus is subjectively identified as conspecific with the type species of *Haematozoon* Thayer & Hewetson, 1895, we see that *Haematozoon* Thayer & Hewetson, 1895, is junior subjective synonym of *Plasmodium* Marchiafava & Celli, 1885.

240. Taxonomically, therefore, the name *Haematozoon* Thayer & Hewetson, 1895, is an unnecessary name which would not be required, even if it were an available name. In fact, however, the name *Haematozoon* Thayer & Hewetson, 1895, is not an available name, for it is invalid under Article 34 as a junior homonym of the older name *Haematozoon* Leisering, 1865 (*Arch. path. Anat.* 33(1):125) published for a genus in the Class Nematoda.

(14) The generic name "Haemosporidium" Lewkowicz, 1897

241. In a paper published in the issue of 6th February 1897 of the "Erste Abteilung" of the *Centralblatt für Bakteriologie, Parasitenkunde u. Infektionskrankheiten*, Lewkowicz published a short paper entitled "Ueber den Entwicklungsgang und die Einteilung der Malariaparasiten" (1897, *Zbl. Bakt. (Erste Abt.)* 21(4):129—133), in which he introduced a new classification for the human malaria parasites, all the species of which he placed in a genus to which he applied the new name *Haemosporidium* (:132—133). He did not cite, or otherwise refer to, any of the earlier generic names proposed for these parasites nor did he explain why he considered it necessary to reject those names in favour of the new name *Haemosporidium*. It may be inferred, however, that he made this change on the ground that his new name was more appropriate than any of those previously proposed, for, when discussing (:130) the young spores ("Die jungen Sporidien") of the Quartan and Benign Tertian Malaria Parasites (the two species placed by him (:132) in Group I ("I. Gruppe") of the genus *Haemosporidium*), Lewkowicz added the following footnote with reference to the word "Sporidien":—"Dieser von Danilewsky vorgeschlagene Name scheint mir für die zoologische Bezeichnung der Malariaparasiten der entsprechendste."

242. Article 32 of the *Règles* provides that a generic name, once published, cannot be rejected on the ground of inappropriateness. Accordingly, if, in fact, this was the ground on which Lewkowicz rejected the earlier generic names published for the human malaria parasites and substituted the new name *Haemosporidium* in their place, his action was invalid.

243. The name *Haemosporidium* Lewkowicz, 1897, is an available name in the sense that it is not a junior homonym of any previously published generic name in the Animal Kingdom. Its nomenclatorial status will, therefore, turn entirely upon the identity of the species selected as its type species.

244. Lewkowicz did not himself designate a type species for this genus, nor was its type species automatically determined under Rules (b), (c), (d) or (f) in Article 30 of the *Règles*. Accordingly, Rule (g) in that Article applies to this name and in consequence the type species of this genus is whatever nominal species is first selected as such by a subsequent author. So far as I have been able to ascertain, no such type selection has ever been made for this genus.

245. Lewkowicz, as has already been explained (paragraph 169), placed in his genus *Haemosporidium* all the species of human malaria parasite that he recognised, but did not cite those species under binominal names, contenting himself with applying to each a simple technical term (in the form of a Latin adjective), indicating the period of development of the fever arising from the parasite in question. Accordingly, the generic name *Haemosporidium* Lewkowicz, being the name of a nominal genus established without any included species cited under a binominal name, falls to have its type species determined under the provisions of the Commission's *Opinion* 46 (1912, *Smithson. Publ.* 2060 : 104—107). The Ruling given in this *Opinion* is obscure and unsatisfactory, and it is much to be hoped that at its next Session the International Commission on Zoological Nomenclature will submit to, and secure the approval of, the International Congress of Zoology proposals for the clarification of the *Règles* in regard to the type species of nominal genera established without cited nominal species. It is fortunately not necessary to examine in detail the Ruling given in the foregoing *Opinion*, for the one provision in it which is clear happens by a lucky chance to be applicable in the present case. The portion of the Ruling given in the so-called "Summary" with which we are concerned reads as follows: ". . . if several species are referred to but not mentioned by name, one of these must be taken as the type." Later

the Ruling turns to the case where a nominal genus is established with a diagnosis but with no indication as to the species which should be treated as being included species, and on this part of the subject the Ruling given was that "the first species published in connection with the genus [i.e. the first validly established nominal species cited as belonging to the nominal genus concerned] (as *Aclastus rufipes* Ashmead, 1902) becomes *ipso facto* the type."²³ In the present case, we must note (1) that we know what are the taxonomic species regarded by Lewkowicz as belonging to his genus *Haemosporidium*, and (2) that so far no author has formally cited under a binominal name any of the included species as being a species referable to this genus. It follows, therefore, that it is still open to any author formally to determine the type species of the genus *Haemosporidium* Lewkowicz, 1897, under the procedure prescribed by the Ruling given in *Opinion* 46.

246. Accordingly, in order to secure a determinate content for the nominal genus *Haemosporidium* Lewkowicz and therefore a definite position for the generic name *Haemosporidium* Lewkowicz in the synonymy of the names of the nominal genera established for the human malaria parasites, I now propose to take the formal action required under *Opinion* 46 to provide the foregoing nominal genus with a type species. To this end, acting in accordance with the procedure prescribed in the foregoing *Opinion*, I hereby formally (1) "recognise" the Quartan Malaria Parasite as one of the species included by Lewkowicz in the nominal genus *Haemosporidium* established by him in 1897, (2) cite the name of the foregoing species (*Haemamoeba malariae* Feletti & Grassi, 1889), in combination with the generic name *Haemosporidium* Lewkowicz 1897, thus forming the combination *Haemosporidium malariae* (Feletti & Grassi 1889), and (3) designate (and select) the foregoing nominal species to be the type species of the nominal genus *Haemosporidium* Lewkowicz, 1897.

²³ The Ruling given in *Opinion* 46 was clarified by the International Commission on Zoological Nomenclature at its Session held at Paris in 1948 (1950, *Bull. zool. Nomencl.* 4 : 160, 346) and the Ruling so clarified was incorporated in the *Règles*. *Opinion* 46 itself was thereupon repealed for interpretative purposes, that is, for every purpose except that of historical record (1950, *ibid.* 4 : 165—166). The action here taken in relation to the name *Haemosporidium* Lewkowicz is in harmony with the provisions adopted by the Paris Congress.

247. The nominal species *Haemamoeba malariae* Feletti & Grassi, 1889, is also the type species of the nominal species *Haemamoeba* Feletti & Grassi, 1889 (see paragraph 220 above). Thus, the same species is the type species both of *Haemamoeba* Feletti & Grassi, 1889, and of *Haemosporidium* Lewkowicz, 1897. As the name *Haemamoeba* Feletti & Grassi is a nomenclatorially available name (and the valid generic name for *Haemamoeba malariae* Feletti & Grassi), the name *Haemosporidium* Lewkowicz, 1897, is invalid, being an junior objective synonym of *Haemamoeba* Feletti & Grassi, 1889.

PART 3 SYNONYMY OF THE SPECIFIC TRIVIAL NAMES BESTOWED (OR ALLEGED TO HAVE BEEN BESTOWED) UPON THE HUMAN MALARIA PARASITES IN THE PERIOD 1881-1897 AND OF THE NAMES OF THE NOMINAL GENERA ESTABLISHED (OR ALLEGED TO HAVE BEEN ESTABLISHED) FOR THOSE SPECIES IN THE SAME PERIOD

248. In Part 1 of the present paper we have firmly established the identity of the taxonomic species represented by each of the nominal species established, or alleged to have been established, for species of human malaria parasite during the period 1881-1897. In addition, we have determined for each of the specific names concerned whether it possesses status under the Law of Priority and whether it is an objectively available name. Similarly, in Part 2, we have determined for each of the nominal genera established, or alleged to have been established, for species of human malaria parasite whether it is a name which possesses status under the Law of Priority. Further, by determining the nominal species which, under the *Règles*, is the type species of each of the validly established nominal genera, we have firmly established the content of those genera for nomenclatorial purposes. We are therefore now in a position to construct synonymies of the names bestowed upon each of the species of human malaria parasite and thus to determine for each of those species what, under the *Règles*, is its oldest available specific trivial name. It is possible also now to arrange in order of priority the names bestowed upon nominal genera established for one or other of the species of human malaria parasite.

249. As will be seen, the synonymies constructed in the foregoing manner are necessarily very complicated, and it has been considered that it would facilitate their presentation and make them more readily understandable, if for the present purposes the bibliographical references were to be omitted. In order, however, that these may be readily available I give in Section (1) of the present Part an alphabetical list of all the names, both generic and specific, which appear in the present paper, together with

the bibliographical references for those names. Next are given the specific synonymies (Section (2)) and then a list of generic names with the type species of the nominal genera so named (Section (3)). In Section (4) I show, on the basis of the particulars given in Sections (2) and (3), what, under the *Règles*, is the valid name (binominal combination) for each of the human malaria parasites, (a) on the basis of the view that all three species are congeneric with one another (the view most commonly held by malariologists), and (b) on the basis of the view that two genera should be recognised. In Section (5), I compare the names applicable to the human malaria parasites under the *Règles* with the names universally applied to those species by malariologists. As will be seen, the two sets of names differ in almost every possible respect.

(1) Original references for the names cited in the present paper

250. The following are the original references for the names bestowed or alleged to have been bestowed upon genera and species of human malaria parasites discussed in the present paper:—

- Cytamoeba* Danilewsky, 1891, *Ann. Inst. Pasteur* 5(12) 762
Cytosporon Danilewsky, 1891, *Ann. Inst. Pasteur* 5(12) : 762
Cytozoon Danilewsky, 1891, *Ann. Inst. Pasteur* 5(12) : 780
Ematozoo (correction of *ematozoo*) Antolisei & Angelini, 1890, *Riforma medica* 6(56) : 334
falciforme, *Ematozoo* (correction of *ematozoo*), Antolisei & Angelini, 1890, *Riforma medica* 6(56) : 334
falciforme, *Haematozoon*, Thayer & Hewetson, 1895, *Johns Hopkins Hosp. Reps.* 5 : 27 (usually cited by the title of the paper which constitutes this volume, namely *The Malarial Fevers of Baltimore*)
falciparum, *Haematozoon*, Welch, 1897, in Loomis's *Syst. pract. Med.* 1 : 36
Haemamoeba Feletti & Grassi, Dec. 1889, *Sui parassiti della malaria* (a pre-print of a paper published in January 1890 (*Riforma medica* 6(11) : 63))

- Haematomonas* Mitrophanow, 1883, *Biol. Zbl.* **3** : 41
- Haematomonas* Osler, 1886, *Philad. med. Times* and 1887, *Brit. med. J.* **1887** (Vol. 1) : 556
- Hämatophyllum* Metschnikoff, 1887, *Russk. Med.* **12** : 207
- Haematozoon* (correction of *haematozoon*) Thayer & Hewetson, 1895, *Johns Hopkins Hosp. Repts.* **5** : 27 (usually cited by the title of the paper which constitutes this volume, namely *The Malarial Fevers of Baltimore*)
- Haemocytosporon* Danilewsky, 1891, *Ann. Inst. Pasteur* **5**(12) : 762
nota
- Haemosporidium* Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) **21**(4) : 132—133
- hominis*, *Laverania*, Danilewsky, 1891, *Ann. Inst. Pasteur* **5**(12) : 780
- immaculata*, *Haemamoeba*, Grassi, 1891, *Zbl. Bakt.* **10** : 517
- irregularis*, *Plasmodium malariae*, Kruse, 1892, *Hyg. Rdsch.* **2** : 467
- irregularis*, *Haemamoeba febris*, Sakharov, 1892 (a cherionym)
- laverani*, *Haemamoeba*, Labbé, 1894, *Arch. Zool. expér. gén.* (3)**2** : 170
- Laverania* Feletti & Grassi, Dec. 1889, *Sui parassiti della malaria* (a pre-print of a paper published in January 1890 (*Riforma medica* **6**(11) : 63))
- malariae*, *Haemamoeba*, Feletti & Grassi, Dec. 1889, *Sui parassiti della malaria* (a pre-print of a paper published in January 1890 (*Riforma medica* **6**(11) : 64))
- malariae*, *Laverania*, Feletti & Grassi, Dec. 1889, *Sui parassiti della malaria* (a pre-print of a paper published in January 1890 (*Riforma medica* **6**(11) : 64))
- malariae*, *Oscillaria*, Laveran, 1881, *Nature parasit. Accidents Impaludisme* : 87
- malariae*, *Plasmodium*, Marchiafava & Celli, 1885, *Fortschr. Med.* **3**(24) : 791
- Oscillaria* Laveran, 1881, *Nature parasit. Accidents Impaludisme* : 87
- Oscillaria* Schrank, 1823, *Nova Acta. Acad. Caes. Leopold. Carol.* **11** (No. 2) : 533
- Plasmodium* Marchiafava & Celli, 1885, *Fortschr. Med.* **3**(24) : 791
- praecox*, *Haemamoeba*, Grassi & Feletti, May 1890, *Arch. ital. Biol.* **13**(2) : 300

- quartana*, *Haemamoeba laverani* var., Labbé, 1894, *Arch. Zool. expér. gén.* (3)2 : 170
- quartanae*, *Haemosporidium*, Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) 21(4) : 132
- quartanae*, *Plasmodium malariae* M. & C. Varietà A, Celli & Sanfelice, 1891, *Ann. Ist. Igiene sper. Univ. Roma* (n.s.) 1 : 61
- quartanae*, *Plasmodium malariae*, Kruse, 1892, *Hyg. Rdschr.* 2 : 466
- quotidianae*, *Plasmodium malariae* M. & C., Varietà C., Celli & Sanfelice, 1891, *Ann. Ist. Igiene sper. Univ. Roma* (n.s.) 1 : 61
- sedecimanae*, *Haemosporidium*, Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) 21(4) : 133
- tertiana*, *Haemamoeba laverani* var., Labbé, 1894, *Arch. Zool. expér. gén.* (3)2 : 170
- tertianae*, *Haemosporidium*, Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) 21(4) : 132
- tertianae*, *Plasmodium malariae* M. & C., Varietà B., Celli & Sanfelice, 1891, *Ann. Ist. Igiene sper. Univ. Roma* (n.s.) 1 : 61
- tertianae*, *Plasmodium malariae*, Kruse, 1892, *Hyg. Rdschr.* 2 : 466
- tropica*, *Plasmodium*, Koch, 1899 (a cheironym)
- undecimanae*, *Haemosporidium*, Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) 21(4) : 133
- vigesimo-tertiana*, *Haemosporidium*, Lewkowicz, 1897, *Zbl. Bakt.* (Erste Abt.) 21(4) : 133
- vivax*, *Haemamoeba*, Grassi & Feletti, May 1890, *Arch. ital. Biol.* 13(2) : 300

(2) **Synonymy of the specific trivial names bestowed (or alleged to have been bestowed) upon the human malaria parasites in the period 1881—1897**

251. In the present Section I give a synonymy for each of the three species of human malaria parasite with which we are concerned. To the names shown in these synonymies must be added one trivial name, *hominis* Danilewsky, 1891, as published in the combination *Laverania* (paragraphs 140—143), which probably applies to the Malignant Tertian Malaria Parasite but is at present indeterminate and can safely be left so, in view of the fact that the International Commission on Zoological Nomenclature has ruled (*Opinion* 101) that the paper in which it was published is not available for nomenclatorial purposes.

(a) The Malignant Tertian Malaria Parasite

252. The following is a synonymy of the names bestowed (or alleged to have been bestowed) upon the Malignant Tertian Malaria Parasite. The paragraph references cited are to the paragraphs in the present paper in which the names in question are discussed in detail :—

(i) Validly published names for the Malignant Tertian Malaria Parasite

Oscillaria malariae Laveran, 1881 (paragraphs 34—45)

Plasmodium malariae Marchiafava & Celli, 1885 (paragraphs 53—77)

Laverania malariae Feletti & Grassi, December 1889 (not a new name but a usage of the trivial name *malariae* Laveran, 1881) (paragraphs 91—93)

Ematozoo (correction of *ematozoo*) *falciforme* Antolisei & Angelini, 1890 (paragraphs 102—119)

Haemamoeba laverani Labbé, 1894 (paragraphs 158—166)

Haematozoon (correction of *haematozoon*) *falciforme* Thayer & Hewetson, 1895 (paragraphs 167—168)

Haematozoon falciparum Welch, 1897 (paragraphs 175—177)

(ii) Validly published names which have been applied to the Malignant Tertian Malaria Parasite but erroneously because the nominal species so named were established for parasites of birds

Haemamoeba praecox Grassi & Feletti, May 1890 (paragraphs 96—101)

Haemamoeba immaculata Grassi, 1891 (paragraphs 120—127)

(iii) *Technical terms published in connection with the Malignant Tertian Malaria Parasite and erroneously treated by later authors as names bestowed upon that species*

Plasmodium malariae M. & C., Varietà C., *quotidiana* Celli & Sanfelice, 1891 (paragraphs 128—139)

Plasmodium malariae irregularis Kruse, 1892 (paragraphs 144—150)

Haemosporidium sedecimanae Lewkowicz, 1897 (paragraphs 169—174)

Haemosporidium undecimanae Lewkowicz, 1897 (paragraphs 169—174)

*Haemosporidium vigesimo-tertiana*e Lewkowicz, 1897 (paragraphs 169—174)

(iv) *Reputed but non-existent names*

Haemamoeba febris irregularis Sakharov, 1892 (paragraphs 151—157)

Plasmodium tropica Koch, 1899 (paragraphs 178—185)

(b) The Quartan Malaria Parasite

253. The following is a synonymy of the names bestowed (or alleged to have been bestowed) upon the Quartan Malaria Parasite:—

(i) *Validly published names for the Quartan Malaria Parasite*

Haemamoeba laverani var. *quartana* Labbé, 1894 (paragraphs 158—166)

Haemamoeba malariae Feletti & Grassi, 1889 (invalid because a rejected junior secondary homonym of the name *malariae* Laveran, 1881, consequent upon the two species so named having been united in the same genus, *Plasmodium* Marchiafava & Celli, 1885) (paragraphs 78—90)

(ii) *Technical terms published in connection with the Quartan Malaria Parasite and erroneously treated by later authors as names bestowed upon that species*

Plasmodium malariae M. & C., Varietà A., *quartanae* Celli & Sanfelice, 1891 (paragraphs 128—139)

Plasmodium malariae quartanae Kruse, 1892 (paragraphs 144—150)

Haemosporidium tertiana Lewkowitz, 1897 (paragraphs 169—174)

(c) The Benign Tertian Malaria Parasite

254. The following is a synonymy of the names bestowed (or alleged to have been bestowed) upon the Benign Tertian Malaria Parasite:—

(i) *Validly published names for the Benign Tertian Malaria Parasite*

Haemamoeba vivax Grassi & Feletti, 1890 (paragraphs 94—95)

Haemamoeba laverani var. *tertiana* Labbé, 1894 (paragraphs 158—166)

(ii) *Technical terms published in connection with the Benign Tertian Malaria Parasite and erroneously treated by later authors as names bestowed upon that species*

Plasmodium malariae M. & C., Varietà B. *tertiana* Celli & Sanfelice, 1891 (paragraphs 128—139)

Plasmodium malariae tertiana Kruse, 1892 (paragraphs 144—150)

Haemosporidium tertiana Lewkowitz, 1897 (paragraphs 169—174)

(3) Names of the nominal genera established (or alleged to have been established) for the human malaria parasites in the period 1881—1897

255. The time has come now to bring together the names of all the nominal genera established (or alleged to have been established) for human malaria parasites in the period 1881—1897. It would have been possible at this point to arrange these names in synonymies based upon current taxonomic judgments as to the number of genera which should be recognised, but this course would have presented certain inconveniences in view of the fact that there is not unanimity among malariologists on the question whether two genera or one genus only should be recognised on taxonomic grounds. In these circumstances it has been judged preferable at this stage to set out the names concerned in a single list arranged by reference to the dates on which the names were published. Altogether, there are sixteen names to be considered. Of these, seven are validly published names and each is applicable to a nominal genus having one or other of the human malaria parasites as its type species. Two are validly published names which have however been applied to the human malaria parasites in error, the nominal genera so named being based upon species of other groups. Next, there are four names (all published by Danilewsky in 1891), the content of which is indeterminate, no type species having ever been designated or selected, but this is of no practical consequence in view of the fact that the International Commission on Zoological Nomenclature has ruled (*Opinion* 101) that the paper in which these names were published is not available for nomenclatorial purposes. Finally there are three reputed but non-existent generic names to which it has been necessary to give consideration.

