ON FAHRENHOLZ'S PURPORTED NEW SPECIES, SUB-SPECIES AND VARIETIES OF *PEDICULUS*.

A CRITICISM OF METHODS EMPLOYED IN DESCRIBING ANOPLURA.

By GEORGE H. F. NUTTALL, Sc.D., F.R.S.

(*From the Quick Laboratory, University of Cambridge.*)

(With 2 Charts.)

CONTENTS.

INTRODUCTION.

The object of this paper is to draw attention to certain grave sources of error underlying the present mode of differentiating Anoplura[1] and more especially species of the sub-order Siphunculata. I am unable to say if the criticisms herewith advanced apply equally to the methods employed in differentiating members of the sub-order Mallophaga, because I am not familiar with the latter group, but the two sub-orders mentioned are in many respects so closely allied that it appears difficult to avoid the suspicion that the considerations herein contained may apply equally in both cases.

Fahrenholz is a recognized authority on Anoplura, he has dealt with the group in *Das Thierreich*, and consequently is in a position to mislead others who may concern themselves with the study of these ectoparasites.

[1] The order Anoplura Leach, 1817, includes two sub-orders: Mallophaga and Siphunculata (see Nuttall, *Parasitology*, XI. 332).

Until recently, owing to the war, most of Fahrenholz's publications herein referred to were rendered inaccessible to me, otherwise their consideration would necessarily have been included in my previous paper (*Parasitology*, XI. 329–346).

The subject-matter that follows has been arranged by me in three sections dealing with (1) Fahrenholz's descriptions of supposedly new species, etc., (2) my detailed criticism thereon, and (3) my conclusions therefrom in respect to the synonymy of *Pediculus humanus*.

I.

FAHRENHOLZ'S EVIDENCE IN SUPPORT OF THE VALIDITY OF HIS SPECIES, SUB-SPECIES AND VARIETIES OF *PEDICULUS*.

In considering the forms described by Fahrenholz, it appears convenient to class them in two groups:

(*a*) Lice derived from man.

Pediculus humanus race *corporis* (mihi).

P. nigritarum Fabricius 1805. Regarded by Fahrenholz as a variety (1915) and subsequently as a sub-species (1916).

P. humanus chinensis Fahrenholz 1916. A sub-species.

P. humanus marginatus (Fahrenholz 1915) Fahrenholz 1916. A sub-species.

"*P. humanus humanus* L." of Fahrenholz 1917. A sub-species.

Pediculus humanus race *capitis* (mihi).

P. capitis angustus (Fahrenholz 1915) Fahrenholz 1916. A sub-species.

P. capitis maculatus (Fahrenholz 1915) Fahrenholz 1916. A sub-species.

"*P. capitis capitis* de Geer" of Fahrenholz 1917. A sub-species.

(*b*) Lice derived from apes and monkeys.

P. schäffi Fahrenholz 1910.

P. oblongus Fahrenholz 1913, subsequently renamed *assimilis* (see below).

P. friedenthali Fahrenholz 1916.

P. lobatus Fahrenholz 1916.

P. assimilis Fahrenholz 1919 (= *oblongus* renamed).

(*a*) Lice derived from man.

In support of his contention that the lice occurring on various races of man constitute distinct sub-species, Fahrenholz (1915, p. 591 *et seq.*) cites Fabricius (1805), Olfers (1816), Denny (1842), Pouchet (1841, pp. 204–5,

quoted by Küchenmeister, 1855, p. 438), O. Fabricius (from Schiödte, 1854), Wallace (1853), Küchenmeister (1855), Murray (1861), and Lumholz (1892).

I have been able to verify the references to Fabricius, Denny, Schiödte and Wallace, those to Pouchet and Lumholz were only accessible in other editions of their works, whilst Olfers and Küchenmeister have proved inaccessible to me.

According to Küchenmeister (1855), Pouchet (1841) regarded the lice of negroes as a distinct species, but I find that Pouchet (1832, p. 412) makes no such statement. Fahrenholz cites Wallace as believing that Amazon Indian lice differ from those of Europeans, but Wallace (1853, p. 244) expresses himself cautiously, stating only that they are "probably a distinct species from that of our own country." Küchenmeister (1855, p. 428, Pl. IX, figs. 9–15) examined *nits* on the mummies of a New Zealander and Peruvian, and measured the claws of the therein contained louse embryos, finding as he supposed that they differed from those of European lice. Fahrenholz (1915, p. 593) remarks that to Küchenmeister undoubtedly belongs the credit "auf den *tatsächlich vorhandenen Längenunterschied in den Krallen der Läuse verschiedener Menschenrassen* hingewiesen zu haben[1]."

Schiödte (1854, p. 154) merely *supposed* that the Greenlander's lice, referred to by O. Fabricius, probably constituted a distinct species like those on negroes, but O. Fabricius (1780, p. 215) makes no mention, I find, of these lice being different from those on Europeans.

Lumholz (1889, p. 117, English edition) states that the head and body of most Australian natives are heavily infested with rather large dark lice that are "quite different from the common *Pediculus capitis*"; Lumholz did not become infested with the Australians' lice though they were dropped about in plenty.

We may now consider in some detail the characters which Fahrenholz, in his various publications, ascribes to the forms he distinguishes:

***Pediculus nigritarum* Fabricius 1805.**

Synonyms:

P. nigritarum Fabricius 1805, p. 340.

P. nigrescens Olfers 1816 (*fide* Fahrenholz).

P. corporis var. *nigritarum* (Fabricius 1805) Fahrenholz 1915, p. 597, fig. 1 (sternal plate).

P. corporis nigritarum (Fabricius 1805) Fahrenholz, VII. 1916, p. 270. Designated as a sub-species for no apparent reason (*vide supra*).

[1] The italicized passages in the quotations from Fahrenholz throughout this paper are printed in spaced type by that author.

N.B. The sign ● introduced by me into citations from Fahrenholz indicates that I challenge the value of the statement he makes. Refer to my adverse criticisms as to the validity of the characters he gives in his diagnoses. See pp. 143 *et seq.*

In my previous papers, whilst I quoted Fabricius (1775 and 1794), I omitted to cite his publication of 1805 to which my attention has since been drawn by a reference of Fahrenholz's (1915). On consulting Fabricius (1805), I find that he describes lice from negroes as *P. nigritarum* n.sp., distinct from *P. humanus*:

Habitat in Nigritarum corpore. Dom. Smidt. Mus. Dom. Lund.

