Suggested short title

MORPHOLOGICAL COMPARISON OF ANTIPODEAN *TELEOGRYLLUS* SPECIES

G. T. Chen

A MORPHOLOGICAL COMPARISON OF ANTIPODEAN *TELEOGRYLLUS* SPECIES (ORTHOPTERA: GRYLLIDAE)

by

G. T. Chen

A thesis submitted to the Faculty of Graduate Studies and Research, McGill University, as partial requirement for the degree of Master of Science.

December 10, 1965

ACKNOWLEDGMENTS

The author wishes to thank Professor D. K. McE. Kevan and Dr. V.R. Vickery for their valuable advice and assistance. Thanks are also extended for special assistances from Dr. R.L. Randell and the laboratory technician Mrs. E. Smythe. A grant from National Research Council of Canada is gratefully acknowledged by the author.

TABLE OF CONTENTS

I. INTRODUCTION

The common "black" field crickets from different areas of Australia and New Zealand have generally been treated previously as belonging to a single species, *Teleogryllus commodus* (Walker), although other related species, such as *T. oceanicus* (Le Guillou) have been recorded from various parts of Australia (see Chopard (1951) and Leroy (1964a)). Owing to close morphological similarities among allopatric specimens, no critical attempt to separate morphological species was made until this was done by Leroy (1964b). However, studies from physiological and genetical approaches have been made by several authors, who have shown that "*T. commodus*" populations constitute different entities isolated reproductively as well as physiologically (Browning, 1952a, 1952b; Hogan, 1960; Bigelow, 1962; Bigelow and Cochaux, 1962; Cochaux, 1964; and Leroy, 1963, 1964a, 1964b).

Recently, Leroy (1964b) has shown that, on the basis of the morphology of the sound-producing organs, Australian *Teleogryllus commodus* and Pacific Island *Teleogryllus oceanicus* are clearly different. Leroy's results have thus indicated that it is possible to differentiate members of the *commodus* group by means of morphological characters. The present work, begun before Leroy's (*l. c.*) work was published, attempts to differentiate Antipodean populations formerly referred to *T. commodus* by comparing morphometrical characters statistically.

II. REVIEW OF PREVIOUS WORK

Browning (1952a, 1952b) and Hogan (1960) studied the diapause characteristics of the eggs of Teleogryllus commodus from South Australia and the State of Victoria and showed that the proportion which enter diapause varies with different incubating temperatures. Hogan (1960) found that 16 per cent. hatched at 26.7^{o}C without evidence of diapause, 64 per cent. at 29.4^{o}C, and 83.3 per cent. at 34^{o}C.

Bigelow (1962) found that a population, which he called T. commodus, from Ingham, Queensland (designated by him as Qn), differed from a South Australian (Adelaide) population (which he designated as Qa) in the length of incubation period at 28^{o}C, and that sterile hybrids were produced by crossing the two populations. A third population from Victoria (designated Qc), had two different hatching rates at 28^{o}C. It comprised a faster hatching group, the eggs of which had an incubation period of about 15 to 20 days, and a slower hatching group, which required from 35 to 85 days incubation. However, fertile hybrids were produced between Qa and Qc. Thus Bigelow claimed that the Qn strain might be a different species from the other two, but that it was also possible that the three strains might be interconnected by an unknown series of interfertile populations.

In a genetical and physiological study of the same strains, Bigelow and Cochaux (1962) found that the F_1 offspring of the cross between Qc and Qa produced large numbers of F_2 progeny, which in turn produced many healthy F_3 nymphs. However, the F_1 offspring from crosses between either Qn and Qa, or Qn and Qc were sterile. As to the physiological aspect, a discrepancy was found between the results of their initial and later experiments on diapause of eggs. Their initial results showed that the proportion of eggs that hatched without diapause at 28°C was different in the three strains. Their later results, however, showed that an increase in the proportion of eggs hatching without diapause occurred in both of the southern strains; i.e., in Qa and Qc. "These differences," the authors suggested, "probably involve different gene frequencies rather than different genes, and the gene frequencies can probably be altered rather quickly in response to climatic changes". Hybrid eggs which were obtained by either crossing or reciprocal crossing Qn with Qa, and Qn with Qc all hatched without diapause. Thus the authors believed "some sort of dominance is exerted by nondiapause over diapause genes".

Cochaux (1964) showed that the hybrids from crosses of either Qn with Qa, or Qn with Qc, or their reciprocal crosses, were all sterile. There was no sexual activity; nevertheless both sexes were alive and vigorous. The females did not lay eggs since the ovaries were not functional. He also found that the speed of development varied between sexes of each type of hybrid. The results showed that the length of development of nymphs was longer if the male parent was Qn and shorter if the female parent was Qn.