Generic names given or applied to human malaria parasites

(a) Validly published generic names published for nominal genera having species of human malaria parasite as type species

Plasmodium Marchiafava & Celli, 1885 (type species, by monotypy: *Plasmodium malariae* Marchiafava & Celli, 1885 (=The Malignant Tertian Malaria Parasite), a junior subjective synonym of *Oscillaria malariae* Laveran, 1881) (an available generic name) (paragraphs 199—204)

Hämatophyllum Metschnikoff, 1887²⁴ (type species, by monotypy: *Plasmodium malariae* Marchiafava & Celli, 1885) (invalid, because a junior objective synonym of the name *Plasmodium* Marchiafava & Celli, 1885) (paragraphs 209—213)

Haemamoeba Feletti & Grassi, 1889 (type species, by monotypy: *Haemamoeba malariae* Feletti & Grassi, 1889 (=the Quartan Malaria Parasite)) (an available generic name) (paragraphs 214—220)

Laverania Feletti & Grassi, 1889 (type species, by monotypy: *Oscillaria malariae* Laveran, 1881) (an available name, but a junior subjective synonym of the name *Plasmodium* Marchiafava & Celli, 1885) (Under a possible but much less probable interpretation, the type species of *Laverania* Feletti & Grassi, 1889, is, by monotypy, the nominal species named *Laverania malariae* Feletti & Grassi, 1889. If such a name had been published by these authors, it would be a junior subjective synonym of *Oscillaria malariae* Laveran, 1881, and in this case also the name *Laverania* Feletti & Grassi, 1889, would be a junior subjective synonym of *Plasmodium* Marchiafava & Celli, 1885.) (paragraphs 221—224)

Ematozoo (correction of *ematozoo*) Antolisei & Angelini, 1890 (type species, by monotypy: *Ematozoo* (correction of *ematozoo*) *falciforme* Antolisei & Angelini, 1890, a junior subjective synonym of *Oscillaria malariae* Laveran, 1881) (an available name but a junior subjective synonym of the name *Plasmodium* Marchiafava & Celli, 1885) (paragraphs 225—228)

Haematozoon (correction of *haematozoon*) Thayer & Hewetson, 1895 (type species, by monotypy: *Haematozoon falciforme* Thayer & Hewetson, 1895, a junior subjective synonym of *Oscillaria malariae* Laveran, 1881) (invalid, because a junior homonym of *Haematozoon* Leisering, 1865 (Class Nematoda); in addition through the foregoing subjective identification of

²⁴ This name was originally published as *Hämatophyllum*, but under a decision taken by the Fourteenth International Congress of Zoology, Copenhagen, 1953, when revising Article 20, a name so published is in future to be written out as *Haematophyllum*. See Footnote 22.

the type species of the above nominal genus, the name *Haematozoon* Thayer & Hewetson, 1895, is a junior subjective synonym of the name *Plasmodium* Marchiafava & Celli, 1885) (paragraphs 235—240)

Haemosporidium Lewkowicz, 1897 (type species, by selection, under *Opinion* 46 by Hemming in the present paper: *Haemamoeba malariae* Feletti & Grassi, 1889) (invalid, because a junior objective synonym of the name *Haemamoeba* Feletti & Grassi, 1889) (paragraphs 241—247)

(b) Validly published generic names which have been applied to the human malaria parasites but incorrectly because the nominal genera so named were established for species of other groups

Oscillaria Schrank, 1823 (the name of a nominal genus of Algae) (paragraphs 187—198)

Haematomonas Mitrophanow, 1883 (the name of a nominal genus established for two flagellates found in the blood of species of fish) (paragraphs 205—208)

(c) Generic names of indeterminate content published in a paper which the International Commission on Zoological Nomenclature has ruled is not available for nomenclatorial purposes

Cytamoeba Danilewsky, 1891 (paragraphs 229—231)

Cytosporon Danilewsky, 1891 (paragraphs 229—231)

Cytozoon Danilewsky, 1891 (paragraphs 229—231)

Haemocytozoon Danilewsky, 1891 (paragraphs 229—231)

(d) Reputed but non-existent generic names

Oscillaria Laveran, 1881 (paragraphs 187—198)

Haematomonas Osler, 1886 (paragraphs 205—208)

Haemamoeba Labbé, 1894 (paragraphs 232—234)

(4) The correct names for the Human Malaria Parasites under a strict application of the "Règles"

256. Having now compiled a synonymy, both generic and specific, for each of the human malaria parasites, we are at last in a position to establish what is the correct name under the *Règles* for each of these species. In the view of the majority of malariologists, all three of the species concerned are congeneric with one another, but in the view of some specialists two genera should be recognised, the Malignant Tertian Malaria Parasite being placed in one genus and the Quartan Malaria Parasite and the Benign Tertian Malaria Parasite in another genus. The oldest otherwise available trivial name (*malariae* Feletti & Grassi, 1889) for one of these species (the Quartan Malaria Parasite) is the same as the oldest available name (*malariae* Laveran, 1881) for another of these species (the Malignant Tertian Malaria Parasite), and, as these species have (by many workers) been united on taxonomic grounds in a single genus, the later-published of these names cannot be used even by those malariologists who regard these two species as being congeneric with one another; for at the time that the two nominal species so named were united in a single genus, the later-published name became a junior secondary homonym of the earlier-published name, and, under Articles 35 and 36, a name rejected and replaced as a junior secondary homonym can never be used again.²⁵ Thus, the specific trivial names of the human malaria parasites are not affected by the differing taxonomic judgments of malariologists on the question whether the three species concerned should be placed in the same genus or whether one of them should be placed in a second genus, and it is only the generic names that vary according to which view is held on the question of generic relationship.

257. With the foregoing explanation, we may now present the following statement showing what under the *Règles* is the correct name (binominal combination of a generic name and a specific

²⁵ The point here raised was still a matter of discussion when this passage was written, but by a decision by the Thirteenth International Congress of Zoology, Paris, 1948, the point at issue was settled in the sense indicated in this passage. See Footnote 7.

trivial name) for each of the three species of human malaria parasite with which we are concerned (a) for those specialists who hold on taxonomic grounds that all three species are congeneric with one another and (b) for those specialists who regard the Quartan Malaria Parasite and the Benign Tertian Malaria Parasite as congeneric with one another but consider that the Malignant Tertian Malaria Parasite is referable to a separate genus:—

TABLE 1

The correct names for the human malaria parasites according to whether two genera or one genus only are recognised on taxonomic grounds

Vernacular name of human malaria parasite (1)	Name of species specified in Col. (1) if only one genus is recognised on taxonomic grounds (2)	Name of species specified in Col. (1) if two genera are recognised on taxonomic grounds (3)
Malignant Tertian Malaria Parasite	<i>Plasmodium malariae</i> (Laveran, 1881)	<i>Plasmodium malariae</i> (Laveran, 1881)
Quartan Malaria Parasite	<i>Plasmodium quartanum</i> (Labbé, 1894)	<i>Haemamoeba quartanum</i> , Labbé, 1894
Benign Tertian Malaria Parasite	<i>Plasmodium vivax</i> (Grassi & Feletti, 1890)	<i>Haemamoeba vivax</i> Grassi & Feletti, 1890

(5) Comparison of the names applicable to the human malaria parasites under a strict application of the "Règles" with the names universally used for those species

258. In the immediately preceding paragraph we have shown in tabular form what are the correct names for the three human malaria parasites, (a) if only one genus is recognised on taxonomic grounds and (b) if two genera are so recognised. In the following table (Table 2) the names so established are compared with the

names universally used for these species on the basis of the Ruling given (though invalidly) by the International Commission on Zoological Nomenclature when in its *Opinion* 104 it placed the generic names concerned on the *Official List of Generic Names in Zoology*. This comparison is made first to show the position for these specialists who take the taxonomic view that all three species are congeneric with one another and, second, for those specialists who consider that two genera are involved.

TABLE 2

Comparison of the names applicable to the human malaria parasites under a strict application of the " Règles " with the names now universally used for those species

Section A.

Position for those specialists who consider that all the human malaria parasites are congeneric with one another

<i>Vernacular name of human malaria parasite</i>	<i>Correct scientific name under the " Règles "</i>	<i>Scientific name universally in use (also the name recognised in " Opinion " 104)</i>
(1) Malignant Tertian Malaria Parasite	<i>Plasmodium malariae</i> (Laveran, 1881)	<i>Plasmodium falciparum</i> (Welch, 1897)
(2) Quartan Malaria Parasite	<i>Plasmodium quartanum</i> (Labbé, 1894)	<i>Plasmodium malariae</i> (Feletti & Grassi, 1889 ²⁶)
(3) Benign Tertian Malaria Parasite	<i>Plasmodium vivax</i> (Grassi & Feletti, 1890)	<i>Plasmodium vivax</i> (Grassi & Feletti, 1890)

²⁶ This name is commonly but incorrectly treated as having first been published in 1890. Further, the names of the authors are normally cited incorrectly in the reverse order as " Grassi & Feletti " (see paragraph 47).

Section B

Position for those specialists who consider that two genera are involved, namely, one for the Malignant Tertian Malaria Parasite and one for the Quartan Malaria Parasite and the Benign Tertian Malaria Parasite

<i>Vernacular name of human malaria parasite</i>	<i>Correct scientific name under the " Règles "</i>	<i>Scientific name universally in use (also the name recognised in "Opinion" 104)</i>
(1) Malignant Tertian Malaria Parasite	<i>Plasmodium malariae</i> (Laveran, 1881)	<i>Laverania falciparum</i> (Welch, 1897)
(2) Quartan Malaria Parasite	<i>Haemamoeba quartanum</i> Labbé, 1894	<i>Plasmodium malariae</i> (Feletti & Grassi, 1889 ²⁷)
(3) Benign Tertian Malaria Parasite	<i>Haemamoeba vivax</i> Grassi & Feletti, 1890	<i>Plasmodium vivax</i> (Grassi & Feletti, 1890)

²⁷ See Footnote 26.

PART 4 PROPOSAL FOR THE STABILISATION OF THE NAMES FOR THE HUMAN MALARIA PARASITES ON THE BASIS OF CURRENT USAGE

259. The nomenclature, both generic and specific, for the human malaria parasites adopted by the International Commission on Zoological Nomenclature in its *Opinion* 104 is the nomenclature now almost universally accepted by malariologists and has been in general use for nearly fifty years. As can however be seen from the table (Table 2) given in paragraph 258, in which the conclusions reached in the earlier part of the present paper have been summarised, the currently adopted nomenclature is incorrect in almost every particular.

260. It is obvious that any material change in the names for the human malaria parasites arising from purely nomenclatorial causes (that is, from the strict application of the *Règles*) would cause the greatest confusion in the literature of malariology and would serve no useful purpose whatever. There is therefore the strongest possible case for the use by the International Commission on Zoological Nomenclature of its Plenary Powers for the purpose of giving valid force to existing nomenclatorial practice and, incidentally, for validating the erroneous entries made by the Commission itself in its *Opinion* 104. We have therefore to consider carefully what is the action required in order to secure the desired end. As in the earlier part of the present paper, it will be convenient to consider this problem, first, in relation to the specific trivial names for the human malaria parasites and, second, in relation to the generic names bestowed upon those species.

(1) The specific trivial name for the Quartan Malaria Parasite

261. The Quartan Malaria Parasite is universally known by the specific trivial name *malariae* Feletti & Grassi, 1889 (usually, though incorrectly cited as "Grassi & Feletti, 1890") as published in the combination *Haemamoeba malariae*. If the greatest confusion is to be avoided, it is essential that means should be found for retaining this name for this species. In order to

validate the use of this trivial name for the Quartan Malaria Parasite, it will, therefore, be necessary for the International Commission to use its Plenary Powers for the purpose of suppressing the name *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*, for the purposes both of the Law of Priority and of the Law of Homonymy. Further, it will be necessary for the Commission to use its Plenary Powers for the purpose of suppressing to a like extent the trivial name *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*, a name bestowed independently by these authors upon the Malignant Tertian Malaria Parasite. Once these two names have been suppressed in this way, all usage of the trivial name *malariae* in the genus *Plasmodium* Marchiafava & Celli, 1885, prior to the publication of the name *malariae* Feletti & Grassi, 1889, for the Quartan Malaria Parasite will have been removed for nomenclatorial purposes. The latter name will, therefore, no longer be a junior secondary homonym of some earlier name *malariae* in the genus *Plasmodium*. At present, the name *malariae* Feletti & Grassi, 1889, as a rejected junior secondary homonym is, under Article 35 and 36, a permanently rejected name which cannot be brought into use again. This difficulty can however be overcome by the use by the Commission of its Plenary Powers expressly to validate this name. By these measures—and by these measures alone—it will be possible for the International Commission to provide a valid basis for the continued use of the specific trivial name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, for the Quartan Malaria Parasite.

(2) The specific trivial name for the Malignant Tertian Malaria Parasite

262. The trivial name *falciparum* Welch, 1897, as published in the combination *Haematozoon falciparum*, is the name now in general use for the Malignant Tertian Malaria Parasite. That name is, however, a long way down the list of names published for nominal species which are subjectively identified as representing the foregoing parasite, and these names will all have to be suppressed by the International Commission on Zoological Nomenclature under its Plenary Powers before a valid status of

availability can be provided for the name *falciparum* Welch. In addition, there are two names which have priority over *falciparum* Welch which have been applied in the past to the Malignant Tertian Malaria Parasite but which, in my opinion, were bestowed by their respective authors not upon the foregoing species but upon parasites of birds. In order to provide a secure foundation for the name *falciparum* Welch, it will be necessary for the International Commission to take appropriate steps to prevent claims from being advanced on behalf of these names as against the name *falciparum* Welch. Finally, there is a name published before *falciparum* Welch which, in my opinion, is no more than a usage of a previously published name but which it has been claimed in the past as having been published as a new name for the Malignant Tertian Malaria Parasite. In this case also, action will need to be taken by the Commission to prevent any possible challenge from being advanced against the name *falciparum* Welch.

263. The five trivial names for the Malignant Tertian Malaria Parasite which have priority over the name *falciparum* Welch are the following:—

malariae Laveran, 1881, as published in the combination *Oscillaria malariae*

malariae Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*

falciforme Antolisei & Angelini, 1890, as published in the combination *Ematozoo* (correction of *ematozoo*) *falciforme*

laverani Labbé, 1894, as published in the combination *Haemamoeba laverani*

falciforme Thayer & Hewetson, 1895, as published in the combination *Haematozoon* (correction of *haematozoon*) *falciforme*

264. Of the foregoing names, I have already recommended the suppression of *malariae* Laveran, 1881 (paragraph 261), and of *malariae* Marchiafava & Celli, 1885, as an essential part of the action needed for the purpose of validating the name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, for the Quartan Malaria Parasite. Here it is

necessary only to note that the suppression of these names forms an essential part also of any plan for validating the name *falciparum* Welch for the Malignant Tertian Malaria Parasite. A further part of any such plan will necessarily be the use by the International Commission of its Plenary Powers to suppress for the purposes of the Law of Priority but not for those of the Law of Homonymy the three other trivial names enumerated in paragraph 263 above, that is : (a) *falciforme* Antolisei & Angelini 1890, as published in the combination *Ematozoo* (correction of *ematozoo*) *falciforme*; (b) *laverani* Labbé, 1894, as published in the combination *Haemamoeba laverani*; (c) *falciforme* Thayer & Hewetson, 1895, as published in the combination *Haematozoon* (correction of *haematozoon*) *falciforme*.

265. Next, it will be necessary for the Commission to take steps to eliminate from consideration as possible names for the Malignant Tertian Malaria Parasite the following names which it has been claimed were published, in part, for that species : (a) *praecox* Grassi & Feletti, 1890, as published in the combination *Haemamoeba praecox*; (b) *immaculata* Grassi, 1891, as published in the combination *Haemamoeba immaculata*. The circumstances in which these names were published has been fully described in Part 1 of the present paper (*praecox*, paragraphs 96—101; *immaculata*, paragraphs 120—127). In the light of the evidence so brought forward it will be necessary for the International Commission to include in its decision on the names of the human malaria parasites a Ruling that these names apply exclusively to the avian parasites so named by the authors concerned.

266. Finally, it is desirable that, as part of any plan for validating the name *falciparum* Welch, 1897, for the Malignant Tertian Malaria Parasite, the Commission should use its Plenary Powers to remove any possible doubt regarding the status of the name *malariae* as used in combination with the generic name *Laverania* by Feletti & Grassi in 1889 for the foregoing species, in so far as that name was on that occasion used by the above authors as a new name; for, if no such action were to be taken, this name, if published as a new name, would, on the suppression of the names *malariae* Laveran, 1881, as published in the combination *Oscillaria*

malariae, and *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*, become the oldest name for the Malignant Tertian Malaria Parasite, and claims might be advanced on its behalf as against the name *falciparum* Welch, 1897, even though it is at present an invalid name by reason of the fact that in the past it has been identified with, or rejected as a junior secondary homonym of, the name *malariae* Laveran, 1881.

267. By the combination of the three sets of measures set out above—and by no other means—it will be possible for the International Commission to provide that the name *falciparum* Welch, 1897, as published in the combination *Haematozoon falciparum*, shall be the oldest available specific trivial name for the Malignant Tertian Malaria Parasite.