Paullo minor P. humano. Caput magnum, planum, laeve, triangulum, antice, subbifidum, atrum. Corpus subrugosum, atrum, immaculatum.

Therefore, as Fahrenholz notes, Fabricius appears to be the first to have regarded the lice of negroes and Europeans as distinct species. Denny (1842, p. 15) states that Latreille "designated" *P. nigritarum* as a species; Fahrenholz, however, finds no record of Latreille having created this supposed species.

Olfers (1816, Pars I, p. 81, cited by Fahrenholz 1915, p. 591) regarded lice from Ethiopians as a distinct species which he named *P. nigrescens*. Fahrenholz is almost right in regarding *nigrescens* as "doubtless" a synonym of *nigritarum*.

Fahrenholz degrades Fabricius's *nigritarum* to a variety of *corporis* and ventures to describe the variety from a *single* ♀ which he assumed represents the form named by Fabricius. Fahrenholz states that his specimen (from the Tana region) represents a distinct variety differing from negro head-lice as follows: Antennae not linear like European body-lice, but of inverted pear-shape ("umgekehrt birnförmig")●; sternum present●; the last abdominal segment bears two brown plates dorsally (as in negro head-lice)●.

P. humanus chinensis Fahrenholz 1916.

A sub-species.

Fahrenholz (x. 1916, p. 87) states of this form that it occurs on Chinese, is "*distinctly larger*"● than "*P. humanus marginatus*" (*vide infra*), and has finely dentate claws.● Of the ♂ he writes: "*schwachen Querplatten auf dem Abdomen*●, *aber auch mit gut entwickelter Genitalplatte*●. *Sternum vorhanden*●. Allgemeinfärbung bräunlich-gelb (in balsam)●.—Lebt auf Chinesen."

Fahrenholz (1917, pp. 2, 6 and text-fig., reprint) states that he identified specimens of this form at the Hamburg Museum[1]. They came from Fokim, China, and he assumes that the host was a Chinese. He comments that they are "distinctly different from those on Japanese" and gives elaborate measurements and a figure of the ♀ sternum with two hairs anteriorly but no "holes"●.

[1] The lot also contained some examples of *capitis* "die vielleicht ebenfalls einer neuen Unterart angehören" (!).

***P. humanus marginatus* (Fahrenholz 1915) Fahrenholz 1916.**

A sub-species.

Synonyms:

"*P. corporis* de Geer var. *marginatus* n.var." Fahrenholz 1915, p. 599.

P. humanus marginatus Fahrenholz VII. 1916, p. 270, and X. 1916, p. 87.

Lice from Japanese, which Fahrenholz believes to be identical with the form described by Murray (1861) as having no spine on leg I. Fahrenholz found, however, that a spine is present and was doubtless lost in the preparation of Murray's specimen. When mounted in balsam, the lice appear pale yellow●, black-brown at the sides of the abdomen●, and in places on the head●. The sternum is "totally absent●." The ♂ shows no ventral plates●; whilst of the dorsal bands only the anterior one of each segment is well developed, the posterior one being scarcely visible●; *these bands do not occur in European body-lice*●, compared to which they are somewhat smaller●. In his two papers of 1916, Fahrenholz raises his variety to the rank of a sub-species, and adds (X. 1916, p. 87): It is much smaller than the European louse● and has claw I dentate●. "Am Abdominalrande schwarzbraune Chitinleisten●. *Sternum fehlt* vollkommen●, ebenso beim ♂ die Genitalplatte●. ♂ im Gegensatz zur Europäerlaus *mit Querplatten* auf dem Abdomen●. Allgemeinfärbung gelblich●.—Lebt auf Japanern."

"*P. humanus humanus* L." of Fahrenholz 1917.

A sub-species.

This new form of terminology, for which Linnaeus need not be held responsible, is applied by Fahrenholz (1917, p. 1, reprint) to specimens in the Hamburg Museum labelled "Negerläuse aus Sansibar." Fahrenholz greatly doubts their recorded origin because they are similar to European body-lice, which, as a piece of special pleading, is difficult to match. He writes: "Der Wirt ist mir sehr zweifelhaft, da die Individuen keine Abweichungen von typischen Europäerläusen aufweisen●."

***P. capitis angustus* (Fahrenholz 1915) Fahrenholz 1916.**

A sub-species.

Synonym:

"*P. capitis* de Geer var. *angustus* n.var." Fahrenholz 1915, pp. 597–8, Pl. XXI, fig. 1 (photo of ♀), text-fig. 2 (♂ abdomen in dorsal aspect).

This form, found on Japanese, is described from balsam-mounted specimens (♂ ♀), Fahrenholz stating that the colour is distinctive●. The ♂ shows dorsal bands●, brown sternum●, and genital plate● which are absent in European lice●; claw I is longer and more curved than in the ♀, and finely toothed irregularities only occur in place of teeth●.

In his two papers of 1916 Fahrenholz raises his variety to the rank of sub-species, terming it *P. capitis angustus* in the first paper (VII. 1916, p. 270), and *P. corporis angustus* in the second (x. 1916, p. 88, *corporis* being obviously printed in error for *capitis*). To the earlier description he adds that *angustus* scarcely attains the size of European *capitis*●, but is *much narrower*, appearing much slenderer●. Claw I is very long and dentate●. "Allgemeinfärbung hellgelb●; Chitinisierung gut entwickelt; Randplatten des Abdomens tiefschwarz●. *Querplatten des Abdomens beim ♂ sehr deutlich*●; desgleichen die Genitalplatte●. Sternum vorhanden●, aber Ränder undeutlich."

Fahrenholz (1917, p. 2, reprint) refers to specimens of *angustus* at the Hamburg Museum.

Pediculus capitis maculatus (Fahrenholz 1915) Fahrenholz 1916.

A sub-species.