Leroy (1963) has shown that the different parametric rhythms and the characteristic frequency of the sound signals of the F_1 produced by crossing T. commodus (assumedly from Canberra, Australian Commonwealth Territory; Burnley, Victoria; and Adelaide, South Australia - see Leroy (1964a)) with T. oceanicus (assumedly from either Brisbane, Queensland, or Tahiti - see Leroy (1964a)) were intermediate between those of the parents. In a further study on the hereditary transmission of the sound frequency in hybrids of the same species (or strains as assumed by former authors), Leroy (1964a) showed that hundreds of F_1 were obtained from crossing T. commodus with T. oceanicus but only a few adults appeared in the back-cross, only about ten males being able to stridulate. The signals of courting and fighting had the same characteristic frequency as those of mating for all the hybrids of the first generations. However,the sound produced by the hybrids of the back-cross had a frequency which was neither that of the F_1 nor of the parents.

Recently Leroy (1964b) has shown a structural difference in the sound-producing organs between the two species: *T. commodus* has a lesser number of pegs (about 170) on the stridulatory vein than *T. oceanicus* (with more than 240).

Bigelow and Cochaux (1962) described some minor and overlapping differences in coloration and in the shape of the proventricular teeth between the Queensland population (Qn strain) and the southern strains (Qa and Qc). Cochaux (1964) has mentioned that morphologically these strains are not different except in certain configurations of the teeth of the proventriculus. Further information, both qualitative and quantitative, on morphological differences between Australian *Teleogryllus* crickets is wanting; no information of this kind exists for New Zealand populations.

III. MATERIALS AND METHODS

A. MATERIALS USED AND THEIR SOURCES

Specimens from six strains of Teleogryllus crickets origniating in different geographical areas of Australia and New Zealand were studied. The strains had been in culture at Macdonald College of McGill University for several generations. The original Australian strains were obtained from the following locations: Adelaide (South Australia) - hereafter referred to as Qa; Perth (Western Australia) - Qw; Ingham (Queensland) - Qn; and Burnley (Victoria) - Qc. The New Zealand strains were from Kaikoura (South Island) - Qk - and Auckland (North Island) - Qz.

Adult crickets of each of these six strains were maintained separately in 24 X 18 X 16-inch glass-walled and screen-covered cages on a diet of commercial "baby rabbit pellets" (manufactured by Ogilvie's Flour Mills, Montreal). Fresh grass was given occasionally. Water was supplied regularly in J-shaped glass vials (5 X 1¼ inch) plugged with absorbent cotton. Paper strips were provided for shelter. Clean, moist sand contained in plastic Petri dishes was provided for oviposition. Twice each week, the sand dishes containing the eggs were removed to an incubator at a temperature of 28°C ± 1 and a relative humidity of 95 per cent., and replaced with new ones immediately. Dead and dying crickets were preserved in 70 per cent. alcohol. Since the primary purpose of the investigation was to compare the morphology of the different strains, only preserved specimens were used; immature stages were not considered.

B. CHARACTERS STUDIED

In comparing the six strains studied, measurements were made of the following: the length of the body exclusive of appendages (mm.); the maximum width of the prothorax of intact specimens (mm.); the dimensions of the frons (mm. - see Fig. 1); the overall dimensions of the pronotum dissected off and flattened (mm. - see Fig. 2); the number of pegs on the stridulatory veins of the tegmina (left and right); the length of the anterior femora and tibiae (mm. - see Fig. 12); the length and width of the tympanum on the exterior face of the fore tibia, measured as in Fig. 13 (1 unit = 0.015 mm.); the dimensions of the ectoparameres of the male genitalia and of the second valvifer of the female genitalia (mm. - see Figs. 19 and 20); the dimensions of the epiproct (mm. - see Fig.

21); the height of the proventricular teeth measured as in Fig. 40 (1 unit = 0.0063 mm.); and the number of the denticles of the proventricular teeth (Fig. 40).

Since individual members of a population may vary considerably in size, and also because the various parts of the body have allometric growth, comparisons of ratios of different parts of the body are more appropriate than single absolute measurements. The ratios of measurements used to compare strains were as follows: the length of the body over the width of the prothorax (of intact specimens), the length of the frons over its width, the total (dorsal plus lateral) width of the pronotum over its length, the length of the anterior tibia over that of the anterior femur, the longitudinal over the transverse diameter of the tympanum, the length of the ectoparamere of male genitalia over its width, the length of AB over that of AC (Fig. 20) for the second valvifer of the female genitalia, and the length of epiproct over its width. Since the bases of the proventricular teeth are not clearly defined, an exact measurement of their widths was hard to make. Therefore, for the proventricular teeth no ratios were calculated and only absolute measurements of height were used.