(3) The specific trivial name for the Benign Tertian Malaria Parasite

268. The oldest available specific trivial name for the Benign Tertian Malaria Parasite is the name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*. This is the name in universal use for this species. Accordingly, no action by the International Commission under its Plenary Powers is required in this case.

(4) Certain terms consisting of Latin adjectives cited in the genitive case published as technical designations, but not as names, for human malaria parasites

269. Dealing—in Part 1 of the present paper—with the specific trivial names bestowed, or alleged to have been bestowed, upon one or other of the human malaria parasites, I had occasion at three points to draw attention to the publication of Latin adjectives in the genitive case in grammatical agreement not (as required by Article 14) with the generic name of the species concerned but with the specific trivial name of that species. For the reasons then explained I am of the opinion that the adjectives so published should be looked upon as constituting technical

designations for the species or "varieties" concerned but not as names possessing rights in zoological nomenclature. In each case I have rejected the claims which have been advanced in favour of the recognition of these terms as specific or subspecific trivial names. It is clearly necessary that, as part of any general cleaning-up of the nomenclature of the human malaria parasites, the status of these terms should be the subject of an authoritative decision. I therefore recommend that the Commission should rule that the terms in question contravene the provisions of Article 14 to such an extent as to put them outside the scope of the decision taken by the Paris Congress in 1948 that minor infringements of that and certain other Articles should be subject to automatic correction (1950, *Bull. zool. Nomencl.* 4: 68) by later authors, that these terms should be regarded as technical designations and not as trivial names and that they are therefore to be rejected as possessing no status in zoological nomenclature. The terms which I ask should be made subject to the recommendation submitted above are: (1) the terms *quartanae*, *tertiana* and *quotidiana* published by Celli & Sanfelice in 1891 in connection with the specific name *Plasmodium malariae* Marchiafava & Celli, 1885 (paragraphs 128—139); (2) the terms *quartana*, *tertiana* and *irregularis* published by Kruse in 1892 in connection with the combination *Plasmodium malariae* (paragraphs 144—150); (3) the terms *quartana*, *tertiana*, *undecimanae*, *sedecimanae* and *vigesimo-tertiana* published by Lewkowicz in 1897 in connection with the generic name *Haemosporidium* Lewkowicz, 1897 (paragraphs 169—174). A recommendation that the International Commission should invite the International Congress of Zoology to insert words in Article 14 for the purpose of laying down the general principle involved in the foregoing cases is submitted at a later point in the present paper (paragraphs 279—280 below).

(5) The generic name "Oscillaria" as used by Laveran in 1881

270. The first step needed to introduce order into the generic nomenclature of the human malaria parasites is to lay the ghost of the alleged generic name *Oscillaria* Laveran, 1881. In Part 2 of the present paper (paragraphs 187—198) I have given grounds for believing that Laveran never published this name as a new

generic name but merely applied it in 1881 to the species of malaria parasite which he then named *malariae*, because he considered it appropriate on taxonomic grounds to refer that species to the genus *Oscillaria* Schrank, 1823. In the same paragraphs I have shown that Schrank looked upon his genus *Oscillaria* as a genus belonging to the Animal Kingdom, and therefore that, under Article 1 of the *Règles*, the name *Oscillaria* Schrank, 1823, retains its status in zoological nomenclature, notwithstanding the fact that the species of Algae included by Schrank in this genus are not now regarded as belonging to the Animal Kingdom. In these circumstances, even if it could be clearly established that in his paper published in 1881 Laveran treated the name *Oscillaria* as a generic name then introduced by himself for the first time, the name *Oscillaria* Laveran, 1881, would be invalid, by reason of being a junior homonym of the name *Oscillaria* Schrank, 1823.

271. It is, therefore neither necessary nor desirable that the International Commission should use its Plenary Powers to suppress the generic name *Oscillaria* Laveran, 1881, for, as appears to me to be clear, no such name was ever published. It is however essential that the Commission should include in its decision a Ruling that, in so far as Laveran may have published this as a new name and not as a usage of the name *Oscillaria* Schrank, 1823, the name *Oscillaria* Laveran, 1881, which would in that event have been brought into existence, is to be rejected as a junior homonym of *Oscillaria* Schrank, 1823.

(6) **The generic name “*Plasmodium*” Marchiafava and Celli, 1885**

272. As the result, mainly, of an uncritical following, by later authors, of pronouncements by Lühe and later by Schaudinn (paragraphs 46—51), the nominal genus *Plasmodium* Marchiafava & Celli, 1885, has been universally treated for many decades as having *Oscillaria malariae* Laveran, 1881, as its type species, and that nominal species has been consistently misidentified as representing the Quartan Malaria Parasite. In actual fact, as has been shown in Part 2 of the present paper, the type species

of this genus is the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, by monotypy (paragraphs 199—204) and this nominal species represents not the Quartan Malaria Parasite but the Malignant Tertian Malaria Parasite (paragraphs 53—77).

273. Very great confusion would arise if at this late date the type species of this genus were to be changed from the Quartan Malaria Parasite to the Malignant Tertian Malaria Parasite, in view of the fact that some malariologists regard these species as belonging to different genera, and a transfer of type species of the kind required by the strict application of the *Règles* would mean that the name *Laverania* Feletti & Grassi, 1889, universally used by specialists who on taxonomic grounds recognise two genera, would disappear as a junior subjective synonym of *Plasmodium* Marchiafava & Celli, 1885, while for such specialists the name *Haemamoeba* Feletti & Grassi, 1889, would replace the name *Plasmodium* Marchiafava & Celli, 1885, as the generic name for the Quartan Malaria Parasite.

274. In these circumstances, there is, therefore, a very strong case for the use by the International Commission on Zoological Nomenclature of its Plenary Powers for the purpose of validating the current practice under which the Quartan Malaria Parasite is universally accepted as the type species of the genus *Plasmodium* Marchiafava & Celli, 1885, after setting aside the existing indication, under Rule (c) of Article 30, of *Plasmodium malariae* Marchiafava & Celli, 1885 as the type species of this genus. It must be realised, however, that this will involve the use of the Plenary Powers to designate as the type species of the genus *Plasmodium* Marchiafava & Celli, 1885, a species not included by those authors in this genus when they published the name *Plasmodium*. Such use of the Plenary Powers in the interests of nomenclatorial stability will, however, constitute no innovation, for already in 1935 at Lisbon (Lisbon Session, 2nd Meeting, Conclusion 22) (1943, *Bull. zool. Nomencl.* 1 : 20—23) the Commission took precisely similar action for the purpose of validating the universally accepted usage of the name *Satyrus* Latreille, 1810 (Class Insecta, Order Lepidoptera), a decision which has since been formally promulgated as *Opinion* 142 (1943, *Ops. Decls. int. Comm. zool. Nomencl.* 2 : 67—80).

275. The action which is now recommended is that the International Commission, acting under its Plenary Powers, should set aside the indication, by monotypy, of *Plasmodium malariae* Marchiafava & Celli, 1885, as the type species of the nominal genus *Plasmodium* Marchiafava & Celli, 1885, and in its place designate as the type species of the foregoing genus the nominal species *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite).

(7) The generic name "Laverania" Feletti and Grassi, 1889

276. The generic name *Laverania* Feletti & Grassi, 1889 (usually misdated as having been published in 1890, and incorrectly attributed to the above authors in the reverse order) is universally used as the generic name for the Malignant Tertian Malaria Parasite by those malariologists who regard that species as being generically distinct from the Quartan Malaria Parasite. This usage is, however, incorrect, for that species is also the type species of the nominal genus *Plasmodium* Marchiafava & Celli, 1885. The objections to the strict application of the *Règles* in this case have been summarised in paragraph 273 above and need not be repeated.

277. In order to secure that the name *Laverania* Feletti & Grassi, 1889, shall be available for use by those specialists who place the Malignant Tertian Malaria Parasite in a different genus from that to which they refer the Quartan Malaria Parasite, while placing the last-named species in the genus *Plasmodium* Marchiafava & Celli, 1885, it will be necessary, in the first instance, for the International Commission on Zoological Nomenclature to use its Plenary Powers to set aside the indication by monotypy of *Plasmodium malariae* Marchiafava & Celli, 1885, as the type species of the genus *Plasmodium* Marchiafava & Celli, 1885. For the reasons explained in paragraph 273 above, this action is in any case necessary, in order to secure the continued use of the generic name *Plasmodium* Marchiafava & Celli, 1885, in its accustomed sense and has already been recommended for that

reason alone. In addition, it will be necessary, before the name *Laverania* Feletti & Grassi can become the oldest available generic name for the Malignant Tertian Malaria Parasite for the International Commission on Zoological Nomenclature to take appropriate action under its Plenary Powers to deprive the generic name *Hämatophyllum* Metschnikoff, 1887, of its prior rights. As has already been explained (paragraph 212), the name *Hämatophyllum* Metschnikoff was published as a substitute name (*nom. nov.*) for the name *Plasmodium* Marchiafava & Celli, 1885, and accordingly takes, as its type species, the same species (*Plasmodium malariae* Marchiafava & Celli, 1885) as is the type species of that genus. Since that nominal species represents the Malignant Tertian Malaria Parasite, the effect, if no further action were to be taken, of changing the type species of the genus *Plasmodium* Marchiafava & Celli from *Plasmodium malariae* Marchiafava & Celli (the Malignant Tertian Malaria Parasite) to *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite), would be to make the name *Hämatophyllum* Metschnikoff, 1887, the oldest available generic name for the Malignant Tertian Malaria Parasite for those malariologists who regard that species as generically distinct from the Quartan Malaria Parasite. In order to make the name *Laverania* Feletti & Grassi, 1889, the oldest available generic name for the Malignant Tertian Malaria Parasite, it will, therefore, be necessary for the Commission to use its Plenary Powers in the case of the name *Hämatophyllum* Metschnikoff, 1887, in the same way as that it is proposed that it should use those Powers in the case the name *Plasmodium* Marchiafava & Celli, 1885, that is, that it should set aside the indication by monotypy (through Rule (f) in Article 30) of the nominal species *Plasmodium malariae* Marchiafava & Celli, 1885, as the type species of *Hämatophyllum* Metschnikoff, 1887, and should designate in its place the nominal species *Haemamoeba malariae* Feletti & Grassi, 1889, to be the type species of this genus. The effect of this action would be to make *Hämatophyllum* Metschnikoff, 1887, a junior objective synonym of *Plasmodium* Marchiafava & Celli, 1885 (in other words, to restore the relative position of these two nominal genera, a position which would have been upset if the type species of one of them (*Plasmodium*) had been varied under the Plenary Powers, while the type species of the other (*Hämatophyllum*) remained unchanged.) By the foregoing means—and only by those means—

it will be possible for the International Commission to secure that the name *Laverania* Feletti & Grassi, 1889, shall be the oldest available generic name for the Malignant Tertian Malaria Parasite for those malariologists who regard that species as being generically distinct from the Quartan Malaria Parasite.

278. The sole species placed in the genus *Laverania* Feletti & Grassi, 1889, at the time when they established that genus—and therefore the type species of that genus, by monotypy—was cited by those authors as “*Laverania malariae*” without the citation of an author’s name. In paragraph 222 of the present paper, I have expressed the view that there can be no reasonable doubt that the nominal species so cited was not a new nominal species then so named by themselves but was the nominal species *Oscillaria malariae* Laveran, 1881. In the past, however, the opposite view has been expressed by some specialists, and it is clearly necessary, therefore, that, in the decision now to be taken, the International Commission should leave no room for doubt on this question. This end could be secured by the adoption of either of two means: First, the Commission could rule under its Plenary Powers, that the name “*Laverania malariae*” as cited by Feletti & Grassi in 1889 is to be interpreted as having the meaning which would have been conveyed if those authors had cited that species as “*Laverania malariae* (Laveran, 1881) (= *Oscillaria malariae* Laveran, 1881).” The second course would be for the International Commission to use its Plenary Powers to set aside the indication, by monotypy, of *Laverania malariae* Feletti & Grassi, 1889, or, as the case may be, *Oscillaria malariae* Laveran, 1881, as the type species of the nominal genus *Laverania* Feletti & Grassi, 1889, and in the place of the species so named, to designate the nominal species *Haematozoon falciparum* Welch, 1897, to be the type species of this genus. The latter course is, in my view, to be preferred, both because it is more consistent with the action proposed in the somewhat parallel case of the type species of the nominal genus *Plasmodium* Marchiafava & Celli, 1885, and partly because in any general clearing-up of the confused nomenclature of the human malaria parasites, it is desirable—because it will promote clarity—that the nominal species which is to be designated as the type species of the genus concerned should be cited under the name which it is proposed

should in future be its valid name and not—as would be the case, if in the present instance if the type species of *Laverania* Feletti & Grassi, 1889, were to be designated by the name *Oscillaria malariae* Laveran, 1881—under an obsolete name which it is now proposed should be suppressed for all purposes. I accordingly recommend the adoption of the second of the two courses outlined above.

PART 5 PROPOSED CLARIFICATION OF ARTICLE 14 OF THE "REGLES" ON THE QUESTION OF THE STATUS OF TERMS CONSISTING OF LATIN ADJECTIVES CITED IN THE GENITIVE CASE WHEN PUBLISHED AS THOUGH CONSTITUTING NAMES FOR SPECIES OR SUBSPECIES

279. One of the serious difficulties encountered in determining the specific trivial names properly applicable to the human malaria parasites arises from the fact that no less than three authors (Celli & Sanfelice, 1891; Kruse, 1892; Lewkowicz, 1897) applied to these species terms consisting of Latin adjectives in the genitive case which, in the first two instances, had the appearance of being varietal (i.e. subspecific) trivial names and, in the third instance, of being specific trivial names. I have given grounds in Part 1 of the present Paper (paragraphs 134—138) for the view that, in fact, these adjectives were not intended by their respective authors to be trivial names in the sense prescribed in zoological nomenclature, but were looked upon by them rather as convenient technical designations for the species concerned. In formulating the recommendations submitted in Part 4 I have treated these terms in this light and have submitted a recommendation in regard for their disposal. While I am not aware of any other case where an author has published Latin adjectives in the foregoing manner, I think it highly probable that cases of this kind do exist, especially in the literature of groups of animals (notably Protozoa) which are of special interest in medicine and on which papers have been published by specialists, whose normal interests lie outside the field of systematic zoology. It seems to me, therefore, that it would be well to guard against the risk of misunderstandings arising in other fields similar to those which have caused so much confusion and inconvenience in the nomenclature of the human malaria parasites.

280. I accordingly recommend that, if, as I hope, the International Commission on Zoological Nomenclature approves the proposals which I have submitted for the stabilisation of the names of the human malaria parasites, it should at the same time recommend the International Congress of Zoology to clarify the

meaning of Article 14 in relation to the question discussed in the immediately preceding paragraph. The proposal which I now submit is that the International Commission should recommend the International Congress of Zoology:—

to insert in the *Règles* provisions as follows:—

- (a) Where, in the case of a nominal species having, as its specific trivial name, a noun in the genitive case, a third term consisting of a Latin adjective is cited in grammatical agreement not with the generic name of the species (as required by Article 14) but with the trivial name of the species, the Latin adjective so cited is not to be treated as having been published as a subspecific trivial name, and a technical designation so published shall possess no rights in zoological nomenclature. Example: In the case of the term published as *Plasmodium malariae quartanae* by Kruse in 1892, the Latin adjective *quartanae*, being in grammatical agreement with the specific trivial name *malariae* and not with the generic name *Plasmodium*, is not to be treated as having been published as a subspecific trivial name.
- (b) Where a Latin adjective is cited in the genitive case in direct association with a generic name, the term so published is to be treated as being in grammatical agreement with a specific trivial name in the same case and number, understood grammatically though not expressed, and a designation so published is to be rejected as a subspecific trivial name in like manner as in (a) above. Example: In the case of the term published as *Haemosporidium quartanae* by Lewkowicz in 1897, the Latin adjective *quartanae* is to be treated as being in grammatical agreement with the specific trivial name *malariae*, understood though not expressed, and is to be rejected as a subspecific trivial name.

PART 6 SUMMARY OF RECOMMENDATIONS

(1) Recommendations for the stabilisation of the names for the human malaria parasites on the basis of current usage

281. Having now surveyed in detail the complicated and unfortunate history of the nomenclature of the human malaria parasites and having indicated the various measures which it would be necessary for the International Commission to take—mainly under its Plenary Powers—in order to provide a sound juridical basis for the names currently used for these species and thus to prevent the appalling confusion in the literature of malariology which would follow the strict application of the *Règles* in the present case, I submit herewith in summary form the following recommendations for the consideration of the International Commission, namely that it should:—

(1) cancel the incorrect particulars relating to the generic names *Plasmodium* and *Laverania* contained:—

(a) in *Opinion* 104;

(b) in consequence of (a) above, in the *Official List of Generic Names in Zoology*;

(2) use its Plenary Powers:—

(a) to suppress for the purposes both of the Law of Priority and of the Law of Homonymy the under-mentioned trivial names for the Malignant Tertian Malaria Parasite:—

(i) *malariae* Laveran, 1881, as published in the combination *Oscillaria malariae*;

(ii) *malariae* Marchiafava & Celli, 1885, as published in the combination *Plasmodium malariae*;

- (iii) *malariae* Feletti & Grassi, 1889, as published in the combination *Laverania malariae*, in so far as this name was published as a new name and not as the trivial name *malariae* Laveran, 1881;
- (b) to suppress for the purposes of the Law of Priority but not for those of the Law of Homonymy the under-mentioned trivial names published for the Malignant Tertian Malaria Parasite:—
- (i) *falciforme* Antolisei & Angelini, 1890, as published in the combination *Ematozoo* (correction of *ematozoo*) *falciforme*;
- (ii) *laverani* Labbé, 1894, as published in the combination *Haemamoeba laverani*;
- (iii) *falciforme* Thayer & Hewetson, 1895, as published in the combination *Haematozoon falciforme*;
- (c) to set aside the indication, by monotypy, of *Plasmodium malariae* Marchiafava & Celli, 1885 (the Malignant Tertian Malaria Parasite) as the type species (i) of the genus *Plasmodium* Marchiafava & Celli, 1885, and (ii) of the genus *Hämatophyllum* Metschnikoff, 1887 (the name of which was published as a substitute name (*nom. nov.*) for *Plasmodium* Marchiafava & Celli, 1885, in the erroneous belief that the latter name could properly be rejected on the ground of inappropriateness), and in place of the foregoing species to designate *Haemamoeba malariae* Feletti & Grassi, 1889 (the Quartan Malaria Parasite) to be the type species both of the genus *Plasmodium* Marchiafava & Celli, 1885, and of the genus *Hämatophyllum* Metschnikoff, 1887;