Synonym:

"*Pediculus capitis* de Geer var. *maculatus* n.var." Fahrenholz 1915, p. 598, Pl. XXI, fig. 2 (photo of ♀), fig. 3 (photo of ♂), text-figs. 3, 4 (♂ venter, ♀ sternum).

This form, emanating from Cameroon negroes, is described from balsam-mounted specimens (♂ ♀). The lice have a light yellow colour● in which they differ at once from lice on Japanese. Pleurae broader than in Japanese lice●. ♂ with dorsal bands dark brown●, sternum●, genital plate● and ventral band clearly defined●, four holes in the sternum bearing hairs●. ♀ with two brown spots dorsally on last abdominal segment● (as in *Haematopinus*); sternum clearly defined●, with two holes anteriorly bearing hairs●.

In his papers of VII. 1916, p. 271; x. 1916, p. 88, and 1917, p. 2 (reprint), he raises the variety to the rank of a sub-species, stating (x. 1916, p. 88) that the general form is distinctive, being shorter than "*P. capitis angustus*" (*vide supra*)●; whilst the ♀ is "*broader than European capitis*●." "Gut unterschieden durch hellbraune Grundfärbung●[1]. Chitinisierung äusserst kräftig; *vordere Randplatten des Abdomens verbreitert*●. Querplatten auf dem Abdomen des ♂ dunkel braun●, desgleichen die Genitalplatte● und *mediane Ventralplatte des II Segments* (our ventral band)●. *Sternum deutlich* gerandet●. Lebt auf Negern (Kamerun); eine etwas abweichende Form auf Hottentoten[2]."

"*Pediculus capitis capitis* de Geer" of Fahrenholz 1917.

A sub-species.

Term applied by Fahrenholz (1917, p. 2, reprint) to specimens in the Hamburg Museum identified by Fahrenholz as such.

[1] Light yellow in his first description, light brown in his second.

[2] Another Fahrenholz variety which no doubt will presently be described.

(*b*) Lice derived from apes and monkeys.

***Pediculus schäffi* Fahrenholz 1910.**

This form was described by Fahrenholz, 1910, p. 57, Pl. III, figs. 2, 6, and text-fig. 1 (eggs); host: *Simia troglodytes*. The species was condemned and "regarded provisionally" for reasons specified by me (*Parasitology*, XI. 336–7) as = *P. humanus* race *schäffi* (Fahr.). I see no reason to change my opinion.

***Pediculus friedenthali* Fahrenholz 1916.**

The author states (X. 1916, p. 88) that this form occurs on *Hylobates mülleri*. He only describes the ♀ which "much resembles the head-louse of man." After dwelling on trivial points of detail he adds:

"Sternum fehlt●...*grösste Breite im V Segment*●...*Letztes Segment des* ♀ *breiter als lang*● so dass die Gonopoden in den Einschnitt desselben hineinragen. *Gonopoden sind nach hinten gerichtet* und stehen der Form nach in der Mitte zwischen denen von *P. capitis* und *P. humanus*●."

***Pediculus lobatus* Fahrenholz 1916.**

This form was named by Fahrenholz in 1913 (p. 373) but not described, the host being given as *Ateles pan*. Fahrenholz (X. 1916, p. 89) afterwards named the host *Ateles rellerosus* (sic) and described the louse (♂ ♀) as follows:

"Kopf ähnlich dem von *P. capitis*. Vorderkopf an den Seiten je eine dunkelbraune Platte●. Sternum fehlt●; Thorax ohne Borsten●; Abdomen sehr breit, mit tiefen Einschnitten (besonders beim ♀). ♂ mit zweiteiliger Genitalplatte (wie bei *P. capitis maculatus*)●: Letztes Segment des ♀ hat statt Ausschnitt nur einen feinen Schlitz●."

Prior to seeing the foregoing description, I had concluded (X. 1919, pp. 337, 340) that the form probably represents *P. humanus* race *capitis*. The description merely confirms me in this belief. Several lots of lice that I have examined from different species of *Ateles*, cannot, I find, be differentiated from ordinary *capitis*.

***Pediculus assimilis* Fahrenholz 1919.**

Synonym:

P. oblongus Fahrenholz 1916.

This form was named by Fahrenholz in 1913 (p. 373) but not described. He gives the hosts as *Hylobates concolor* (*mülleri*) and *Symphalangus* (*Hylobates*) *syndactylus*. Fahrenholz (X. 1916, p. 88) gives the host as *Hylobates syndactylus* Desm. and describes the ♀ only. Omitting the trivial details he gives, the diagnosis mentions the following supposedly specific characters:

"grösste Breite im VII Segment●...*Gonopoden* in Form denen voriger Art gleichend; die *nach innen gerichteten Spitzen* erreichen nicht den Einschnitt● des *letzten Segments, das in Länge und Breite gleich ist*●."

Fahrenholz (1919, p. 27) renamed the form *assimilis* finding the name *oblongus* preoccupied. This form was regarded by me (x. 1919, pp. 337, 340) as probably *P. humanus* race *capitis*, and I am confirmed in this belief by the foregoing diagnosis which has since become accessible.

II.

EVIDENCE DISPROVING THE VALUE OF THE CHARACTERS WHEREBY FAHRENHOLZ DISTINGUISHES THE BEFORE-MENTIONED FORMS OF *PEDICULUS*.

Of the older authors who have examined lice obtained from different races of man, Murray (1861), whom I have cited elsewhere (II. 1919, p. 206), did not venture to regard such lice as belonging to distinct species. He does not, however, distinguish clearly between head-lice and body-lice in reaching his conclusions. Piaget (1880, p. 623), who regarded *corporis* and *capitis* as separate species, in referring to the latter, fully appreciated its variability, for he wrote:

"Il ne me semble pas qu'il faille attacher beaucoup d'importance à ces différences. En examinant un plus grand nombre d'individus de la même race, il en sera probablement comme de ce que j'ai eu sous les yeux. Quelques individus avaient le côté interne de la griffe dentellé, d'autres entièrement lisse; la couleur passait du gris au jaunâtre. C'était le cas chez les parasites d'Européens et de Malais faisant partie de ma collection. Du reste, je ne vois pas que l'on puisse tirer de ces minimes différences quelque argument pour ou contre l'unité d'origine des races ou espèces humaines."