C. SAMPLING METHOD

In order to measure accurately the individual variation within strains, a different sample from each was used to study each different morphological character, except in the study of the morphology of the fore-leg and tympanum,where the same sample was used for the two characters in each strain. Twenty specimens (10 males and 10 females) were taken from each population or strain at random and used for studying such characters as the proportions of body, frons, pronotum, fore-leg and auditory organ. Since the structure of the external genitalia and the shape of the epiproct are clearly different in the two sexes,and a fully developed stridulatory vein exists in the male, only 10 individuals of one sex were used in studying these characters. In comparing the numbers of denticles and the heights of the proventricular teeth,five individuals of each sex of each strain were compared with similar samples from the other strains. Since, in this case, the variables are the teeth themselves,the actual sample size for each strain was, therefore, not 5, but 72 (the tooth number for each individual) X 2 (sexes) X 5 (number of individuals), or 720.

The sampled specimens were preserved individually in 70 per cent. alcohol in small glass vials, and each specimen was given a random number. In studying any particular character, the portion of the insect concerned was removed and the remainder of the insect returned to the original population, so that such used specimens might be sampled again for studying a second or subsequent character.

D. PREPARATION OF SLIDES

Slides were prepared as follows:the portion of the insect to be examined was treated first in 10 per cent. cold KOH solution for 16 - 24 hours, to digest muscles and other tissues, and then rinsed with tap water and distilled water three times each. All materials were treated in the same way and then kept in their original containers with 70 per cent. alcohol.

Polyvinyl lacto-phenol[1] was used as the mounting med-

1. Commercial polyvinyl alcohol (Elvonol, type A, 51.A.05, Hartman-Leddon) -------------------------- 2.5 grams

Lacto-phenol solution (45 grams phenol detached crystals in 45 cc. of lactic acid) ------------------ 30 cc.

(Beirne, 1955).

ium. A drop of the medium was placed on a clean slide and a piece of the treated material inserted into the medium. A cover-glass was then applied, and the slide marked with an inscriber giving details of the source of the material, the sex, the random number, etc., and dried.

E. EXAMINATION

The prepared slides of the proventriculus and wings were examined under a binocular compound microscope (eye-pieces 10 X objective 10). A 10 mm. calibrated micrometer was used to measure the height of the teeth of the proventriculus (Fig. 40) and the diameters of the tympana (Fig. 13), and the latter was measured under an uniocular compound microscope (eye-piece 4 X objective 10). A hand-counter was used when counting the number of pegs on the stridulatory vein.

A rectangular block of wood was used in measuring the length and the width of the body. An insect pin was put vertically into the wood. The preserved specimen was straightened and set on the wood with the ventral side up. The head of the insect was closely adpressed to the pin. A second pin was applied perpendicularly at the tip of the abdomen. The insect was then removed and the distance between the two pins measured to the nearest mm. by means of a centimeter scale. As the prothorax is rigid and has a constant shape, it was taken to represent the width of the body and measured in a similar way as for the length of the insect.

As it was not possible to make a satisfactory slide of the hemispherical head, a special measuring device was used. A plastic ring with a diameter of 15 mm. and a height of 4 mm. was sealed to a clean slide by means of wax paraffin around the outer edge of the ring. The head of a decapitated cricket was put in the ring and covered with the micrometer slide and the measurements made under a dissecting microscope. The length and width of the frons, as illustrated in Fig. 1, were measured from the apex to the fronto-clypeal suture and from one mesal edge of the antennal sockets to that of the other.

A binocular dissecting microscope (Wild, Heerbrugg, M5-51029) with an attached camera lucida (Wild) was used for drawing figures. A desk calculator (Monroe, CSA-8, 636731) was used for making calculations.

F. ANALYSIS

Owing to close morphological similarity in the six strains studied, it is very difficult to compare them by qualitative means. The interpretation of the findings in the present work is therefore based mainly on statistical analyses of data obtained by measurements. Analysis of variance (Steel and Torrie, 1960) was used for testing differences between strains, within strains and between sexes. The *t*-test (Steel and Torrie, *op. cit.*) was also used to compare two sample means in those cases in which there was a significant different between strains.