- (d) to validate the under-mentioned trivial names:—
- (i) *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, to be the name of the Quartan Malaria Parasite, notwithstanding the fact that, prior to the suppression under the Plenary Powers of the trivial names consisting of the word “*malariae*,” specified in (a) above, that name had been invalid as a junior secondary homonym in the genus *Plasmodium*;
 - (ii) *falciparum* Welch, 1897, as published in the combination *Haematozoon falciparum*, to be the name of the Malignant Tertian Malaria Parasites;
- (e) to set aside the indication, by monotypy, of *Laverania malariae* Feletti & Grassi, 1889, or, as the case may be, of *Oscillaria malariae* Laveran, 1881 (being names for the Malignant Tertian Malaria Parasite suppressed under (a) above) as the type species of the genus *Laverania* Feletti & Grassi, 1889, and, in the place of the species so named, to designate *Haematozoon falciparum* Welch, 1897, to be the type species of that genus;
- (f) to validate the generic name *Laverania* Feletti & Grassi, 1889 (type species, by designation under the Plenary Powers, under (e) above: *Haematozoon falciparum* Welch, 1897, validated under the Plenary Powers, under (d) above), as the generic name of the Malignant Tertian Malaria Parasite ;
- (3) declare the under-mentioned generic names to be invalid or not required for the reasons severally stated below against the names in question:—

<p style="text-align: center;"><i>Generic name</i></p> <p style="text-align: center;">(1)</p>	<p style="text-align: center;"><i>Reason why generic name cited in Col. (1) is invalid or not required</i></p> <p style="text-align: center;">(2)</p>
<p>(a) <i>Oscillaria</i> Laveran, 1881 (in so far as Laveran published this as a new name and not as <i>Oscillaria</i> Schrank, 1823)</p>	<p>Invalid because a junior homonym of <i>Oscillaria</i> Schrank, 1823, that name retaining under Article 1 its rights under Article 34, notwithstanding the fact that the genus so named has been transferred to the Vegetable Kingdom</p>
<p>(b) <i>Hämatophyllum</i> Metschnikoff, 1887</p>	<p>Invalid because a junior objective synonym of <i>Plasmodium</i> Marchiafava & Celli, 1885, the two nominal genera having the same nominal species as type species</p>
<p>(c) <i>Haemamoeba</i> Feletti & Grassi, 1889</p>	<p>Invalid because the type species of this genus (<i>Haemamoeba malariae</i> Feletti & Grassi, 1889) has, under (2)(c) above, been designated under the Plenary Powers to be the type species of the genus having the older name <i>Plasmodium</i> Marchiafava & Celli, 1885</p>
<p>(d) <i>Ematozoo</i> Antolisei & Angelini, 1890</p>	<p>Not required because its type species (<i>Ematozoo falciforme</i> Antolisei & Angelini, 1890) is a junior subjective synonym of <i>Haematozoon falciparum</i> Welch, 1897, desig-</p>

<p style="text-align: center;"><i>Generic name</i></p> <p style="text-align: center;">(1)</p>	<p style="text-align: center;"><i>Reason why generic name cited in Col. (1) is invalid or not required</i></p> <p style="text-align: center;">(2)</p>
<p>(d) <i>Ematozoo</i> Antolisei & Angelini, 1890 (continued)</p>	<p>nated under the Plenary Powers, under (2) (e) above, to be the type species of the genus <i>Laverania</i> Feletti & Grassi, 1889</p>
<p>(e) <i>Haematozoon</i> Thayer & Hewetson, 1895</p>	<p>Invalid, because a junior homonym of <i>Haematozoon</i> Leisering, 1865; in addition, not required because its type species (<i>Haematozoon falciforme</i> Thayer & Hewetson, 1895) is a junior subjective synonym of <i>Haematozoon falciparum</i> Welch, 1897, designated under the Plenary Powers, under (2) (e) above, to be the type species of the genus <i>Laverania</i> Feletti & Grassi, 1889</p>
<p>(f) <i>Haemosporidium</i> Lewkowicz, 1897</p>	<p>Invalid because its type species <i>Haemamoeba malariae</i> Feletti & Grassi, 1889 (by selection under Article 30, Rule (g) and <i>Opinion</i> 46) is the same nominal species as that which, under the Plenary Powers, has, under (2) (c) above, been designated as the type species of the genus having the older name <i>Plasmodium</i> Marchiafava & Celli, 1885</p>

- (4) declare that the undermentioned trivial names, each of which was published as the name of a new avian parasite but in the description of each of which there appeared an incorrect statement that the parasite in question had been found in the blood of human malaria patients, are not available as trivial names for the Malignant Tertian Malaria Parasite (the parasite mis-identified with the avian parasite concerned), these trivial names adhering under the *Règles* to the avian parasites from which the original descriptions of these parasites were drawn up by their respective authors:—
- (a) *praecox* Grassi & Feletti, 1890, as published in the combination *Haemamoeba praecox*;
 - (b) *immaculata* Grassi, 1891, as published in the combination *Haemamoeba immaculata*;
- (5) declare that the undermentioned terms consisting of Latin adjectives published in the genitive case, in agreement not with the generic name (as required by Article 14 (1)(a)) but with the specific trivial name, either expressed or understood, were published not as subspecific trivial names of human malaria parasites, but as technical designations for those species and that the Latin adjectives in question accordingly possess no status under the *Règles* as subspecific trivial names:—
- (a) *quartanae* Celli & Sanfelice, 1891, as published in connection with the combination *Plasmodium malariae*;
 - (b) *tertiana*e Celli & Sanfelice, 1891, as published in connection with the combination *Plasmodium malariae*;
 - (c) *quotidiana*e Celli & Sanfelice, 1891, as published in connection with the combination *Plasmodium malariae*;
 - (d) *tertiana*e Kruse, 1892, as published in connection with the combination *Plasmodium malariae*;

- (e) *quartanae* Kruse, 1892, as published in connection with the combination *Plasmodium malariae*;
- (f) *irregularis* Kruse, 1892, as published in connection with the combination *Plasmodium malariae*;
- (g) *tertiana* Lewkowitz, 1897 as published in connection with the generic name *Haemosporidium*;
- (h) *quartana* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (i) *undecimana* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (j) *sedecimana* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;
- (k) *vigesimo-tertiana* Lewkowitz, 1897, as published in connection with the generic name *Haemosporidium*;

(6) place on record:—

- (a) that there is no such generic name as *Haematomonas* Osler, 1886, Osler in the passage in question not having published a new generic name but having referred to the previously published name *Haematomonas* Mitrophanow, 1883;
- (b) that the undermentioned generic and trivial names published for human malaria parasites by Danilewsky, 1891, possess no status under the *Règles*, the paper in which they were published having been declared by the Commission in *Opinion* 101 to be unavilable for nomenclatorial purposes:—
 - (i) The generic names:—
 - Cytamoeba* Danilewsky, 1891
 - Cytosporon* Danilewsky, 1891
 - Cytozoon* Danilewsky, 1891
 - Haemocytosporon* Danilewsky, 1891

- (ii) the trivial name *hominis* Danilewsky, 1891, as published in the binominal combination *Laverania hominis*;
- (c) that the trivial name *quartana* Labbé, 1894, as published as a subspecific trivial name in the trinominal combination *Haemamoeba laverani* var. *quartana*, is not required for the Quartan Malaria Parasite, it being a junior subjective synonym of the trivial name *malariae* Feletti & Grassi, 1889, as published in the combination *Haemamoeba malariae*, validated under the Plenary Powers under (2)(d) above;
- (d) that the undermentioned alleged trivial names, not having been published, are cheironyms and accordingly possess no status under the *Règles*:—
 - (i) *irregularis* Sakharov, erroneously alleged to have been published in 1892 as a subspecific trivial name in the combination *Haemamoeba febris irregularis* ;
 - (ii) *tropica* Koch, erroneously alleged to have been published in 1899 in the combination *Plasmodium tropica* ;
- (7) declare that the trivial name *vivax* Grassi & Feletti, 1890, as published in the combination *Haemamoeba vivax*, is the oldest available trivial name for, and therefore the valid trivial name of, the Benign Tertian Malaria Parasite;
- (8) declare that the trivial name *tertiana* Labbé, 1894, as published as a subspecific trivial name in the combination *Haemamoeba laverani* var. *tertiana*, is not required for the Benign Tertian Malaria Parasite, being a junior subjective synonym of the earlier published trivial name *vivax* Grassi & Feletti, 1890;

(9) substitute the following particulars in regard to the generic names *Plasmodium* and *Laverania* in the *Official List of Generic Names in Zoology* in place of the particulars deleted therefrom in accordance with (1) above:—

- (a) *Plasmodium* Marchiafava & Celli, 1885 (type species by designation under the Plenary Powers: *Haemamoeba malariae* Feletti & Grassi, 1889) (the Quartan Malaria Parasite);
- (b) *Laverania* Feletti & Grassi, 1889 (type species by designation under the Plenary Powers: *Haematozoon falciparum* Welch, 1897) (the Malignant Tertian Malaria Parasite) (generic name to be used by authors who consider the Malignant Tertian (or Aestivo-Autumnal) Malaria Parasite to be generically distinct from the Quartan Malaria Parasite).

(2) Recommendation for the clarification of Article 14 in relation to the status of terms consisting of Latin adjectives cited in the genitive case when published as though constituting names for species or subspecies

282. Arising out of the Recommendation numbered Recommendation (5) in the summary submitted in the immediately preceding paragraph, I recommend that the International Commission on Zoological Nomenclature should invite the International Congress of Zoology²⁸:—

to insert words in the *Règles* providing as follows:—

- (a) Where, in the case of a nominal species having, as its specific trivial name, a noun in the genitive case, a third term consisting of a Latin adjective is cited in grammatical agreement not with the generic name of the species (as required by Article 14) but with the trivial name of the species, the Latin adjective so cited is not to be treated as having been published as a

²⁸ This recommendation was approved by the International Commission on Zoological Nomenclature, on whose recommendation a provision on the lines suggested was inserted in the *Règles* by the Thirteen International Congress of Zoology, Paris, 1948 (1950, *Bull. zool. Nomencl.* 4 : 624—625).

subspecific trivial name, and a technical designation so published shall possess no rights in zoological nomenclature. *Example:* In the case of the term published as *Plasmodium malariae quartanae* by Kruse in 1892, the Latin adjective *quartanae*, being in grammatical agreement with the specific trivial name *malariae* and not with the generic name *Plasmodium*, is not to be treated as having been published as a subspecific trivial name.

- (b) Where a Latin adjective is cited in the genitive case in direct association with a generic name, the term so published is to be treated as being in grammatical agreement with a specific trivial name in the same case and number, understood grammatically though not expressed, and a designation so published is to be rejected as a subspecific trivial name in like manner as in (a) above. *Example:* In the case of the term published as *Haemosporidium quartanae* by Lewkowicz in 1897, the Latin adjective *quartanae* is to be treated as being in grammatical agreement with the specific trivial name *malariae*, understood though not expressed, and is to be rejected as a subspecific trivial name.

APPENDIX 1

The discovery by Golgi of the Quartan Malaria Parasite

By SIR RICKARD CHRISTOPHERS, C.I.E., O.B.E., F.R.S.
(*University of Cambridge, Department of Zoology, Cambridge*)

(Enclosure to a letter dated 24th March 1944
addressed to Francis Hemming)

Golgi's complete works on malaria have been republished in a volume by Perroncito (Perroncito, A., 1929, *Gli studi di Camillo Golgi sulla malaria*, Rome). Five papers are given prior to 1890. I have been carefully over these and the only ones relevant to the present issue are:—

Golgi, C. 1885. Sull'infezione malarica.

Communicated R. Accad. di Med. di Torino at Meeting of
20th November 1885.

Published *Giornale della R. Accademia di Medicina di Torino*
in 1885, in Vol. 33, p. 734.

Published later (in 1886) in extenso (di poi in esteso) in
Archivio per le Scienze mediche di Torino Vol. 10, p. 109.

Republished (with the plate inscribed "Arch. per le Sci.
Med., Vol. X," so presumably same plate used as for the
1886 printing) Perroncito, *loc. cit.* 1929.

Golgi, C. 1886. Ancora sulla infezione malarica.

Communicated Soc. Med. Chir. di Pavia at Meeting of
5th June 1886.

Published in 1886 in *Gazetta degli Ospedali* No. 53 (Wenyon
gives Vol. 7, p. 419).

Golgi, C. 1889. Sul ciclo evolutivo dei parassiti malarici nella febbre terzana. Diagnosi differenziale tra i parassiti endoglobulari malarici della terzana e quelli della quartana. Published in 1889 in *Arch. per le Sci. Med.* Vol. 13, p. 173.

In the first paper Golgi showed that in quartan malaria the pyrexial attacks correspond with segmentation of the parasite and that there may be a double quartan or quotidian sequence of attacks, in which case they correspond to two or three generations of parasite respectively. He described the various stages the parasite goes through and gives a plate with unmistakable forms of quartan. Further he points out that the tertian fever is not associated with the quartan parasite "Riguardo alla terzana si puo anzi dire, a priori, che il parassita rappresentante l'infezione malarica, deve avere un ciclo di sviluppo diverso da quello della quartana e sue combinazioni."

In the second paper he returns to this latter point and describes the tertian parasite (named *vivax* by Grassi & Felletti).

In the third paper he describes in detail the differences between quartan and tertian parasites, etc.

There can be no doubt but that the first paper is that in which Golgi first recognised and described the quartan parasite, though he did not give it a zoological name. He not only gives beautiful reproductions in his plate of this parasite which include most of its characters but he also worked out its periodicity. He also clearly suspected another species to be present and practically said that this was not the quartan.

APPENDIX 2

Reproduction in facsimile of the paper entitled *Sui parassiti della malaria* by Feletti (R.) and Grassi (B.) as published in the serial publication *Riforma medica*, Napoli, in its issue of 15th January 1890 and of the supplement to the foregoing paper entitled *Sui parassiti della malaria : aggiunta alla nota preliminare* published in the same serial publication in its issue of 1st March 1890

Documents 1 to 3 : Feletti (R.) & Grassi (B.), 1890, *Sui parassiti della malaria* : facsimile reproductions of pages 62 to 64 of the issue of 15th January 1890 of the serial publication *Riforma medica*, Napoli, in which the foregoing paper was published

Document 1 : Facsimile reproduction of page 62

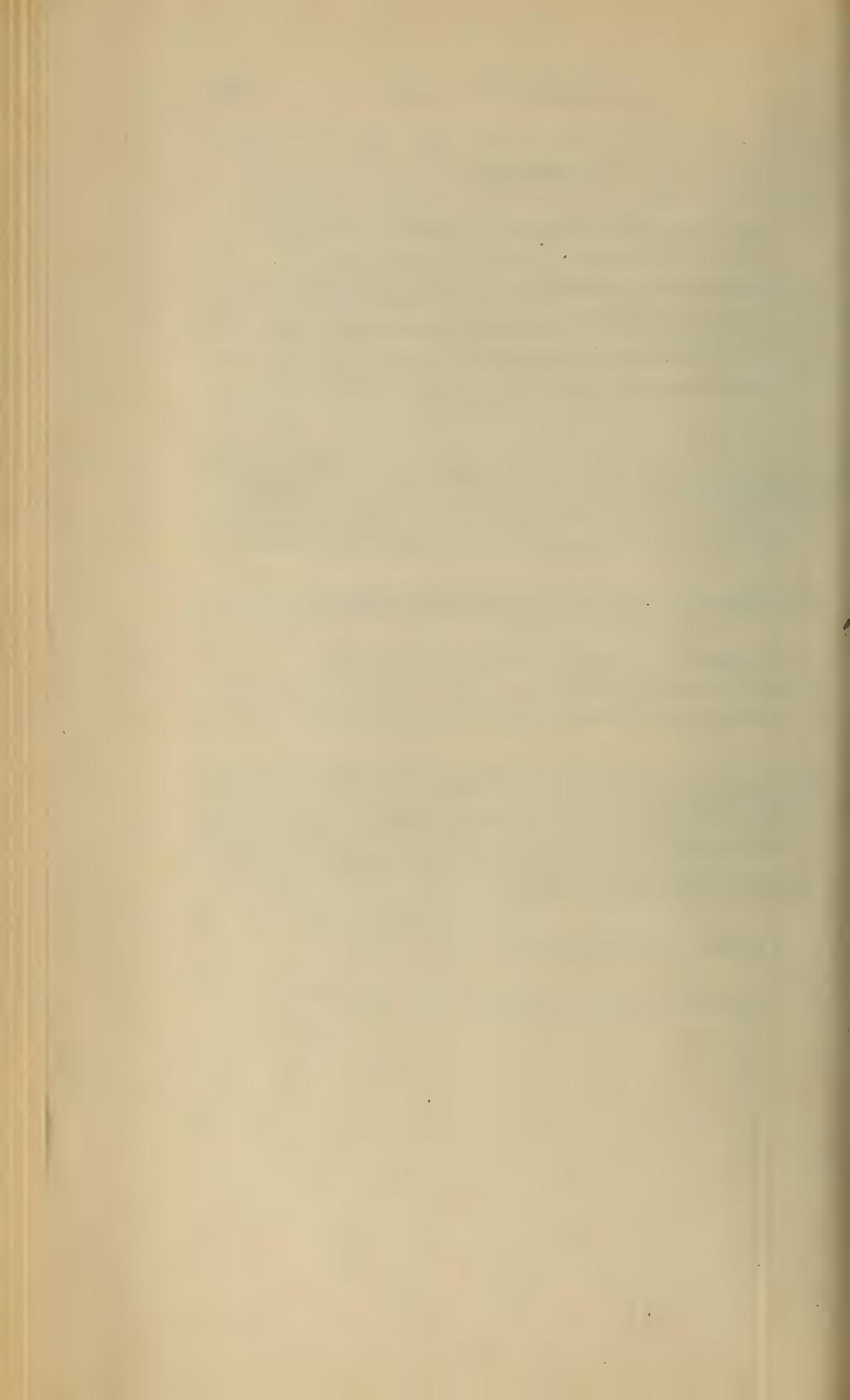
Document 2 : Facsimile reproduction of page 63

Document 3 : Facsimile reproduction of page 64

Documents 4 and 5 : Feletti (R.) & Grassi (B.), 1890, *Sui parassiti della malaria : aggiunta alla nota preliminare* : facsimile reproductions of pages 296 and 297 of the issue of 1st March 1890 of the serial publication *Riforma medica*, Napoli, in which the foregoing paper was published