Neumann (1910, p. 411), who also quotes the foregoing passage from Piaget, lays stress on the need of examining many adult lice from various races of man before reaching conclusions. Having examined many such specimens, he concluded that "les transitions sont insensibles entre la forme type (européene) et les diverses formes exotiques et que l'on est porté à les réunir toutes en une espèce unique." The pigmented chitinous structures which possess great taxonomic value in Anoplura, correspond in lice from negroes "à des renforcements chitineux, incolores ou peu colorés chez le pou de l'Européen. Il en résulte que *P. capitis* est infiniment mieux caractérisé par les spécimens des races noires...."

It is remarkable that Fahrenholz should attach importance to the superficial statements of the earlier authors I have cited on p. 137 and not have taken a warning from the writings of vastly more careful observers like Murray, but especially Piaget and Neumann, whom I have just quoted.

The subject of the relation between *capitis* and *corporis* has already been discussed at length by me (*Parasitology*, XI. pp. 339 *et seq.*) and I see no reason to modify my statements in view of those of Fahrenholz's publications which have since become accessible to me in the original. I was thinking not only of Fahrenholz but also of others when I stated (*Ibid.* p. 333) that "Such

studies require the use of other methods than the usual one of treating specimens with caustic potash and mounting them in balsam." Fahrenholz's purported species of *Pediculus, i.e. schäffi, lobatus* and *oblongus* (= *assimilis*) were degraded by me (*Ibid.* pp. 334–340), the first to a race of *P. humanus*, whilst the others were merely regarded as probably forms of the variable race *capitis*. Of Fahrenholz's varieties of "*P. capitis*," *i.e. maculatus, angustus* and *marginatus* (since raised to the rank of sub-species by that author), I ventured "to assert that these names will not stand and that they will fall into the synonymy of *P. humanus*," also that they "are surely based on faulty observation." Already in an earlier paper (II. 1919, p. 208), referring to the three above-mentioned varieties, I wrote: "Judging from Fahrenholz's other publications to which I shall refer elsewhere (meaning here), this author has also in this instance merely burdened science with three names which will fall into the synonymy of *Pediculus humanus*." That these comments were justified is proved by the following detailed criticism dealing with (*a*) the measurements, (*b*) morphology and (*c*) pigmentation of *Pediculus* and their bearing on the forms which Fahrenholz has attempted to define.

(*a*) Measurements of *Pediculus*.

There are certain sources of error that cut at the base of all measurements made on lice, and these require consideration because they have been widely ignored: (*a*) When lice die and dry up, the soft parts of the integument shrivel so that the insects shrink considerably. The antennae become shortened, the hard parts, this being especially evident in *capitis*, becoming partly telescoped into each other. The neck-like portion of the head is retracted into the thorax, the abdomen collapses and may shorten greatly. (*b*) When dried lice are placed in water their soft parts imbibe the fluid and the body resumes its normal contour, but by placing them afterwards in alcohol whose strength is gradually increased, such previously dried specimens may be made to retain their normal external form. (*c*) When dried specimens are placed in 10 per cent. caustic potash their bodies imbibe fluid and become swollen to the limit of their capacity if the exoskeleton is uninjured. (*d*) When fresh or dry caustic-treated specimens are cleaned and mounted in balsam, they frequently collapse again more or less provided extra precautions are not taken; therefore measurements made on balsam-mounted specimens are fallacious in most cases.

When living or well preserved lice are examined, it is evident (*e*) that the amount of food they have imbibed alters their dimensions and (*f*) that the number of eggs contained in the body of the female distinctly alters the length and width of the abdomen. Moreover, (*g*) the head protrudes more from the body of fully fed lice than from those that are unfed or but partly fed.

As an example of the effect of feeding upon the body-length I cannot do better than cite an observation by Sikora (IX. 1917, p. 276) who measured two females before and after feeding, the result being more striking in the

case of *corporis* because of its habit of gorging (see Nuttall, *Parasitology*, XI. 343–344): Sikora found *capitis* when unfed measured 2·84, fully fed 2·92; *corporis* when starving measured 3·2 by 1·4, fully gorged 3·84 by 1·56 mm.

Finally, owing to the lack of sharply defined structural demarcations, it is difficult to measure the length of the head, thorax and abdomen (especially its segments) more than approximately. Therefore little value necessarily attaches to small differences in size, and seeing that *Pediculus* varies considerably in size, measurements can have but small importance unless applied to a large number of full distended specimens assuming that these are obtainable.

With regard to the width of the abdomen, Fahrenholz states that it is greater in his "*P. capitis marginatus*" than in "*P. capitis angustus*" whose abdomen is elongated, and that the greatest width is attained at the "7th segment" in *assimilis* and at the "5th segment" in *friedenthali*[1].

The value of Fahrenholz's statements bearing on the width of the abdomen is nil, because I have often detected elongated, broad, and intermediate forms of abdomen in both sexes where I have examined large lots of *capitis* and *corporis* that have been collected from single individuals in different parts of the world. Pure strains of *corporis*, raised in the laboratory, have yielded a like result. Moreover, as with the length, the width of the abdomen in both sexes varies according to the state of engorgement, and in females according to the number and size of the ova they contain. Thus in laboratory strains of *corporis* I find that the greatest width ranges forward and backward from the 4th, 4th–5th and 5th abdominal segments (the 5th = Fahrenholz's "7th") in the ♂, whilst in the ♀ the greatest width alternates between the 3rd–4th, 4th, and 5th abdominal segment, the latter most frequently attaining the greatest width (abdominal segment 3 = Fahrenholz's "5th").

For the reasons previously given, no value can be attached to Fahrenholz's statement that the last abdominal segment in "*P. assimilis*" ♀ is equally long and broad, such measurements being fallacious especially in balsam-mounted specimens.

Following the lead of many previous authors, Fahrenholz lays stress on the relative size of *capitis* and *corporis* and of his purported new forms. Examined critically, however, in the light of the subjoined table, these differences should be seen once and for all not to hold good. I have stated this repeatedly in a general way but the appended table will perhaps carry more conviction.