IV. RESULTS

A. PROPORTIONS OF BODY, FRONS AND PRONOTUM

In comparing the ratios of the measurements of length to width of the body and frons and of width to length of pronotum, twenty specimens,ten of each sex, were drawn from each strain. The analysis of variance, for these data, as tabulated in Tables I, V and IX, shows clearly that in every case the main factor 'strain' is significant. The significant 'strain X sex' interaction, as shown in Table V for the frontal ratio, implies that the differences among strains are influenced by the differences which exist between sexes, and *vice versa*. A comparison of sample means between strains of each sex,as shown in Tables II, VI and X, shows that for each character the results for the two sexes within a given strain do not always coincide. This, however, is not surprising as there is morphological sex differentiation within certain strains. Means and the ranges of ratios of the measurements for each of the three characters mentioned are tabulated in Tables III, VII and XI, for both sexes of each strain. The low value of standard deviation in each case suggests that the observed values do not deviate much from the calculated means. Means of actual measured dimensions for each character are listed in Tables IV, VIII and XII. It is clear, from the range of measurements, that in each character, the observed values overlap each other both in sexes and strains. These characters cannot therefore be used satisfactorily to separate single specimens of these various strains.

B. NUMBER OF STRIDULATORY PEGS

Tegminal sound-producing organs were studied in males of all six strains. The numbers of pegs on the stridulatory vein of each tegmen were compared for ten males of each strain. In Table XIII, the analysis of variance shows that differences in the number of pegs for both strain and side are significant. The results of comparison of sample means between strains for each tegmen, as listed in Table XIV, show no conformity between the tegmina of the left and right sides in certain strains. The morphological difference between the two tegmina in a single strain is perhaps due to a functional need, since from the means tabulated in Table XV, the right tegmen, which is almost always on top, usually has a larger number of pegs. It was found, from the data listed in Table XV, that the numbers of pegs on the files of both tegmina in the Qn strain are far greater (a mean value of 257.5 on the right tegmen and 252.6 on left) than in other strains. In addition, the shape of the pegs in Strain Qn differs from that of the other strains (Fig. 3 to 8). These findings agree with those of Leroy (1964b, fig. 6). Therefore, by using these characters, it is easy to differentiate between Strain Qn and the others.[2]

C. PROPORTIONS OF FORE-LEG AND TYMPANUM

Statistical analysis of the ratio of tibia to femur length and of length to width of the tympanum on the exterior

2. A dry specimen from Hawaii of what appears to be correctly called *Teleogryllus oceanicus* was examined. This was found to lack a small triangular cell which is constantly present at the tip of the tympanic membrane of the tegmen in Strain Qn, as shown in Figs. 10 and 11, but the number (246) and shape of the pegs on the file of the right tegmen were similar to those of Strain Qn (see Figs. 5 and 9), which is thus probably referable to *T. oceanicus* or a very closely related species. It is also of interest to note that in a series of *Teleogryllus* from Easter Island, the number of teeth varied from 166 to 191; i.e., within the range of *T. commodus* and not of *T. oceanicus* to which this population had been referred by Chopard (1924) and subsequent authors.

face of the fore tibia shows that the differences among strains are highly significant for both characters, but that no difference between the sides of the insects occurred in any case (see analysis of variance in Tables XVI and XX). The latter result, however, was not unexpected, since it can be presumed that the development of the fore-legs and tympana, in relation to their respective functions, would be symmetrical. The ratio mean, which is an average value for the two sides, compares each sex of each strain with the corresponding sex of another strain for each of the two characters. A comparison of sample means between strains for the two characters is shown in Tables XVII and XXI. The results show no conformity between the sexes for each strain in the two characters (excepting that for Strain Qk in the ratio of tympanal measurements). However, from the tabulated results shown in Table XVII, it is found that Strain Qn males are always different from the others in the mean of ratio of the fore-leg measurements. Also, the females of the Qn strain differ in the mean of ratio of tympanal dimensions (see Table XXI) from all of the rest, except Qk. It is also found, from Table XXI, that Strain Qk is different in both sexes from the other strains, except Qn, in its ratio of the diameters of the tympanum. Data listed in Tables XVIII and XIX, like those in Tables XXII and XXIII, show the means of ratios and their ranges, and the mean value of measured dimensions for each sex in all the different strains. It is interesting to find that the female, with the exception of the Strain Qa, has always a large tympanal ratio (i.e. the tympana are longer or narrower). This may be due to a functional need, since, in courtship, the roles of the two sexes differ, the female always being the passive member. Just what the difference in function may be, and how the shape of the tympanum affects this, is difficult to surmise.