Document 4 : Facsimile reproduction of page 296

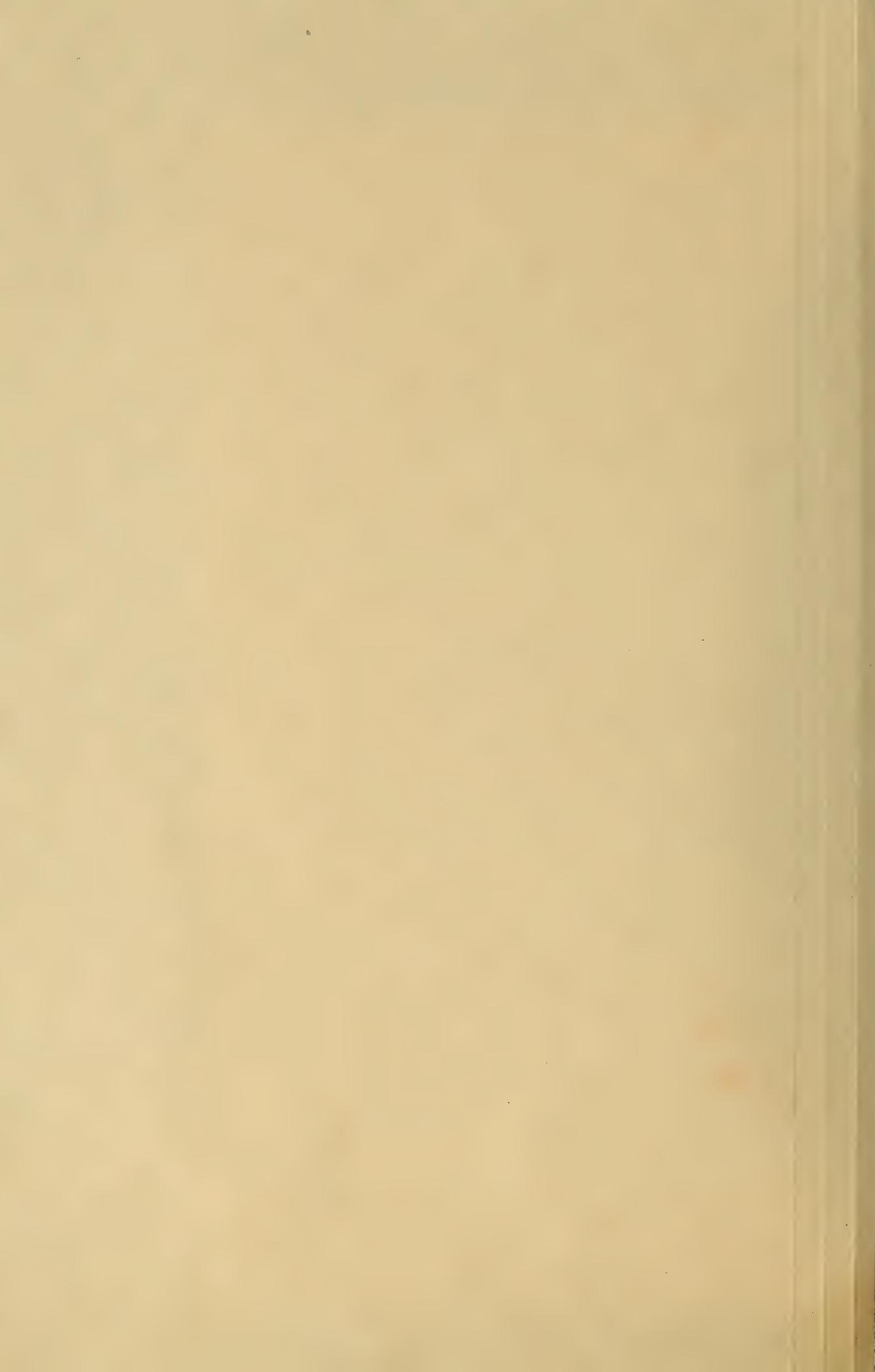
Document 5 : Facsimile reproduction of page 297



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bilando la anastomosi intestinale con l'esclusione permanente della sede della occlusione dal passaggio attivo delle fecce.

13. La ripetizione dell'accidente deve essere impedita con l'accorciamento del mesentere a mezzo di una piegiatura parallela all'asse lungo dell'intestino, e con la sutura dell'apice della piegiatura alla radice del mesentere.

LAVORI E LEZIONI ORIGINALI

R. UNIVERSITÀ DI CATANIA (Prof. R. FELETTI e B. GRASSI). — *Sui parassiti della malaria.*

Lo stato presente della questione riguardanti i parassiti della malaria è questo.

Da una parte Laveran, Marchiafava, Celli, Golgi, Guarneri ecc. sostengono che è causa della malaria un parassita da loro studiato, il quale presenta sicure somiglianze, secondo Laveran con la Oscillaria, secondo Marchiafava, Celli e Guarneri coi Mictozoi, con gli Sporozoi e coi Flagellati.

Da un'altra parte stanno Tommasi-Crudeli, Mosso, Maragliano, Hayem ecc., i quali ammettono che il supposto essere vivo, così bene studiato dai suddetti Autori, altro non sia che un prodotto dell'alterazione e del successivo disgregamento dei globuli rossi.

Di fronte a due opinioni diametralmente opposte, la maggior parte degli studiosi crede prematuro qualunque giudizio.

È ben vero che i corpi semilunari, i flagellati, i plasmodi istintivamente (se ci si permette la parola) si giudicherebbero esseri vivi. È vero che i così detti *cieli evoluti*, messi in luce specialmente da quel micidissimo osservatore che è il prof. Golgi, a primo aspetto sembrano riferirsi soltanto ad esseri inferiori. Ma non è in verità che il globulo rosso, alterandosi, si presenta forme, che hanno somiglianza con le semilune, con le margherite, coi corpi flagellati ecc. Somiglianza non lontana, ma sufficiente a far sorgere dubbi. Com'è vero del pari che, presentandosi la febbre malarica comunemente ad accessi, si può supporre che le alterazioni dei globuli rossi corrispondano all'andamento dei singoli accessi, e simifino perciò dei cicli evolutivi.

Ma gli studiosi che dubitavano, erravano noi pure. Ed uno di noi (Grassi) suggerì al collega Celli, che la più ovvia soluzione dell'oscuro quesito doveva trovarsi nello studio dell'intima struttura del supposto parassita, e soprattutto nella dimostrazione che esso possiede un nucleo. Il Celli e il Guarneri si misero pertanto sopra questa strada. A noi sembra però che essi non siano riusciti a toccare la meta; e ci pare assai ragionevole la prudente riserva che adoperano nell'interpretare i nuovi fatti trovati. È invero: un nucleo che si colora meno, o come l'ectoplasma; un endoplasma, talvolta ad un lato dell'ectoplasma, e inoltre chiaro, e scindibile molto debolmente, (nelle fi-

gure però è incolore). Mentre l'ectoplasma sarebbe colorabile molto intensamente; i granuli di pigmento non occupanti mai l'endoplasma; dei flagelli con pigmento; il nucleo delle semilune ritenuto simile a quello dei coccidi; un principio del differenziamento del nucleo ecc., ci parvero espressioni oscure e fatti poco provanti l'asserto degli Autori. Bisogna confessare però che l'interessantissimo lavoro di questi Autori segnò un vero progresso, perchè fece nascere la speranza di potere sciogliere definitivamente la questione.

I dubbi, che abbiamo volti qui accennare, ci mossero ad intraprendere nuove ricerche. Molti furono i tentativi infruttuosi, durante i quali, ora propendevamo a credere che il supposto protozoa fosse un pseudoparassita, perchè non presentava indubitabili caratteri di essere vivente, ora invece ritenevamo il contrario, perchè impressionati dai corpi in segmentazione e dalle semilune, che ci parevano troppo belli per poter essere prodotti da alterazioni d'un globulo rosso. Però dovetti molte e molte oscillazioni siamo arrivati alla conclusione desiderata.

Il problema fu da noi posto in questi termini: Se il plasmodio e la semiluna sono *Rizopodi*, o *Missomiceti*, o *Chitridi* (che altro vero protista possono essere?), debbono avere quasi sicuramente un nucleo, e questo deve nella riproduzione comportarsi come tutti i nuclei degli esseri vivi.

Ora noi, modificando alquanto i metodi di ricerca finora usati, siamo appunto riusciti a vedere costantemente e molto esattamente, e perciò a potere con sicurezza interpretare, quanto avevano già osservato Celli e Guarneri. Non solo, ma abbiamo potuto seguire il nucleo anche durante il processo di divisione dei corpi pigmentati.

Riservando al lavoro completo di esporre i metodi e di far rilevare punto per punto quanto spetta agli altri Autori, vogliamo qui semplicemente riassumere le nostre osservazioni e le conseguenze che ne derivano.

Il così detto plasmodio (1) consta di plasma (corpo o sostanza cellulare), in cui l'ectoplasma e l'endoplasma non sono distinti (il che sta in rapporto specialmente con la sua molto imperfetta locomozione e col suo peculiare modo di nutrizione), e di un *evidentissimo* e grosso nucleo, vescicolare, come si trova in molti Rizopodi. Il nucleo è per lo più molto eccentrico; possiede una delicatissima membrana, succo nucleare (nucleochiloma), che pare semisolido, e reticolo. Questo reticolo nu-

clearo è rappresentato da un nodo, in forma di nucleo più o meno eccentrico, il quale è di varia forma: rotondeggiante, o subtriangolare, o subquadriangolare; e da esso partono parecchi fili (3-4) delicatissimi (nei plasmodi ancor piccoli non sono quasi mai visibili), che vanno verso la membrana. Questa assume talora, nei preparati artificialmente colorati, una tinta come quella del corpo nucleiforme, e può mostrare degli ispessimenti egualmente colorati; se la colorazione appartenga alla membrana stessa, od a delicatissimi fili del reticolo nucleare ad essa addossati, non sappiamo decidere. Il plasma ora presenta un aspetto reticolare (spugnoso), ora mostra dei granuli finissimi (microsomi), che si colorano facilmente ad es. col bleu di metile. Nel plasma poi possono trovarsi dei corpuscoli, che sono evidenti frammenti di globulo rosso (cibo ancora indigerito), oppure dei corpuscoli di melanina (residuo della digestione). Alle volte vi si notano anche uno o parecchi vacuoli non contrattili.

Come si vede, il corpo qui descritto, tenendo conto che presenta movimenti ameboidi, può fin d'ora giudicarsi un *ambiba senza vacuoli contrattili* (in molti protozoi parassiti mancano i vacuoli contrattili).

Man mano che va avvicinandosi alla maturazione, il plasmodio ingrandisce, diventa poi tondeggiante (*corpo pigmentato* degli Autori) e presenta spesso volte il suo plasma distinto in due strati: uno esterno contenente i granuli di pigmento, e uno interno, che ne è privo (questo si colora come il corpo nucleiforme). Ingrandisce in proporzione forse più il nucleo che il plasma. Del nucleo poi ingrossa relativamente molto di più quel corpuscolo nucleiforme, che sopra si è accennato; esso cresce tanto da finire per occuparlo in gran parte. Abbiamo trovato molti esemplari in cui questo corpuscolo si era allungato a guisa di bastoncino; molti altri in cui tendeva a dividersi o s'era già diviso in due; molti altri in cui ciascuno dei due tendeva pure a dividersi, o già s'era diviso in due; altri (questi stadi corrispondono a circa 15, 16 ore prima dell'accesso); molti altri esemplari, infine, in cui se ne contavano 5, 6, 8, 10 e più. Ad un momento, che non abbiamo ben determinato, attorno ad ognuno dei corpuscoli nucleiformi, ecco neoformati per divisione, disposti succo nucleare ed una delicatissima membrana nella (1).

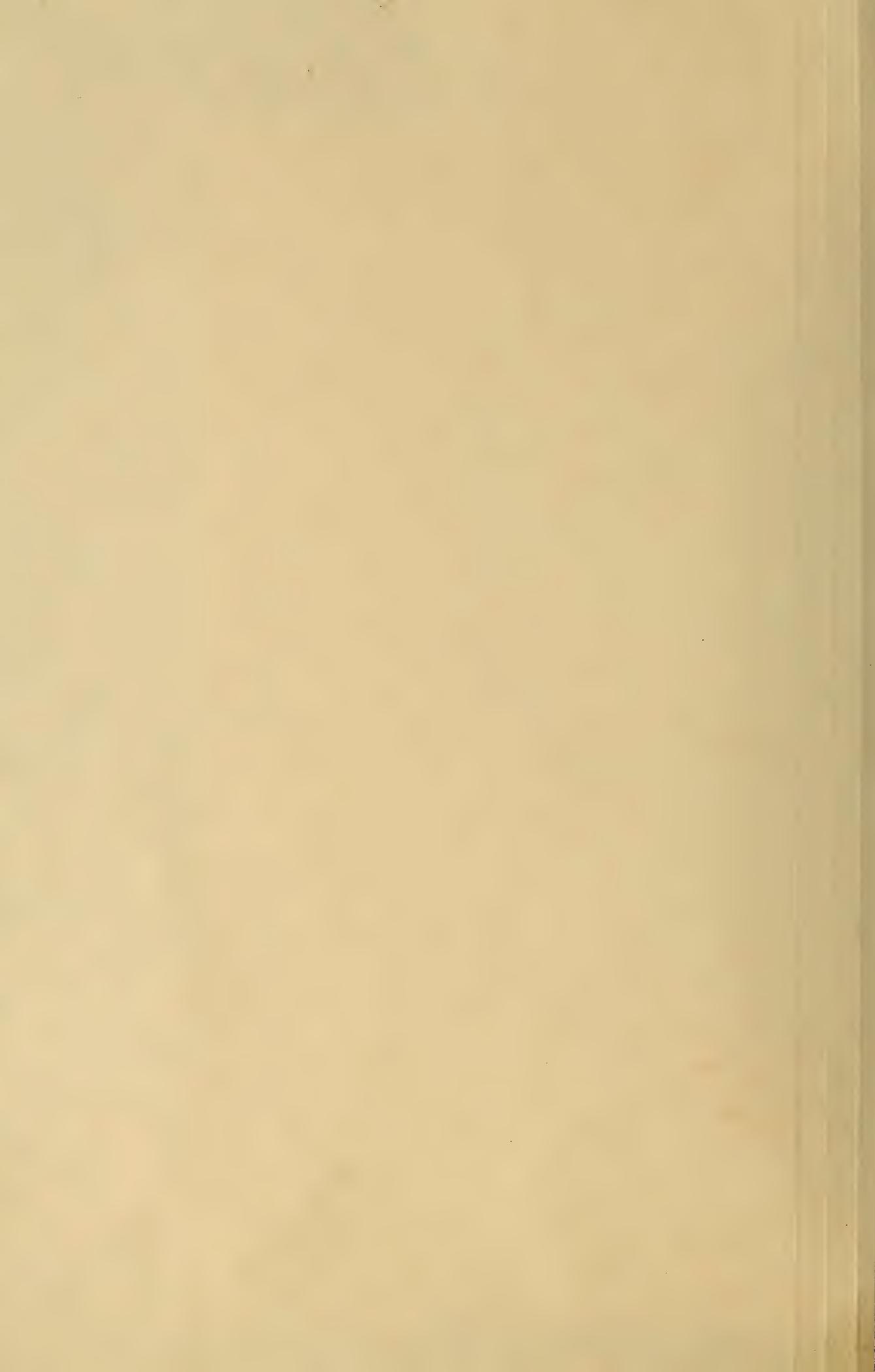
(1) Il fenomeno in discorso ci pare si verifici ad ogni successiva divisione, avendo trovato succo nucleare attorno a ciascun corpuscolo già quanto meno appena due, quattro, ecc. Ad aumentare la sostanza del corpo nucleiforme, ossia la cromatina, concorre probabilmente lo strato interno del plasma che non acquiesce pigmento. I corpuscoli nucleiformi sono quelli il volume dello stesso corpuscolo nell'ambiba adulta, finché sono in numero di due o quattro; dopo (a talora) consumato lo strato interno del plasma ad ogni successiva divisione impiccoliscono. Tutti questi fenomeni parebbero accennare ad una riproduzione per fram-

(1) Questi studi si riferiscono specialmente al plasmodio della quartana. Il termine *plasmodio*, nel senso usato dagli A. e da noi seguito per render facile la lettura della presente Nota, è del tutto improprio. Sugeriamo di sostituirvi il termine *ambiba*, quando è ancor piccolo; *ambia*, quando è grande; *ambia* in rapporto si decomporà quindi il corpo pigmentato.



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Abbiamo allora un'amiba, ossia una cellula plurinucleata (riproduzione endogama). Più tardi, attorno ad ogni nucleo, disponendosi, pure in un momento e in un modo che non abbiamo ancora precisato, un po' di plasma.

Resta infruttuoso il pigmento, e con essa una sostanza, che probabilmente è una porzione periferica del plasma: il pigmento e questa sostanza di solito si accumulano in un piccolo globo residuale. A poco a poco i nuclei, formati come teste si disse, col rispettivo plasma si allontanano alquanto l'uno dall'altro; e formano un mucchietto, che (almeno nei casi da noi osservati) ha per lo più forma di calotta più o meno alta. (C'osi si hanno le ben note figure di sporulazione, o di segmentazione).

In questo mucchietto distinguiamo: 1.^a una membrana, che è lo strato periferico, o se si ammette, la tanto contrastata membrana del globo rosso; 2.^a un globo residuale (*nucleus de reliquiis*) (per lo più collocato nel centro della faccia piana della calotta); 3.^a i nuclei vescicolari (disposti per lo più in uno strato che delimita appunto la figura di calotta) contenenti un evidente corpo nucleoliforme più o meno eccentrico, e circondati da plasma molto scarso, specialmente in corrispondenza a circa una metà del nucleo.

Denomineremo questi corpi neoformati *gimnospora*, e forse anche potremmo già dirli *amibule*.

Varia molto il numero delle gimnospore, che ogni amiba può produrre, e forse anche varia alquanto il modo di divisione del nucleo (in alcuni esemplari troviamo una gimnospora grande e parecchie piccole).

Il modo di riproduzione qui accennato trova sicuro riscontro nell'*Amoeba pigmentifera* scoperta e descritta da uno di noi (Grassi) e, riguardo al comportarsi del nucleo, nell'*Amoeba coli* da uno di noi (Grassi) studiata.

È certo che il globo rosso, il quale od è sfornito, od ha soltanto residui del nucleo, alterandosi, non potrebbe riprodurre nuclei presentanti i caratteri suddescritti.

I nuclei delle gimnospore sono perfettamente uguali a quello del plasmodio, da cui sono stati generati (1).

Eccezzionalmente le gimnospore si fondono in un vero plasmodio (con parecchi nuclei); alle volte lo fanno, com'è già noto, i plasmodi endoglobulari consistenti in un globo rosso. È probabile che le gimnospore con movimenti ameboidi invadano il globo rosso giovane, al mo-

mento in cui il suo nucleo si è disfatto. Con ciò potrebbe star benissimo in rapporto il fatto, anche da noi ripetutamente riscontrato, che ad un momento, in cui il sangue è ricco di corpi in segmentazione, ne segue un altro in cui essi mancano o sono molto scarsi, e nei globuli rossi (dal sangue ottenuto con la puntura del dito) non sono ancora presenti i plasmodi (1).

La perfetta identità che abbiamo riscontrata tra il plasmodio appena entrato nel globo rosso e la gimnospora dimostra che molto probabilmente tra l'uno e l'altro non v'è stadio intermedio.

I corpi semilunari derivano, com'è noto, da così detti plasmodi, o, giusta la nostra denominazione, da amibule. Queste hanno i caratteri sopracitati; ma quando diventano adulte, assumono appunto l'aspetto di semiluna. Le semilune differiscono dal corpo pigmentato specialmente per la forma, per la disposizione del pigmento e per la quantità del plasma.