Dismissing the measurements of *capitis* and *corporis* given by older writers, as perhaps wanting in accuracy, I have arranged the following table of measurements by recent authors and newer measurements of my own in accordance

[1] The reader is liable to be confused by Fahrenholz's enumeration of the segments. He does not state that he includes segments 1–3 in the thorax. What *appears* to him and most observers to be the 1st abdominal segment is numbered 4 by Fahrenholz, but it actually consists of two fused segments (abdominal segments 1 and 2) which bear the first abdominal spiracle. Fahrenholz when he refers to segments 5–6–7 must therefore, in the light of our present knowledge, be understood to refer to abdominal segments 3–4–5 which bear correspondingly numbered abdominal spiracles.

with the size of the males, beginning with the smallest. Where measurements of males are lacking, those of the females are ranged in what appears to be a suitable place. In some of Fahrenholz's measurements I have omitted the second decimal figure. I omit so-called "average" measurements given by different authors, recording only those showing the range in size, smallest to largest, observed in both sexes. Apart from my hitherto unpublished figures, those of Sikora bearing on *capitis* are the only ones regarding which a statement is made as to the number of individuals measured.

Table.

Giving the body-length of the smallest and largest specimens of different forms of *Pediculus humanus* measured by various observers and the author. My measurements were made on well-preserved alcohol specimens.

Length of ♂ in mm.	Length of ♀ in mm.	Name	Number examined	Author and remarks
2·0 –2·7	2·4 –3·4	*capitis*	104 ♂ 123 ♀	Sikora, IX. 1917
2·1 –2·3	2·3 –2·8	"*capitis maculatus*"	?	Fahrenholz, X. 1916, "shorter than *angustus*"
2·1 –2·6	2·2 –3·3	*capitis*	85 ♂ 81 ♀	Nuttall, Lot 208, woman, Cambridge
2·1 –2·8	2·2 –3·7	*corporis*	27 ♂ 77 ♀	Nuttall, Lot 204, woman, Lambeth
2·1 –2·8	2·4 –2·9	*corporis*	137 ♂ 94 ♀	Nuttall, Lot 265, Lab. Stock
—	2·19–2·85	"*friedenthali*"*	?	Fahrenholz, X. 1916. Host: *Hylobates*
2·19–2·39	2·67–3·06	"*capitis angustus*"	?	Fahrenholz, X. 1916, "scarcely as large as European *capitis*"
2·2 –2·3	—	*capitis**	3 ♂	Nuttall. Hosts: *Ateles ater* and *geoffroyi*
—	2·4 –2·66	"*assimilis*"*	?	Fahrenholz, X. 1916. Host: *Hylobates*
2·2 –2·5	2·4 –3·3	*capitis**	7 ♂ 11 ♀	Nuttall, Lot 315. Host: *Ateles paniscus*
2·25–3·0	2·75–4	*capitis*	?	Popoff, 1916
2·35–2·9	2·6 –3·3	*corporis*	31 ♂ 100 ♀	Nuttall, Lot 314, tramp, Cambridge
2·43–2·56	2·61–3·1	*capitis*	?	Fahrenholz, 1912
2·5 –2·9	3 –3·3	"*humanus marginatus*"	?	Fahrenholz, X. 1916
2·55–3·3	2·85–3·7	*corporis*	56 ♂ 52 ♀	Nuttall, Lot 212, London
2·7 –3·55	2·7 –4·2	*corporis*	220 ♂ 226 ♀	Nuttall, Lot 252, tramp, Cambridge
2·74–3·6	2·74–4·4	*corporis*	?	Sikora, IX. 1917
2·75–3·75	3 –4·75	*corporis*	?	Popoff, 1916
—	3·29–3·36	"*schäffi*"*	?	Fahrenholz, 1912. Host: *Simia troglodytes*
2·9 –3·3	3·9 –4·37	"*humanus chinensis*"	?	Fahrenholz, X. 1916, "distinctly larger than *marginatus*, the largest larger than European louse" (*vide infra*)
3·02–3·23	3·55–4·20	*corporis*	?	Fahrenholz, 1912 (European no doubt)
3·75	4 –4·5	*capitis*†	2 ♂ 2 ♀	Popoff, 1916, from Java

* Denotes forms found on apes and monkeys. I have measured two "*schäffi*" ♀♀, both 3·3 mm. in length. (Fahrenholz, 1910, gives 2·7 as the length, I assume his later statement to be correct.)

† If correctly determined, the size is remarkable. Thus far, in a very large material, I have seen no *capitis* approaching these in size.

The accompanying Chart II, moreover, records measurements made by me on 100 ♀♀ *P. humanus* race *corporis* (Lot 252, from tramp, Cambridge, 1918). The measurements relate to the antennae, head, thorax and abdomen as indicated on the chart, all being arranged along a straight line representing the anterior margin of the thorax. The lice were graded in accordance with the size of the thorax, the largest on the left leading to the smallest to the right. The length of the thorax varied between 1·1 and 0·7 mm. which may be taken as a good index of the relative variation in size in the lot. The great inequality in the length of the abdomen is due to its being more or less filled with blood

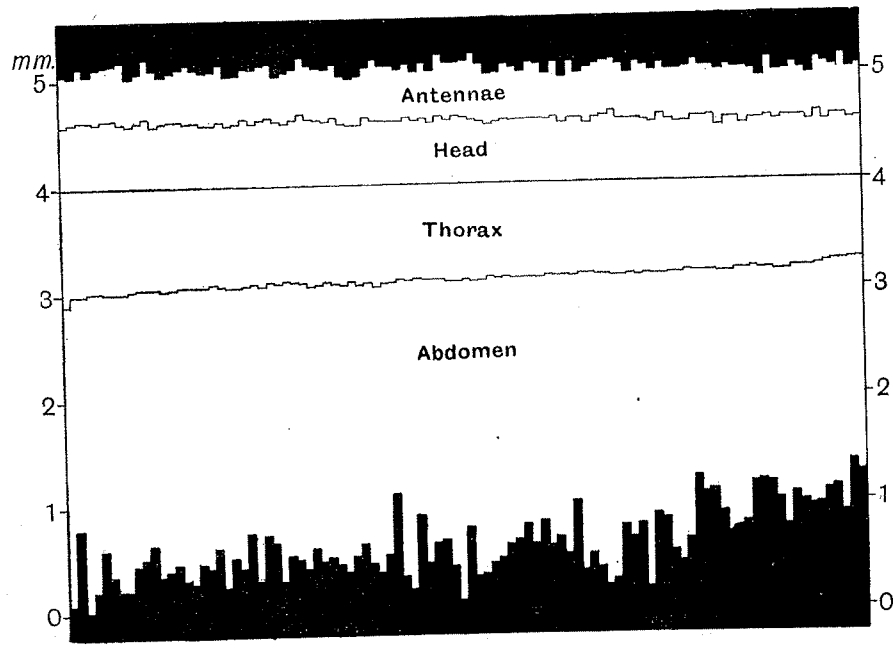

Chart I. Length-measurements of *Pediculus humanus* race *corporis*, 100 ♀♀, arranged in accordance with the length of the thorax.

and ova. The variation in the length of the head and antennae is relatively slight though distinct.

(*b*) Morphology of *Pediculus*.

The morphological characters and their bearing on Fahrenholz's diagnoses will be considered in sequence, beginning with the head and ending with the legs:

HEAD. There is no doubt that in *capitis* the head is shorter than in *corporis* when *typical* forms are considered. The shortness in *capitis* is due to the more blunted shape of the clypeus which terminates the head anteriorly, and the less elongate form of the neck-like posterior portion. Nevertheless, in pre-

sumably pure breeds of *capitis* and *corporis* respectively, the form of the head varies so that its taxonomic value is largely vitiated. In cross breeds a complete series of intermediate forms may be observed.

ANTENNAE. The statement that *capitis* has shorter antennae than *corporis* likewise holds for typical forms. In presumably pure breeds, a distinct variability is however noticeable, and in cross breeds all kinds of intermediate forms of antennae are seen. In pediculi derived from apes and monkeys, the antennae, like the head, are of the *capitis* type.

In body-lice from negroes ("*P. nigritarum* Fabricius") Fahrenholz describes the antenna as inverted-pear-shaped, the author apparently meaning to refer to the form of the segments composing the antenna, but his wording implies that the whole antenna has this form, this being absurd. He only describes the form from a single ♀ which may well have been a *capitis* with collapsed antennae.

THORAX. It is difficult to define the shape of the thorax dorsally because the outer margin is virtually colourless and the pigmented portions which lie within the margin mislead the eye into accepting them as indicating the form of the thorax. Its shape varies slightly in individual specimens, the lateral contours being more or less convex.

Therefore, when Fahrenholz describes the shape of the thorax in "*P. capitis angustus*" as "parallel sided," in dealing especially with balsam-mounted specimens, the supposed character must be dismissed as valueless. The six large hairs situate dorsally on the thorax in all pediculi I have examined, are stated to be absent in "*P. lobatus*" but I firmly believe that they were merely overlooked by being viewed through balsam (see further under Pigmentation).

ABDOMEN. Fahrenholz, writing of the ♂ abdominal structures, refers to what we have termed the dorsal bands, genital plate, and anterior ventral band. His statements regarding these structures are largely controverted in the following section on Pigmentation, *q.v.*

The Genital plate, in the ♂, is stated by Fahrenholz to be bipartite in "*P. lobatus*" and "*P. capitis maculatus*," and absent in other pediculi. We have, however, shown that this structure varies in normal individuals of one lot (see Keilin and Nuttall, *Parasitology*, XI. 282, fig. 3) and consequently there is no significance to be attached to its consisting of one or two parts, whilst it is never absent.

In the ♀, the *posterior abdominal lobes*, when retracted, become approximated, giving the semblance of a slit in contrast to the usual bilobed appearance of the end of the abdomen when the lobes are protruded. This accounts for what Fahrenholz gives as a specific character in "*P. lobatus*."

The *gonopods*, in the ♀, are stated by Fahrenholz to point back in "*P. friedenthali*," inward in "*P. assimilis*," and to be "short" in both forms, being intermediate in shape between those of *capitis* and *corporis*. I find, however, as already stated elsewhere (Nuttall, *Parasitology*, XI. p. 341), that the form of the gonopods is inconstant in both of these races of *P. humanus* and that

the two forms cannot be distinguished by their gonopods. As to the gonopods pointing "backward" or "inward," this is frequently due to pressure or shrinkage, such abnormal orientation being often seen in balsam mounts.

In both sexes, the *pleurae* vary greatly in appearance according to the degree of chitinization and pigmentation. There is no constant difference between *capitis* and *corporis* in this respect, but in "*P. schäffi*," the 6th abdominal segment certainly projects in an exceptional manner, forming a ridge dorsally and ventrally which is especially evident in ungorged specimens. The 6th abdominal segment does not protrude exceptionally in the adult lice I have examined from monkeys, but it protrudes distinctly in 2nd and 3rd-stage larvae. In corresponding larval stages of human *capitis* it is exceptional to find the 6th abdominal segment protruding somewhat more than the others laterally.

CLAWS. These are described by Fahrenholz as longer or shorter in lice from different races of man, as toothed in "*P. capitis angustus*" and "*P. corporis marginatus*," but not toothed in European lice. These statements are untrue, for the claws vary in length normally and I have often seen toothed claws in European head and body-lice. See also the quotation from Piaget (p. 143).

(*c*) Pigmentation in *Pediculus*.

The worst blunders committed by Fahrenholz are due to his relying upon pigmentation in his diagnoses, this leading to his referring to various structures as "absent" in some pediculi and "present" in others. Thus

The HEAD in "*P. lobatus*" has dark brown "plates" at the sides.

THORAX. Here the *sternal plate* is said to be present in "*P. corporis nigritarum*" and "*P. capitis angustus*" and "absent" in "*P. lobatus*" and "*P. friedenthali*." In "*P. capitis maculatus*" there occur "holes" in the sternum where hairs arise anteriorly, there being four holes in the ♂ and two in the ♀ sternum.

ABDOMEN. The degree of pigmentation of the *pleurae* serves to distinguish "*P. capitis maculatus*" and "*P. capitis angustus*."