Nella parte mediana della semiluna, quasi addossato alla faccia concava, e quindi sempre discosto dalla faccia convessa, sta il nucleo vescicolare, eccentrico, perciò, come nei corpi pigmentati. Il nucleo spesso ha un corpo nucleoliforme semplice, talvolta un corpo nucleoliforme che si direbbe tendente a dividersi. Il plasma ha l'aspetto di quello del corpo pigmentato, però è molto più abbondante. Il pigmento sta per lo più addossato alla delicatissima membrana del nucleo.

Non è del tutto impossibile che la semiluna, la cui membrana è uguale a quella del corpo in sporulazione, si riproduca per gemmazione, come credono Celli e Guarneri. Noi pure abbiamo verificato il fatto, ma non abbiamo potuto in alcun modo stabilire che nelle supposte gemmule entri una parte del nucleo. Incliniamo invece a credere che si tratti di un'alterazione (diffuza).

In ogni caso, nessun zoologo, specialmente dopo le inoculazioni di Antolisei e Angelini, esiterà ad ammettere che il corpo pigmentato della terza e della quartana è differente dalla semiluna. Noi proponiamo di riferire l'uno al nuovo gen. *Haemamoeba* e l'altro al nuovo gen. *Laverania*.

Nel periodo giovanile di *amibula* (plasmodio secondo tutti gli A.) sono perfettamente identici l'uno all'altro. Più tardi si differenziano gradatamente anche per la forma, forse ciò dipendendo dalla differente parte del globo rosso, che vengono ad occupare.

I generi in discorso, nello stato attuale delle nostre cognizioni, debbono inscri-

versi tra i *Sarcodini* (Rizopodi) nella tribù delle *Amoebiformes*.

Le amibe in riposo (corpi pigmentati), o ancora piuttosto giovani (contenenti già pigmento), ma più frequentemente le semilune (quest'ultime spesso diventando prima rotonde) possono emettere dei prolungamenti, che contengono o no pigmento, e che per lo più non si possono dire né flagelli né pseudopodi, ma di solito rassomigliano più a quelli che a questi. In quanto alle semilune, noteremo, che in tutti e cinque i malarici con semilune da noi studiati nel novembre scorso qui a Catania, vedemmo i così detti corpi flagellati, sempre, tanto nell'apressia, che sotto la febbre; e così vicino come lontano da essa. Per trovarne sicuramente, basta osservare il sangue ad una sufficiente temperatura e impedirne lo schiacciamento, mettendo ad es. ai quattro angoli del vetrino coprogetti un po' di cera impastata coll'olio.

Neppure una volta trovammo forme flagellate nel sangue, prima che fossero trascorsi circa 20 minuti da che avevamo fatto il preparato. Non le trovammo nel sangue istantaneamente fissato coi vapori di acido osmico. Questi fatti collimano con quanto ha osservato Danilewskij nelle semilune degli uccelli. Considerando che a produrre i flagelli in discorso occorre, secondo ogni verosimiglianza, soltanto il plasma, neghiamo che essi siano capaci di riprodurre il corpo da cui derivano. *Sospettiamo* invece che esprimano nient'altro che fenomeni agonici, forse paragonabili a quelli presentati da certi flagellati, i quali nel periodo agonico si forniscono di uno pseudopodo, che emettono e ritirano rapidissimamente (Grassi, Blochmann). Il sospetto è avvalorato dalle svariate forme, che possono assumere i flagelli in discorso; dal fatto, che si distaccano via poco dopo che sono stati emessi, dal fatto che alle volte il corpo, invece di fornirsi di flagelli, presenta una sorta di orlo ondulante, ecc. Infine il sospetto è giustificato dal fatto da uno di noi (Folletti) minutamente studiato: che dai globuli rossi possono uscire dei filamenti simili ai flagelli in discorso, e come questi distaccarsi, locomoversi ecc.

Giacché accennammo alle osservazioni di Danilewskij, diremo che quest'Autore ha trovato negli uccelli delle forme, che ritiene eguali a quelle della malaria. Noi facciamo notare che veramente una forma da lui riscontrata ha somiglianza con la semiluna di *Laverania*, ma non è della stessa specie, come risulta anche da un semplice confronto delle figure (1).

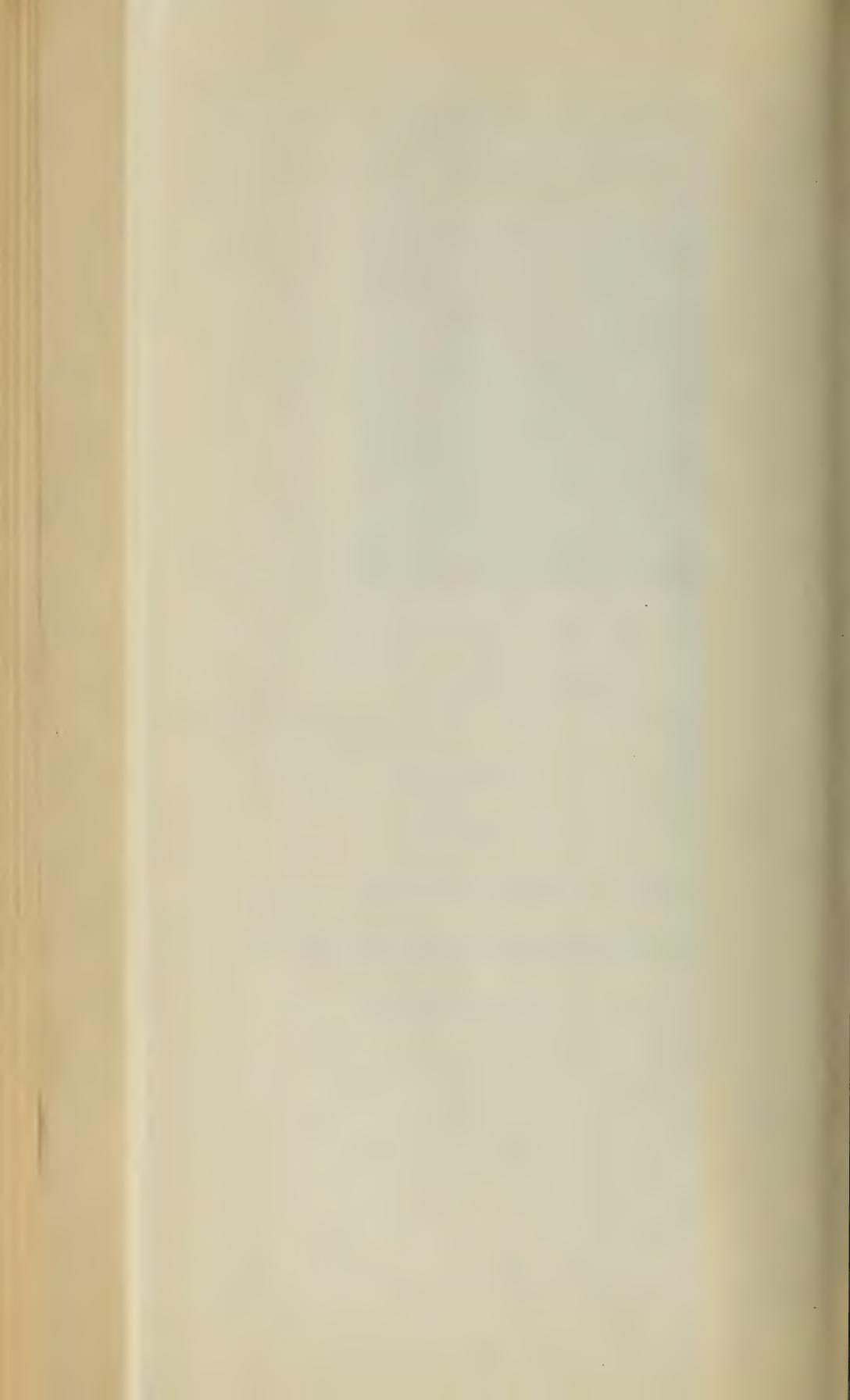
In conclusione, sono certamente paras-

(1) Se fosse vero che le gimnospore invadessero soltanto i globuli rossi giovani, il valore della vera factio (che non osservammo ancora nel sangue fissato all'istante coi vapori di ac. osmico) si ridurrebbe assai. Ma di ciò parleremo più estesamente dopo nuove osservazioni.

(1) Finora non abbiamo trovato nel sangue dei mammiferi forma parasitaria di parositi a quelle della malaria; solamente uno di noi (Grassi) ha visto nel sangue di vari pipistrelli un *Trypanosoma* simile a quello dei ratti.

mentazione (Arnold). Non oiano però dare una interpretazione definitiva; come pure non serbiamo che nei nuclei in discorso manchi la linea (plasma). La straordinaria piccolezza del nostro oggetto e la difficoltà d'osservarlo spiegano la nostra riserva.

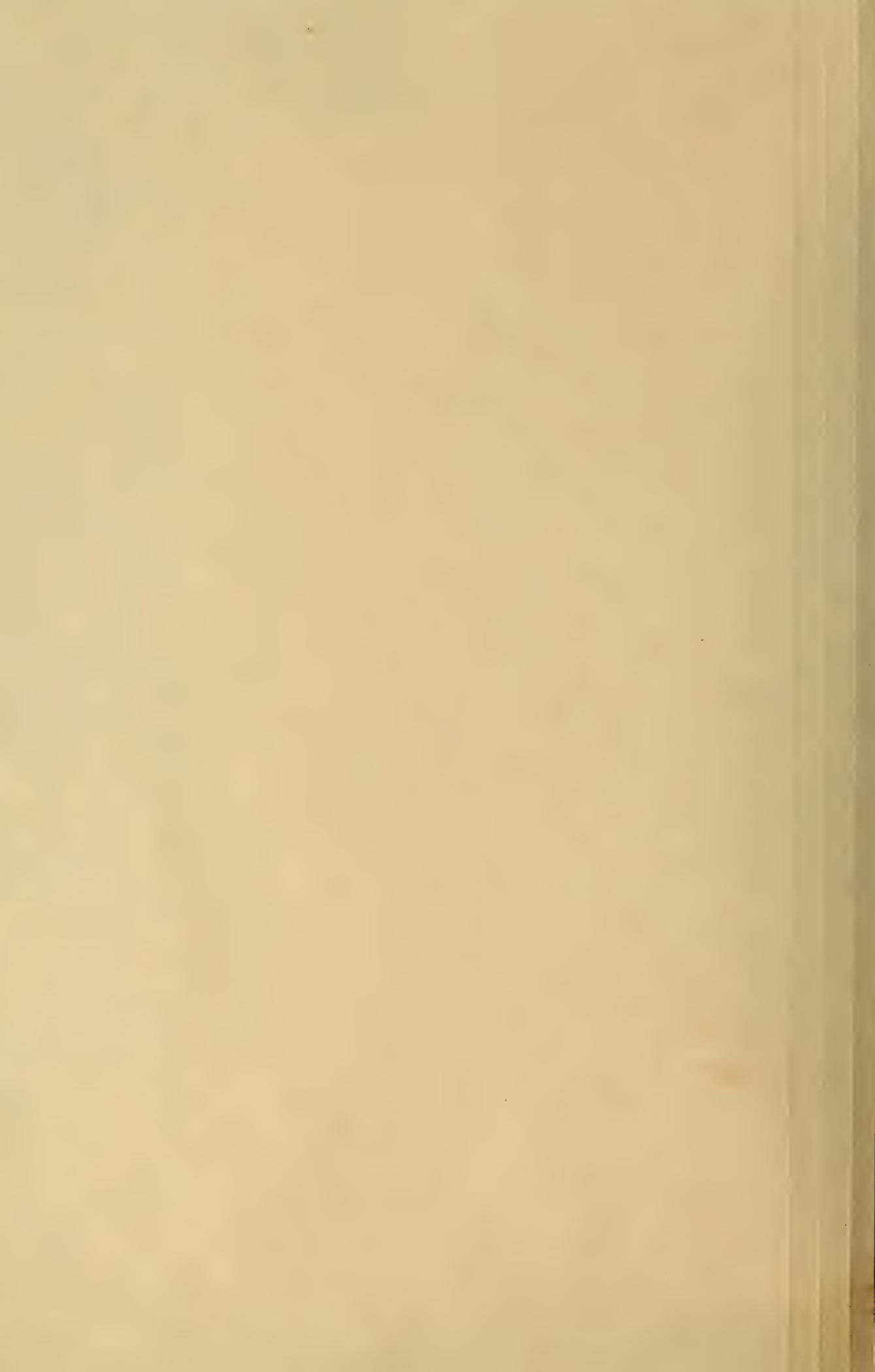
(1) Supporre che il nucleo del plasmodio sia il nucleo del globo rosso giovane è assurdo, specialmente perché: 1.^o il nucleo del plasmodio è differente da quello del globo rosso giovane; 2.^o perché le semilune (V. più avanti) negli uccelli occupano il protoplasma del globo rosso, lasciando intatto il nucleo.



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**ALLE CLINICHE
UTI SCIENTIFICI**

Facsimil



zioni della malaria le forme descritte da Laveran, Marchiafava, Celli ecc; secondo ogni verosimiglianza appartengono ai *Rizopodi* e particolarmente agli *Amoebiformes*, e ne esistono per lo meno due specie: la *Haemamoeba malariae* (delle febbri regolari) e la *Laverania malariae* (delle febbri irregolari).

RIVISTA DELLE CLINICHE E DEGLI ISTITUTI SCIENTIFICI

COLLEGIO REALE DEI CHIRURGI DI LONDRA. — (Prof. BRYANT). Della colotomia iliaca e lombare; con particolare riguardo alla scelta dell'operazione (I).

Colotomia lombare per cancro.

Casi urgenti 100, di cui 55 seguiti da buon successo:

- in 45 (casi troppo tardivi) morte entro un mese.
- > 18 morte dopo 12 mesi.
- > 19 » tra il primo ed il secondo anno.
- > 12 » tra il secondo ed il terzo anno.
- > 6 Sono tuttora in vita, cioè 3 tra due anni e mezzo e cinque dopo l'operazione, ed 1 dopo sei anni.

Casi non urgenti, 60:

Nessuna morte nel mese successivo:

- 18 (cioè 15 %) morirono nei primi 12 mesi.
- 24 (cioè 34 %) vissero da uno a due anni.
- 16 (cioè 22 %) vissero da due a tre anni.
- 12 (cioè 17 %) sono ancora viventi, di cui 8 dai due ai sei anni dopo l'operazione.

38 % di tutti il numero sopravvissero all'operazione dai 2 ai sei anni.

Aggiungo a questa statistica che, nei tre quarti dei pazienti sopravvissuti alla operazione, questa ebbe un pieno risultato, in quanto che tutti i materiali fecali venivano, emessi dall'ano artificiale, con gran vantaggio della lesione locale per cui l'operazione erasi eseguita, essendo affatto cessata su di essa l'irritamento prodotto dal passaggio delle fecce. Nell'altro quarto questo risultato tanto desiderato non erasi ottenuto completamente, e le fecce, specialmente se liquide, continuavano in parte a passare per la via normale, aggiungendo irritazione alla lesione occlusiva. Anche questi infermi intanto ritraevano vantaggi dalle lavande fatte dal retto o dall'ano artificiale, e dall'applicazione di suppositori caldanti.

Ed ora credo opportuno discutere il valore relativo dell'operazione lombare od estraperitoneale o della iliaca od intraperitoneale, quest'ultima preconizzata superiore alla prima specialmente da Reeves, Herbert Allingham, Harrison Cripps, e Chavasse.

Gli argomenti principali su cui questi chirurghi si fondano per proclamare la superiorità della operazione iliaca sono: 1° Che essa in sé stessa è più facile della lombare; 2° che la incisione addominale permette di chiarire la diagnosi nei casi oscuri, prima di aprire l'intestino; 3° che per questa via non è possibile scambiare il grosso intestino con il tenue, col duodeno, con lo stomaco, e che le possibili anomalie del colon non possono rendere frustranea l'operazione, potendo essere l'addome esplorato in tutto il suo ambito; 4° che l'intestino può prestamente e senza fatica essere portato fuori dell'incisione, e per conseguenza fissato strettamente alla cute, senza produrre indebita tensione sui punti di sutura; 5° che nella colotomia lombare il prolasso frequente e considerevole dell'intestino induce veri disturbi

e 6°, finalmente, che la posizione inguinale della ferita è molto più conveniente all'infermo per la pulizia, e per l'applicazione di apparecchi contenitivi delle fecce e dei gas intestinali.

Esamineremo tutti questi pregi in base alla esperienza clinica dei differenti casi, ammettendo che la diagnosi di occlusione intestinale per cancro o per altra causa sia certa. Tutti questi casi possono andar divisi in tre grandi categorie: Nella prima vanno i casi urgenti, associati a sintomi acuti generali ed a forte distensione dell'addome; nella seconda quelli di occlusione intestinale cronica (prevalentemente dell'ultima porzione del retto senza sintomi generali acuti, ma con distensione dell'addome; nella terza i casi di occlusione rettale non urgenti, in cui i sintomi, quantunque bene sviluppati, non si associano a distensione dell'addome. Ora l'operazione della colotomia ha le sue indicazioni speciali per ciascuna di queste categorie di casi.

L'operazione iliaca è essa più facile della lombare? Eseguita nelle due prime categorie, cioè quando vi è distensione addominale, l'operazione iliaca, e che ne dicano i suoi fautori, è difficile ed associata a pericoli indiscutibili.

In questi casi l'intestino tenue con assai facilità proltrude e si avvanza fuori dell'addome, e quando vi sia necessità di ricercare l'intestino grosso, di esplorare l'addome a scopo diagnostico, i pericoli consecutivi sono sempre tali da non essere disprezzati. Nella terza categoria di casi, essendo l'addome non disteso, flaccido, la difficoltà di rinvenire l'intestino è di molto ridotta. Dall'altra parte la distensione dell'addome costituisce una condizione favorevole per la colotomia lombare e la ricerca dell'intestino non è circondata, per lo più, da nessuna difficoltà. Solo quando il paziente è pingue, può esservi qualche difficoltà nella ricerca dell'intestino, ma in generale si riesce a diminuirlo e superare questa difficoltà, se il chirurgo dirige le sue ricerche in avanti, verso la ripiegatura del peritoneo, e non in dietro, verso l'addipisciamento lombare; e se nel tempo stesso fa girare il paziente dalla posizione supina, che si era precelta per cominciare l'operazione, alla semisupina, in modo che l'intestino meccanicamente cada verso la incisione lombare: e l'istessa pratica riesce bene quando l'intestino è totalmente o parzialmente vuoto.