In the ♂, the *dorsal bands* are present in "*P. corporis marginatus*" and "absent" in European body-lice. The *genital plate* is present in "*P. capitis angustus*," "*P. capitis maculatus*" and "*P. humanus chinensis*," but "absent" in European lice. The ventral band is a feature in "*P. capitis maculatus*."

In the ♀, on the last abdominal segment, there occur two brown spots dorsally in "*P. capitis maculatus*," indistinct plates (dorsally?) in "*P. capitis angustus*," and two brown plates in "*P. corporis nigritarum*" (based on one ♀!) and negro head-lice.

It is surprising that Fahrenholz should have been so grossly misled. He might at least have taken a warning from Neumann's paper (see quotation on p. 143). Today we know that by raising unpigmented strains of European *P. humanus* on a black background, the "absent" structures of Fahrenholz

are rendered visible even in balsam-mounted specimens! Fahrenholz merely overlooked existing structures because they were unpigmented. Conversely, by raising pigmented lice on white backgrounds, all of Fahrenholz's specific characters may be made to disappear.

Nearly all of the before-mentioned structures in *Pediculus* are illustrated in *Parasitology*, XI. p. 220, Pl. X, figs. 1 and 2 (pigmented and unpigmented specimens raised on black and white respectively), pp. 281 *et seq.*, figs. 2, 3. Others will be considered shortly in papers dealing with our studies on the anatomy of the insect.

It is obviously fatuous for Fahrenholz to describe colour differences in balsam-mounted specimens of lice derived from various races of man ("*P. capitis angustus*" and "*P. capitis maculatus*").

How much he was misled by preconceived notions regarding the different appearances observable in *P. humanus*, is further exemplified by the circumstance that when he found typical *P. humanus* race *corporis* in the Hamburg Museum collections bearing a label stating that they came from negroes, he considered their origin as "very doubtful." He would not believe that negro clothes-lice could be similar to those of Europeans, hence there must have been an error in the labelling (see p. 140). I have many hundreds of specimens which prove that body-lice from negroes and whites are identical in appearance.

Proof that there is no constant relation between the degrees of colouration shown by different parts of the exoskeleton in pigmented P. humanus.

The following observations were made by me with a view to determine if in a series of more or less pigmented specimens the colouration of the various parts follows any uniform law.

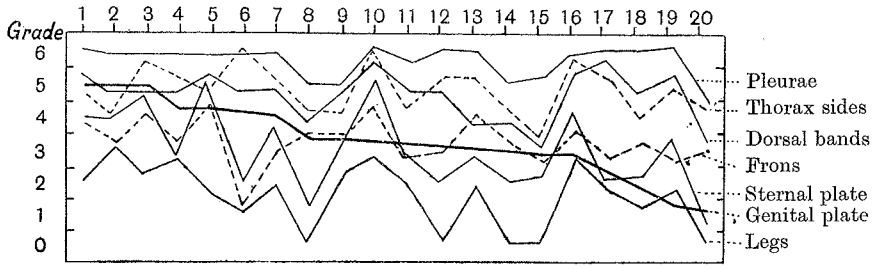

Chart II. Recording the variation in pigmentation shown by 20 selected *Pediculus humanus* race *capitis*, ♂♂, arranged in accordance with the degree of pigmentation shown by the genital plate which is darkest (*i.e.* Grade 5) in specimen 1 and palest in specimen 20, as indicated by the heaviest line among the curves.

From several hundred *capitis* ♂♂ (Lot 252, well-preserved), collected from a negro's head in Tropical Africa, 20 specimens were chosen which showed various degrees of pigmentation when viewed by daylight whilst immersed in alcohol in a dish. A scale giving seven grades of colour from blackish brown

(Grade 6) down to practically colourlessness (Grade 0) was painted on paper with water-colours, and the various degrees of pigmentation exhibited by the lice were recorded on a chart with the aid of the colour scale. The specimens were at first charted in no particular order, but afterwards they were ordered in accordance with the degree of pigmentation shown by their genital plates. The results of this colorimetric study are shown in the accompanying Chart II wherein the thickest line among the curves records the gradual fall in the degree of pigmentation shown by the genital plate in 20 ♂♂. It will be noticed at once that the degree of colouration of the genital plate bears no relation to that of the other structures. This plate may even be colourless whilst all the other structures are distinctly pigmented. The degree of pigmentation appears fairly uniform in the pleurae, whilst in some other structures (*i.e.* frons, sides of thorax, etc.) it often rises and falls, sometimes synchronizing with the varying colouration of other parts and sometimes not. In short, there is often agreement but no constant relation between the degrees of pigmentation shown by the different parts.

These observations bear on my criticism of Fahrenholz's work in so far as they prove that considerable individual variation may occur in the degree of pigmentation shown by different parts of the exoskeleton of *Pediculus* and that this has to be taken into account in all descriptions.

III.

SUPPLEMENTARY NOTE UPON THE SYNONYMY OF *PEDICULUS HUMANUS*.

The following synonymy requires to be added to that supplied in my previous paper in *Parasitology*, XI. pp. 334–7:

(*a*) *Pediculus humanus* race *corporis*.

1805. *Pediculus nigritarum* Fabricius 1805, p. 340. From negroes.

1816. *Pediculus albidior* Olfers 1816, p. 81, cited by Fahrenholz, VII. 1916, p. 270.

1816. *Pediculus nigrescens* Olfers 1816 (*fide* Fahrenholz, *loc. cit.*).

1910. *Pediculus capitis vestimenti* Neumann 1910, p. 412. "Il me paraît logique de conclure qu'il conviendrait de faire descendre *P. vestimenti* du rang d'espèce à celui de sous-espèce et de le considérer comme *P. capitis vestimenti*." This procedure is not permissible under the rules of zoological nomenclature, for *humanus* has priority over *capitis* as a specific name and *corporis* has priority over *vestimenti* as a sub-specific varietal, or racial name.

1915. *Pediculus corporis* var. *nigritarum* (Fabricius 1805) Fahrenholz 1915, p. 597, fig. 1.

1916. *Pediculus humanus chinensis* Fahrenholz X. 1916, p. 87. From Chinese.