Nella colotomia iliaca, intanto, anche ammettendo che la difficoltà di rinvenire l'intestino sia minore che nella lombare, e i pericoli necessariamente inerenti alla incisione del peritoneo parietale debbono essere tenuti in considerazione, anche da quei chirurghi, che credono poter il peritoneo sano aprire senza alcun timore. Nell'operazione lombare il peritoneo viene inciso solo in casi eccezionali, ed in questi casi non vi è nessuna ragione di differenza di gravità tra la ferita del peritoneo nella regione iliaca e quella nella regione lombare. I pericoli della peritonite, qualunque essi sieno, saranno gli stessi per ambo le regioni.

Nelle 170 colotomie lombari da me eseguite, due solo volte, scientemente, ho aperta la cavità peritoneale, senza che perciò fosse conseguito alcun pericolo. Laonde sono obbligato a concludere che l'operazione iliaca non è più facile della lombare, quando l'addome è disteso, quantunque riconosca che ciò possa essere, quando l'addome è flaccido. Nel cadavere la ricerca del colon nella incisione iliaca può sembrare, ed è, una cosa non difficile, ma nell'infermo l'incisione peritoneale e la manovra del ricercare col dito nella cavità un intestino lesso per congestione, e per tutte le alterazioni secondarie al male primitivo, certamente sono più pericolose, che non la semplice esplorazione del colon esternamente al peritoneo. Nella

regione lombare. Nella metà dei casi, le operazioni iliache eseguite dall'Allingham, e nei terzi di quello del Cripps, l'intestino non tocca alla incisione, o quindi si dovette ricercarlo nel cavo peritoneale con manovre abbastanza complicate, le quali, se semplici e non difficili per il chirurgo sperimentato, non sono senza cattivi risultati per l'ammalato, mentre nella colotomia lombare, salvo rare eccezioni, non vi sarà bisogno di questa ricerca difficile e minuziosa, perché l'intestino, se disteso naturalmente od artificialmente, si presenta immediatamente nel fondo della incisione. Ed in tutti i casi la ricerca del colon dalla incisione lombare non importa tante difficoltà, e non implica tanti organi, quanto nella iliaca. Concludo quindi che la ricerca dell'intestino riesce più facile e meno pericolosa dalla regione lombare anziché dalla iliaca.

Quanto al secondo argomento avanzato a favore del metodo iliaco, essere con questo, cioè, possibile di verificare la diagnosi dei casi oscuri prima di aprire l'intestino, io osservo solo che è assai difficile che possa essere una oscurità di diagnosi nelle occlusioni rettali, le quali possono in gran parte essere esplorate dal dito, e nelle coliche, in cui i sintomi non possono presentarsi alcun dubbio di interpretazione. Ed anche se i sintomi clinici non indicano abbastanza chiaramente la sede dell'occlusione, vi è l'anatomia patologica che si insegna come, nei $\frac{1}{2}$ dei casi di occlusione, questa sia sita in sotto dell'angolo splenico del colon, e quindi in sotto di un taglio fatto nella regione iliaca sinistra, e come nel rimanente quinto dei casi l'occlusione lombare destra con quasi completa certezza sia adeguata agli scopi che si propone. Divuando quindi: Può una regola di pratica chirurgica, che ha sempre corrisposto nella cura delle occlusioni croniche del retto, essere modificata, per poter rispondere nei casi eccezionali e non già nei più che frequenti, e si deve modificare la pratica generale chirurgica per adattarla ai soli casi di eccezione?

La terza ragione a favore della colotomia iliaca è che per questa via non è possibile l'errore di captare sul tenue intestino, sul duodeno o sullo stomaco, e che le anomalie del colon non possono rappresentare una ragione di esito sfavorevole dell'operazione, poiché dalla incisione addominale si può esplorare l'addome in tutte le direzioni.

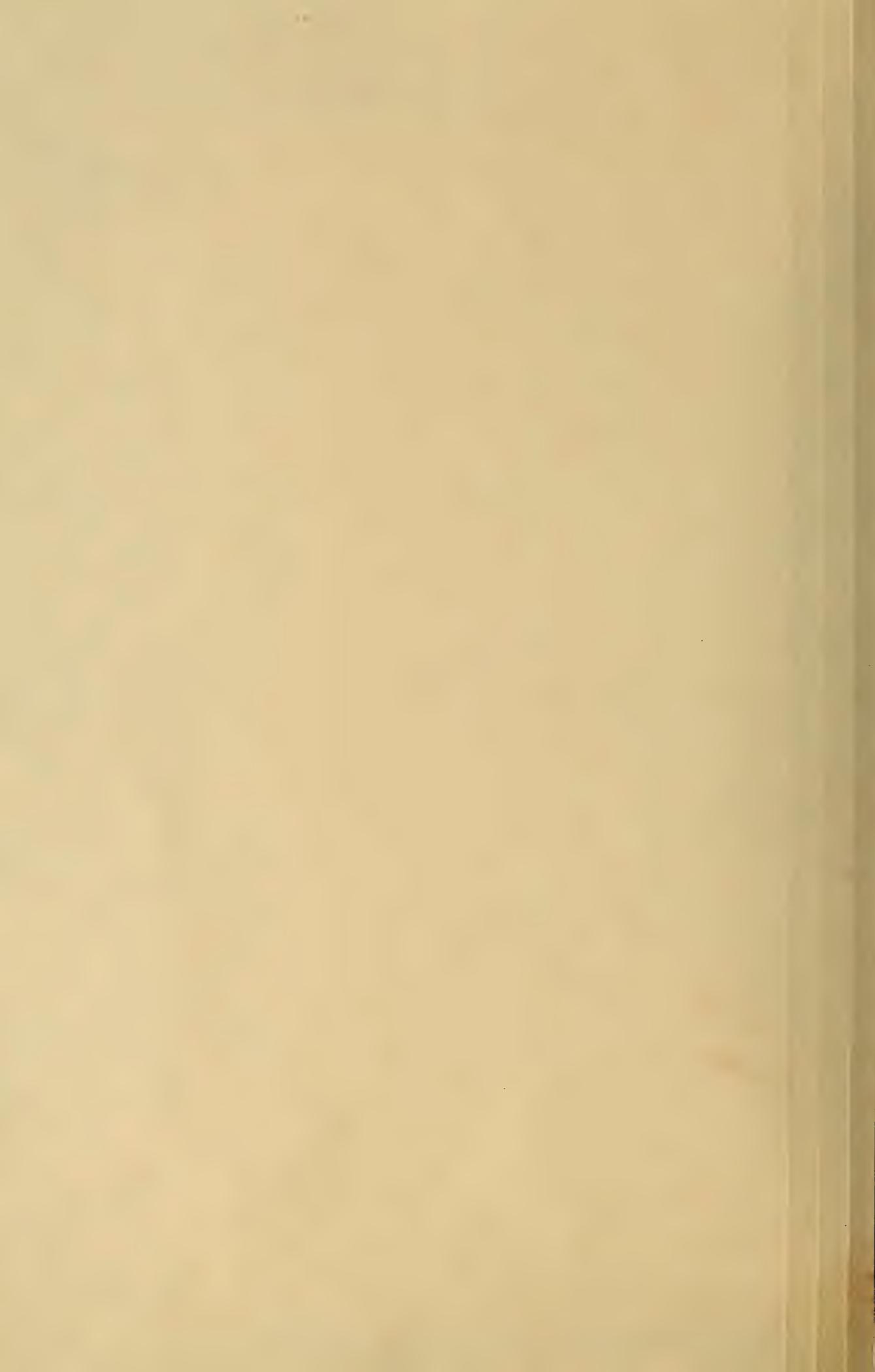
Quanto al primo fatto, io credo che gli erri non sieno possibili, e quando avvengono, siano da attribuirsi a mancanza di accuratezza nell'operatore, anziché all'operazione in sé stessa. In ogni specie di attività, e quindi anche in quella propria del chirurgo, sono possibili errori, ma questi non devono costituire fondamento di leggi speciali.

Quanto poi alle anomalie del colon, di cui i fautori della colotomia lombare si fanno argomento validissimo, ed intorno alle quali è stato tanto detto e scritto, io ho poco da dire. Ammetto che le anomalie in parola possano occorrere, ma tanto col metodo iliaco quanto col lombare sono le stesse, e le difficoltà operative esistenti per ambo le operazioni, quantunque possano essere di forma differente. Ma dal punto di vista chirurgico l'anomalia di sede del colon è un fatto così sfavorevole al metodo lombare che all'iliaco? Per mia esperienza devo rispondere di no, poiché in 170 casi, finora da me osservati, non mi sono mai imbattuto in condizioni tali da produrre serio ostacolo, e molto meno da rendere l'operazione non favorevole nel risultato. In alcuni casi dovetti prolungare l'incisione in avanti ed andare ad afferrare il colon al distretto superiore della pelvi, aprendo perciò il peritoneo, ma dopo suturati i margini della incisione per-



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i quali come *ultima ratio* sono indispensabili. E, per adoperarli razionalmente, occorre che, insieme con le cause predisponenti, si ricerchino in ogni singolo caso le cause immediatamente occasionali dell'agripnia ed a questa si conformi la terapia ipnotica individuale.

La causa dell'agripnia è l'eretismo cerebrale, in quanto che l'organo psichico soggiace all'azione consecutiva degli stimoli del lavoro del giorno. Per calmare questo eretismo, oltre ad una giusta dietica, al riposo del cervello, alla calma campestre, è da accettare buono effetto dal bromo, dalla piscidia, dal solfonale, dalla valeriana, dai bagni tiepidi usati la sera.

I semicupi, e in generale i procedimenti idropatici con bassi gradi di calore, riescono piuttosto eccitanti che calmanti e non sono da raccomandare che come cura consecutiva.

Se sono in ginocchio processi emotivi nella coscienza, non si può aspettar sussidio che da una terapia psichica, estetizzante. In questo caso sono indicati oppio e la morfina, eventualmente avvalorati dal bromo, dalla piscidia, dal solfonale. Nei casi miti e con energia di associazione sufficientemente forte si può deviare il corso dei pensieri col ricordare poesie ecc.; le letture leggierie riescono calmanti e menano al sonno desiderato.

In molti neuropatici la paura dell'insonnio è la causa della reale mancanza del sonno. Gli infermi potrebbero propriamente dormire, ma l'aspettazione, se ciò accade realmente, li tiene in tensione ed eccitamento e fuga il sonno.

Ecco il giusto canone della terapia psichica, in quanto che l'ipnotico fino allora efficace, senza che l'infermo lo sappia, viene notevolmente diminuito nella dose, o si finge d'inniettarlo, o si dà all'infermo un rimedio affatto indifferente, p. es. mollica di pane, con la necessaria circospezione e raccomandazione.

In analoga maniera psichica, cioè calmante sul morale degli infermi, agiscono i confetti degli omeopati, l'elettro-neuropatia di Mattei e simili. In tali casi giova la fiducia, quando è scoccata da una occasione favorevole, p. es. ottenere accidentalmente il sonno con un rimedio p. s. è indifferente.

In tutti i neuropatici, che soffrono insonnio ed usano ipnotici eroici, il medico coscienza dovrebbe di tempo in tempo provare il reale bisogno di tali rimedi. Spesso una simile prova la dà l'infermo medesimo, trovandosi il mattino seguente ancora intatto l'ipnotico permesso. Non si privi l'infermo di questo sussidio morale, ma ad ogni modo allora è tempo di diminuire la dose o di sostituire al medicamento attivo uno che sia tale in apparenza.

Causa frequente dell'agripnia dei neuropatici sono le sorgenti di eccitamento periferico. I narcotici, rendendo insensibili gli organi centrali, sono qui certo rimedi sovrani, specialmente la morfina per iniezione, che agisce prontamente e per lo più sicuramente; ma spesso si può risparmiare questa terapia brusca e non inaudita ed ottenere l'effetto desiderato in una maniera più mita.

Nelle palpazioni di cuore e nel molesto senso di pulsazione all'epigastro e nei visi sono da sperimentare come rimedi

fisici il bagno tiepido, la fascia addominale e quello sui polpacci.

Dei medicamenti sono opportuni il bromo e la piscidia, possibilmente anche l'ipnopo.

Come rimedi più miti si raccomandano l'acqua di lauro regio ed i preparati di valeriana. Anche il monobromuro di canfora in suppositori (0,7) non pare inefficace.

Nelle iperestesi muscolari (*anxieta ti biacuta*) pare raccomandabile il bagno tiepido, il leggero massaggio, il monobromuro di canfora, l'estratto di cicuta, la bella onna; in caso di forte e generale iperestesia muscolare la chimina associata alla morfina per uso ipodermico.

Le condizioni paralgiche e nevralgiche cedono molte volte ai preparati salicilici, al salolo ed all'antipirina, in casi gravi alla morfina.

Spesso l'agripnia deriva dallo stomaco. Nel tempo che si vuol dormire la digestione non è ancora compiuta e molte volte turbata da disordini dispeptici. Qui devevi attentamente invigilare alla dietica del pasto della sera e provvedere eventualmente con preparati di soda. Può riuscir bene anche la fascia addominale.

I disturbi spastici riflessi (cistospasmo, contrazioni muscolari ecc.), cedono al bromo e in certo circolo anche al monobromuro di canfora (*per anam*) con o senza belladonna ed oppio.

Specialmente spesso è eccitata la sfera sessuale, costituendo un ostacolo al sonno. Quando la causa è centrale (esagerata *trihido sexualis*), il bromo conviene in grandi dosi, ed altresì quando la causa è periferica; eventualmente si ricorrerà ai semicupi freschi, al monobromuro di canfora, alla belladonna, alla luppolina ed all'applicazione dell'anode al perineo.

LAVORI E LEZIONI ORIGINALI

R. UNIVERSITÀ DI CATANIA. Sul parassiti della malaria. Aggiunta alla nota preliminare. Prof. R. FELETTI e B. GIASSI.

Parecchi lavori pubblicati in questi ultimi giorni, e particolarmente due, uno di Celli e Marchiafava e l'altro di Canalisi, riguardanti le *Laveraniae* (forme similari), ci persuadono a fare una aggiunta alla nostra nota preliminare.

Noi finivamo sostenendo che, secondo ogni *verosimiglianza*, semilune (*Laveraniae*) e corpi pigmentati (1) (*Haemamoebae*) rappresentano generi differenti. Questa nostra opinione, che riteniamo l'unica plausibile nello stato attuale delle nostre cognizioni sulla malaria, ci sembra fortemente appoggiata da tutte le ricerche finora pubblicate. Con essa armonizzano anche le nostre osservazioni cliniche che vogliamo qui riassumere. A Catania la seconda stagione malarica è cominciata in settembre (dopo le prime piogge), e tutti i casi, caduti sotto il nostro esame, furono fin da principio ben distinti in febbri regolari

(1) Gli autori veramente denominano corpo pigmentato anche il plasmodio pigmentato e quindi anche le giovani *Laveraniae*.

(con presenza nel sangue dell'*Haemamoeba*) ed in febbri irregolari (colla *Laverania*). In questi ultimi casi noi trovammo le semilune più o meno numerose; talora invece scarsissime, ma sempre presenti, quando l'esame del sangue fu prolungato a sufficienza (4-10 preparati). Si noti che alcuni ammalati di *Laverania* ci si presentarono prima d'aver presa la chimina, o già al quarto giorno da che la febbre era comparsa per la prima volta, ed essendo primitiva l'infezione. È bene ripetere che gli individui, nel cui sangue furono viste fin da principio le *Laveraniae*, le presentarono costantemente in seguito e le presentano ancora oggi, che son passati parecchi mesi. Quelli invece che avevano *Haemamoebae*, presentarono sempre questi parassiti nei loro differenti stadi di sviluppo. Un individuo affetto da quarantena, arrivò a circa 25 accessi senza che mai mostrasse nel sangue una sola *Laverania*. Così pure avemmo casi di guarigione spontanea, o prodotta colla chimina, di febbri terzane e quarane, senza comparsa della *Laverania*.

Come si vede tutti questi fatti (in gran parte anche da altri Autori osservati) tendono a dimostrare la diversità e l'indipendenza della *Laverania* dall'*Haemamoeba*.

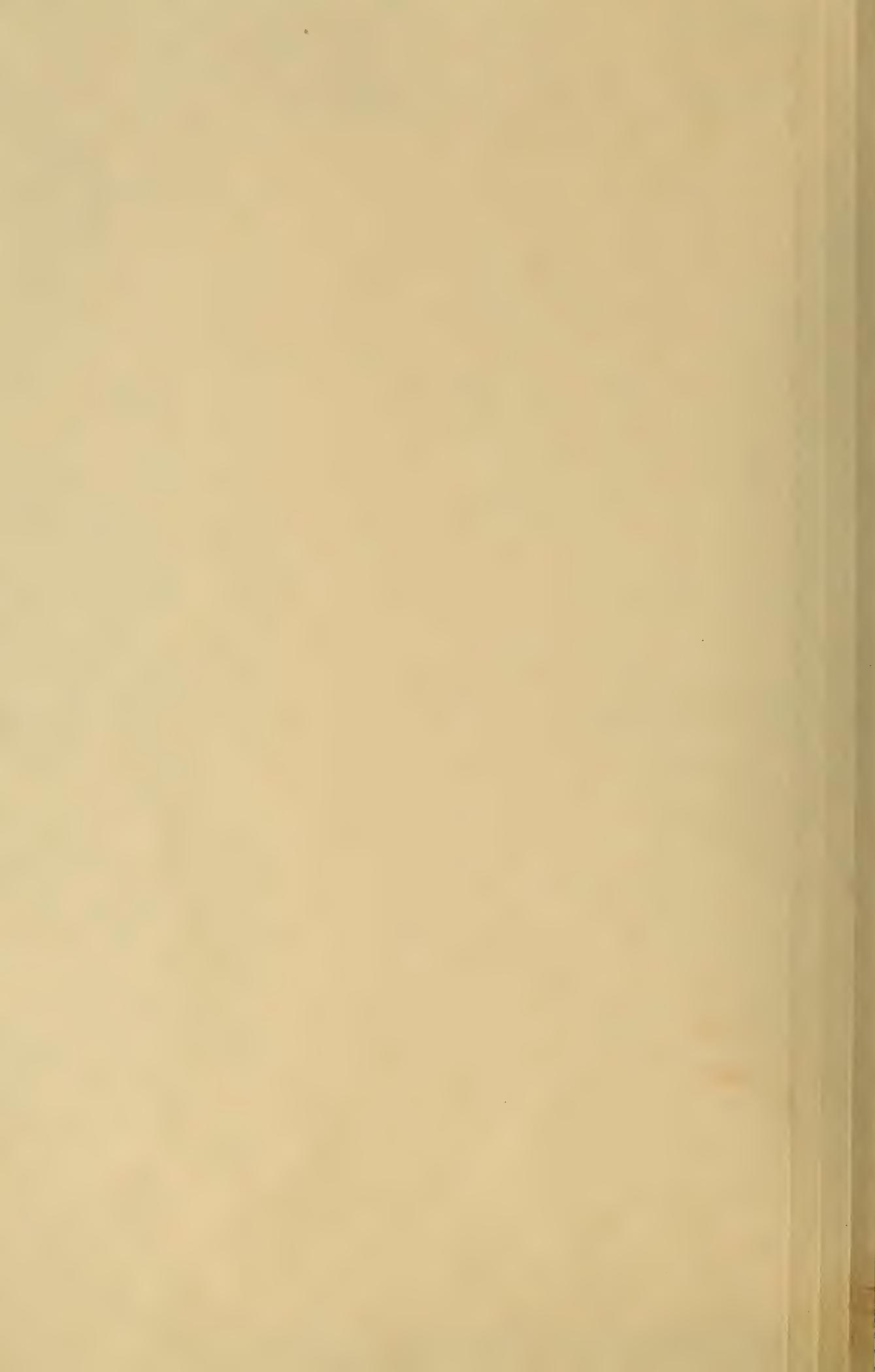
Riguardo al numero delle semilune, ecco quanto abbiamo osservato nel sangue cavato dal polpa-strello. Generalmente quando le semilune erano molto numerose, presto (al più tardi tra quattro giorni) sorgeva la febbre e di solito piuttosto forte; il periodo febrile soleva presentarsi o con parecchi accessi ravvicinati, o con uno solo lungo. Dopo questi accessi le semilune riscontravansi ancora, ma più o meno scarse; successivamente, perdurando il periodo d'apiressia, per 5-8 giorni tornavano ad aumentare. Una sola volta vedemmo diminuire notevolmente il numero delle semilune, senza che la febbre fosse comparsa. Parecchie altre volte, pur essendo molto scarse le semilune, vedemmo comparire la febbre. In complesso è però evidente che in corrispondenza alla febbre scompare una certa quantità di semilune, e tante più ne scompaiono quanto più violenta è la febbre, e quanto più numerosi sono i sopraindicati accessi ravvicinati.