1916. *Pediculus humanus marginatus* (Fahrenholz 1915) Fahrenholz VII. 1916, p. 270. From Japanese.
1916. "*Pediculus corporis nigritarum*" of Fahrenholz VII. 1916, p. 270.
1917. "*Pediculus humanus humanus* L" in Fahrenholz 1917, p. 1 (reprint).

(*b*) *Pediculus humanus* race *capitis*.

1816. *Pediculus pubescens* Olfers 1816, p. 81, cited by Fahrenholz, VII. 1916, p. 270.
1916. *Pediculus capitis angustus* (Fahrenholz 1915) Fahrenholz X. 1916, p. 88. From Japanese.
1916. *Pediculus capitis maculatus* (Fahrenholz 1915) Fahrenholz VII. 1916, p. 271. From Negroes.
1916. *Pediculus friedenthali* Fahrenholz X. 1916, p. 88. From *Hylobates mülleri*.
1917. "*Pediculus capitis capitis* de Geer" in Fahrenholz 1917, p. 2 (reprint).
1919. *Pediculus assimilis* Fahrenholz, 1919, p. 27 (= *P. oblongus* Fahrenholz renamed).

CONCLUSIONS.

The evidence adduced in this paper points to the imperative necessity for the employment of more scientific method in the description and differentiation of species of Anoplura. It is shown that a leading authority on the group has blundered greatly in dealing with *Pediculus*, and this may be taken as a fair example (compare *Haematopinus*, etc.) of the manner in which many purported species, sub-species and varieties of Siphunculata are being foisted into the literature by that author. Surely it is time to call a halt to this unwarranted process of burdening science with useless specific and other names that are destined in many cases to fall into synonymy.

REFERENCES.

In conjunction with the following, see Bibliographies in *Parasitology*, X. 1–42, 582–586.

FABRICIUS, J. C. (1805). *Systema antliatorum, secundum ordines, genera, species adjectis synonymis, locis, observationibus, descriptionibus*, xiv + 15–372 + 30 pp. 12°. Brunsvigae. (P. 340, *P. humanus* and *P. nigritarum* Fabr. 1805, n.sp.) **G.S.**

FABRICIUS, O. (1780). *Fauna Groenlandica*, systemice sistens animalia Groenlandiae, etc. I. p. I. xvi + 452 pp. 1 pl. Hafniae et Lipsiae. 22 × 15 cm.

(P. 215. "*Pediculus humanus*" on Greenlanders is referred to as a variety because of its colour which is described. "Habitat copiosissime in capite vestimentisque.... Editur a Groenlandis ut delicatulus, et capitur ramento pellis canine vel ursini sub vestimentis agitato." **G.**

FAHRENHOLZ, H. (1915). Läuse verschiedener Menschenrassen. *Zeitschr. f. Morphol. u. Anthropol.* Stuttgart, XVII. 591–602, pl. xxi and 6 text-figs. **S.**

FAHRENHOLZ, H. (11. vii. 1916). Zur Nomenklatur einiger Anopluren-Arten. *Zool. Anz.* XLVII. 269–272. **S.**

—— (17. x. 1916). Diagnosen neuer Anopluren. III. *Zool. Anz.* XLVIII. 87–93. **S.**

—— (1917). Anopluren des Zoologischen Museums zu Hamburg. (3. Beitrag zur Kenntnis der Anopluren.) *Mitteil. a. d. Zool. Mus.* (2. Beiheft zum *Jahrb. d. Hamb. Wiss. Anst.*), XXXIV. reprint 22 pp., 5 figs. **S.**

—— (1919). Zur Nomenklatur einiger Anopluren-Arten. II. *Jahresber. d. Niedersächs. Zool. Ver. zu Hannover* (Zool. Abt. d. Naturh. Ges. zu Hannover), reprint pp. 22–27. (*Pediculus oblongus* Fahr. 1916, renamed *assimilis* Fahr. 1919.) **S.**

LUMHOLZ, C. (1889). *Among Cannibals.* An account of four years' travels in Australia and of camp life with the aborigines of Queensland. xx + 395 pp., maps, pls., figs. London: John Murray. 23 × 16 cm. (p. 117 refers to lice). **G.**

—— (1892). *Unter Menschenfressern.* Eine 4-jährige Reise in Australien, pp. 150, 229. (Referred to by Fahrenholz, 1915, p. 594. Contains same matter as Lumholz, 1889.) **G.**

OLFERS, I. F. M. VON (1816). *De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius.* vi + 112 pp. 1 l., 1 pl., 20 figs. 8° Berolini. (Cited by Leach, 1817, and by Fahrenholz. Title taken from S. and H. bibl. Original inaccessible.) **S.**

POPOFF-TCHERKASKÝ, D. (19. xii. 1916). Beitrag zur Kenntniss der Differentialcharactere zwischen *Pediculus capitis* de Geer und *Pediculus corporis* de Geer. *Centralbl. f. Bakteriol.* I. Abt. Orig. LXXXIX. 29–33, 4 figs. **S.**

POUCHET, F. A. (1832). *Traité élémentaire de Zoologie* ou histoire naturelle du règne animal. x + 643 pp., 8 pls. Rouen. 20 × 12 cm. (pp. 412–413: "*Pediculus humanus corporis*" brief reference.) **G.**

—— (1841). *Zoologie classique* ou histoire naturelle du règne animal. 2 éd. 2 v., 44 pls, 5 tables. 8° Paris. (pp. 204–205 contain same matter as Pouchet, 1832, *q.v.*) **G.**

SCHIÖDTE, J. C. (1859). Uebersicht der Land-, Süsswasser- und Ufer-Arthropoden Grönlands. Aus dem Dänischen von A. von Etzel. *Berlin. entomol. Zeitschr.* III. 134–157. (P. 154, "Die *Pediculus* der Grönländer Fn. groenl. (215–182) über den Fabricius einige Nachrichten mitteilt, gehört wahrscheinlich, wie die der Negerrace einer selbständigen Art an.") **S.**

WALLACE, A. R. (1853). On the insects used for food by the Indians of the Amazon. *Trans. Entomol. Soc. London,* n.s. II. 241–244. **G.**