In qualunque momento il sangue degli ammalati affetti di *Laverania* offre qualche semiluna che ha già assunta, o che assume sotto al microscopio, la forma tondeggianta, e può anche muoversi dei così detti flagelli, specialmente se la temperatura è molto opportuna (da 20° a 35° C.). Quando un accesso forte di febbre è venuto ad appena cominciato, il numero delle semilune, già tonde o che diventano tonde, ci appare sempre maggiore.

Che i così detti corpi flagellati esprimano un fenomeno non fisiologico persistiamo a crederlo, per le ragioni allora volta esposte.

E ciò, nonostante che li abbiamo visti





prodursi molto prontamente tenendo il sangue a 38° C. sul tavolino riscaldabile di Löwit. Avemmo in queste esperienze la precauzione di raccogliere il sangue tra vetrini riscaldati a circa 38° e di chiudere anche talvolta i preparati con paraffina. Ma con tutto ciò non crediamo a dover eliminato le cagioni che valgono a produrre il fenomeno in discorso (forse il salto di temperatura).

Riguardo alla morfologia delle semilune, dobbiamo far notare che il nucleo non è sempre eccentrico; anzi per osservazioni ulteriori possiamo asserire che in quasi tutte è centrale.

La membrana della semiluna è isolabile, e vari casi di formazione delle semilune, anche da noi seguiti, ci hanno confermato nella persuasione che veramente essa spetta al globulo rosso. Ciò risulta anche dal nuovo lavoro di Marchiafava e Celli.

In quanto alla riproduzione della Laverania, ecco le nostre osservazioni.

Prima di tutto neghiamo la gemmazione ammessa da Celli, Guarneri ecc. I fatti da loro osservati sono esatti, ma la loro interpretazione per noi è insostenibile, soprattutto perchè le così dette gemmule sono corpuscoli senza traccia di nucleo; poi perchè si producono indipendentemente dal nucleo delle semilune.

In secondo luogo è indubitato che certe semilune, per lo più evidentemente quelle che tendono a diventar rotonde, o che già lo sono, hanno un corpuscolo nucleiforme (ossia una quantità di cromatina) molto più grande delle altre, o con forma che accenna a divisione, o già diviso in 2 o in 4. Questo aumento di cromatina e la tendenza a dividersi, o la già avvenuta divisione, trovano riscontro nei fatti da noi osservati per l'Haemamoeba ed eridentemente indicano che si prepara la segmentazione. Noi però non siamo riusciti a vedere nel sangue cavato dal dito i diversi stadi di segmentazione. Soltanto una volta in un malato di Laverania (infezione primitiva) che presentava un'enorme quantità di semilune e che noi avevamo studiato minutamente per due mesi e mezzo, abbiamo visto all'inizio d'un accesso febbrile due forme, l'una di scissione appena cominciata e l'altra di scissione compiuta. Rasmigliavano a corpi in segmentazione delle febbri regolari; e nella seconda forma, oltre al residuo formato dal pigmento, si contavano non meno di 8 gemmospore ovalari, ognuna col proprio nucleo.

Per quanto poi abbiamo cercato tante e tante volte, null'altro abbiamo potuto trovare: in ciò collimano interamente le nostre osservazioni con quelle di Marchiafava e Celli.

Quindi anche noi riteniamo che la Laverania si segmentino come le Haemamoebae (1), ma sospettiamo che la loro

segmentazione abbia luogo nel midollo delle ossa, confortati in questa supposizione dalle ricerche de Danilewskij sui rettili. Del tutto accidentale è, secondo noi, la comparsa nel sangue periferico delle sopradette forme di segmentazione. In complesso, a nostro parere, neanche lo sviluppo delle semilune avviene, almeno in gran parte, nel sangue periferico.

Ed invero è cosa rara trovar Laveraniae in via di sviluppo nel sangue estratto dal dito, eccettuato il primo stadio (amebule non ancora pigmentate, o con pochi corpuscoli di pigmento, e forse non distinguibili da quelle delle Haemamoebae).

Non vogliamo tacere che noi sospettiamo siasi presentata a Marchiafava ed a Celli, e forse anche a noi in alcuni casi, un'altra Haemamoeba, diversa da quella della terza e della quarta (1).

Mentre i fatti da noi osservati si accordano sempre con quelli di Marchiafava, Celli e Guarneri ecc, noi non sappiamo conciliare le nostre osservazioni con quelle del Canalis. Egli avrebbe visto facilmente la segmentazione della Laverania nel sangue periferico: questa segmentazione si compirebbe, come risulta evidente specialmente dalle figure del Canalis, senza che ciò, che noi riteniamo indiscutibilmente nucleo, vi pigliasse parte alcuna. È inutile soggiungere che quest'ultimo fatto non sarebbe secondo noi possibile.

RIVISTA DELLE CLINICHE E DEGLI ISTITUTI SCIENTIFICI

CLINICA TERAPEUTICA DI EDIMBURGO (Prof. FASSER). — Sull'azione analgesica della metilacetanilide od esalgina.

« Il allontanamento, in questa lezione, apparentemente degli argomenti che sogliono formare l'ordinario oggetto dei nostri studi, perchè mi sembra che lo studio di quegli agenti, i quali servono a curare un sintoma tanto importante quale è il dolore, sia intimamente collegato con la clinica, e contribuisca a rafforzare la fiducia nella nostra scienza.

Limitandoci al campo degli agenti farmaceutici, noi riconosciamo, come i più importanti rimedi analgesici, l'oppio ed i suoi alcaloidi, la belladonna, lo stramonio, l'aconite, la cocaina, i bromuri, gli oli volatili, il clorofornio, l'etero, il cloralo ed altri anestetici ed ipnotici generali artificialmente ottenuti. Intanto i nostri studi farmaceutici ci pongono in grado di affermare che gli effetti ottenibili da tutti questi agenti non sono semplici ed innocui. Molti di essi, quali l'oppio e la belladonna, riescono analgesici, ma quest'azione è accompagnata da altri effetti non desiderati né desiderabili. Altri agiscono sol-

tanto se applicati localmente, e questa applicazione locale spesso riesce impossibile, ovvero difficile. Ed, oltre a ciò, il dolore è una sensazione alla cui produzione non è necessario che partecipino tutte le parti del sistema nervoso cerebro-spinale, e nemmeno i gangli sensitivi nel cervello o tutte le fibre di un nervo di senso; e conseguentemente non è necessario, perchè venga curato, che si agisca su più di uno o di pochi elementi del tessuto nervoso sensitivo. Insomma il dolore è funzione di sistemi di fibre di un centro speciale affatto individualizzato, la regione dell'ipocampo del Ferriar; per cui lo studio della terapia deve tendere ad agire direttamente su di questi sistemi e centri, lasciando non influenzate le altre parti del sistema nervoso. Una analgesia di questa specie attualmente è ottenibile con l'uso di composti chimici recentemente scoperti, specialmente di parecchi composti nelle serie aromatiche dei composti di carbonio.

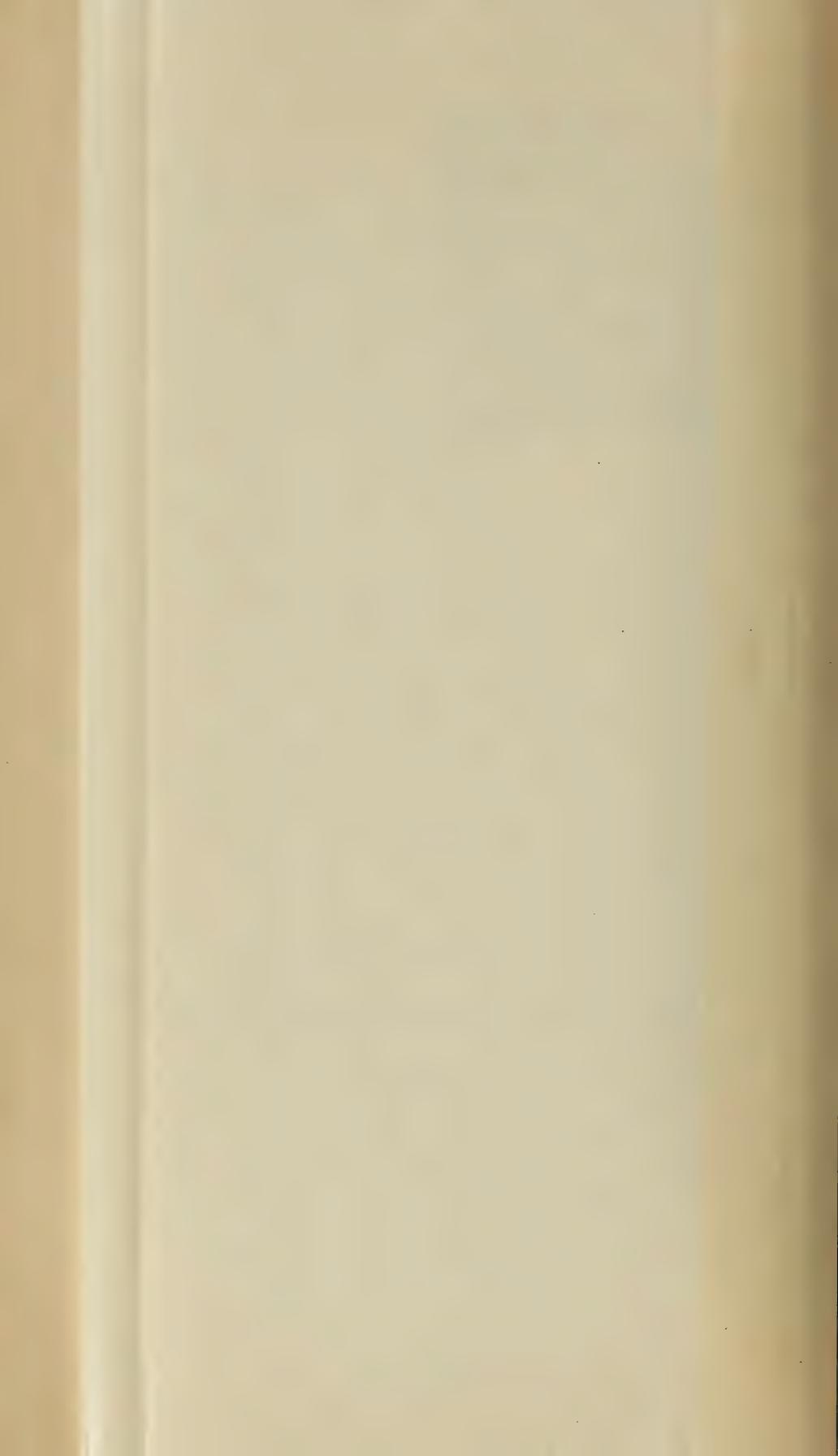
Probabilmente i composti salicilici furono quelli nei quali prima si studiò l'azione analgesica, se non si vuol tener presente che l'azione calmante dei dolori, sempre riconosciuta nei sali di chinina, debba ritenersi della stessa natura, essendo questi sali un prodotto naturale delle stesse serie chimiche.

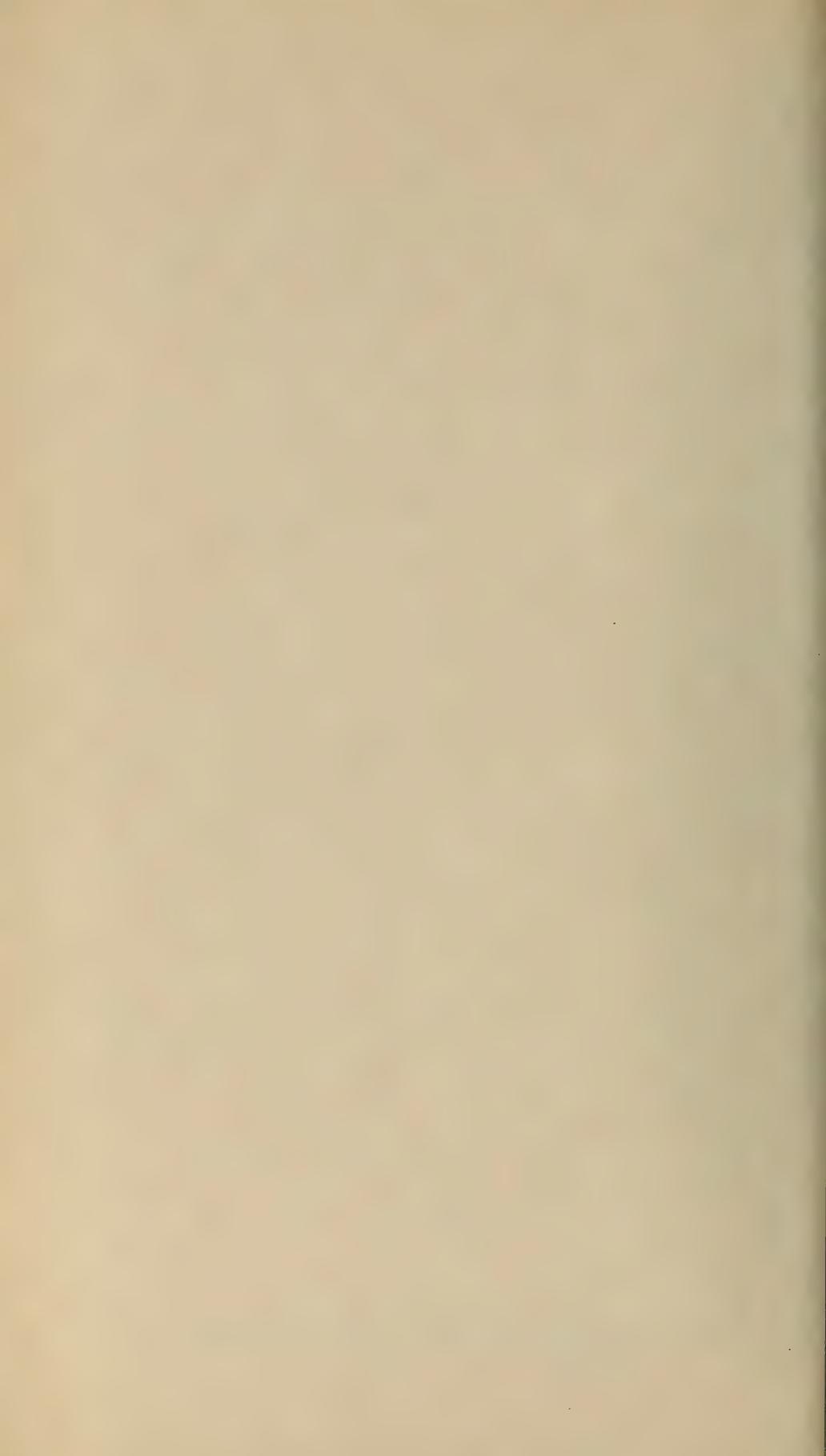
In generale però la proprietà analgesica di molti di questi composti aromatici è secondaria alle proprietà antipiretiche, diaforetiche, ed antisetiche, più particolarmente inerenti ad essi, e non si ottiene se non con grandi dosi. Quindi l'uso di questi composti a scopo analgesico, a simiglianza di ciò che si verifica con l'oppio e con altri farmaci simili, ha degli inconvenienti, che li rendono pericolosi. Perciò i bisogni della terapia non sono da essi completamente soddisfatti, poichè, mentre riescono a sedare il dolore nevralgico per la loro azione sul tessuto nervoso conduttore o recettore delle sensazioni dolorifiche, essi producono, nelle dosi necessarie ad ottenere l'effetto predetto, altre azioni, che non hanno nulla da fare con l'azione analgesica, e che possono inoltre riuscire dannose all'infermo. Questi vantaggi sono già riconosciuti nell'antipirina e nell'antifebrina, composti che probabilmente sono i più efficaci analgesici di questa serie. L'analgesia da essi prodotta con dosi rilevanti non va mai scompagnata da disturbi gastrici, ottusità di udito, sudore profuso, disturbi circolatori ed alterazioni del sangue.

Gli studi dei vari componenti di questo serie aromatiche hanno intanto dimostrato che lievi modificazioni della loro costituzione chimica possono dar luogo a notevoli cambiamenti nella loro azione farmaceutica. L'antifebrina od acetanilide, infatti, combinata al metile, forma un nuovo composto, la metilacetanilide, il quale ha proprietà analgesiche molto superiori all'acetanilide, da cui è derivato, e con dosi di molto inferiori, sicchè non produce nessuno di quegli accidenti spiacevoli, che necessariamente tengono dietro all'uso delle dosi massime.

La metilacetanilide od esalgina è uno dei quattro derivati della combinazione del metile con l'acetanilide, scoperti dall'Hoffmann nel 1874. Gli altri tre sono: Porto, la metta e la paracetanilide. La sua formula è CH_3NO . Bolle ad 83°, 85°, coll'acido nitrico concentrato forma una soluzione quasi incolore, la quale col riscaldamento diviene giallo-brillante, ma non ha svolgimento vapori irritanti. Si presenta in aspetto di cristalli agghiformi di notevole lunghezza, di odore fortemente aromatico, e di sapore leggermente pungente. È quasi insolubile nell'acqua, solubile nell'alcol rettificato od anche allungato. Io mi sono servito di una soluzione idro-alcolica, contenente cinque centigrammi per ogni cucchiaino di liquido.

(1) Di riferisce forse la Laverania dall'Haemamoeba sospinto in ciò che questa resta in riposo (ameba in ri-







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