D. PROPORTIONS OF EXTERNAL GENITALIA

The structure of the external genitalia for each sex is basically the same in all strains (Figs. 14 to 20). The dimensions of the ectoparamere of the male and of the second valvifer of the female, as illustrated in Figs. 19 and 20, were measured for ten individuals of each sex of each strain. In every case the analysis of variance showed highly significant differences among the strains for each of the characters (see Table XXIV and Table XXV). A comparison of sample means between all possible combinations of strains, as listed in

Table XXVI, shows that in each case, the ratio mean of the ectoparamere dimensions for males of Strain Qn is different from that of the other strains. However, in females of the same strain (Qn) the results do not exactly correspond with those of the males. From the data given in Table XXVII, it is demonstrated that the ratio mean values for the two characters discussed above is larger in Qn males than in the males of other strains. The ratio mean for Qn females, on the contrary, is smaller than that of females of the other strains, with the exception of the Qz strain. Table XXVIII and Table XXIX show the means of actual dimensions from which the ratios were obtained.

E. PROPORTIONS OF EPIPROCT

A more useful and reliable morphological character that can be used for identifying the different strains, discovered in the present work, lies in the morphology of the epiproct. The shapes of the posterior margin and of the postero-lateral pigmented areas of the epiproct are clearly different for each strain (see Figs. 22 to 39). This feature is very constant for both sexes within Strains Qa, Qw and Qn, and it is also constant in female Qk, but less so in Qk, Qz males and Qz females, while it varies greatly within both sexes of Strain Qc (see Figs. 32 to 39). The ratios obtained from the dimensions of epiprocts of each sex, were also compared. The results of analysis of variance and of the comparison of sample means between strains of each sex are shown in Tables XXX, XXXI and XXXII. From the results listed in Table XXXII, it is shown that the ratio of epiproct measurements in the female of Strain Qn is different from the same sex of other strains, but no difference is found between Qa, Qw, Qk, Qz and Qc. In the male, however, the results are not the same as for the female. It is found that the Qn is different from Strains Qa, Qw, Qk, Qz and Qc. Qz is different from Qw, Qk, Qc but not Qa. It is also found that Qa is different from Qw, Qk and Qc, however, there is no difference between the last three strains. The ratio means and the means of the measured dimensions are tabulated in Tables XXXII and XXXIV.

F. PROVENTRICULUS

The morphology of the proventriculus is rather complicated. The outer shape of the proventriculus resembles that of a pear, and its inner wall contains many sclerotized teeth, which, depending on how one looks at them, are arranged in twelve transverse rows or six vertical columns. In each row there are six teeth, or conversely, in each column there are twelve teeth. The total number of proventricular teeth is 12 X 6, or 72. Each tooth bears several denticles, each of which is either slender with a sharp point, or stout with a blunt point. The features of the teeth, however, vary within strains as well as among strains.

The analysis of variance, as shown in Tables XXXV and XXXVIII for each of the two characters, indicates that the factors, strains, replication, individual, and row, are all highly significant. The larger calculated value of 'row' in both cases, implies that the difference between rows is more significant than that for the other factors. A comparison of sample means of denticles and of tooth-height between rows of strains is shown in Table XXXVI and Table XXXIX. Since there is a highly significant difference between replications and that of the individuals, the differences between the rows in the various strains scarcely enable one to conclude that any one of the strains is significantly different from the others. In addition to this, the inconsistency in the form of the teeth also shows that the reliability of this character is questionable. Therefore, the author would not place much confidence in tooth-form. The means and the range of means in respect to the tooth characters are tabulated in Tables XXXVII and XL. The high value of standard deviation implies a wide spread in the measurements of the individuals in each strain.

V. DISCUSSION AND CONCLUSIONS

The analysis of the data discussed above shows that when a character from one strain is compared with that from the others the results are not always in agreement between sexes or between sides (right and left) in the same strain. This is, of course, owing to the morphological differentiation between the sexes, and also between the sides in the case of the tegmina. It was also found, that the results obtained from a comparison between two strains for one character did not necessarily conform with those obtained when another character was compared for the same two strains. This, however, may be explained on the basis of the hypothesis that the same morphological feature or features occurring in different strains may have followed the same pattern of evolution.

The results of the present study are summarized in Table XLI. They show statistically that in every case Strain Qn is different from Qw, and, with few exceptions, also from Qk, Qz, Qa and Qc. In the case of the last two strains, the present findings agree with those of former workers obtained by adopting different approaches. This enables one to conclude that Strain Qn belongs to different group from the rest. It should, in fact, be referred to as *Teleogryllus oceanicus* (Le Guillou).

Chopard (1951) recorded both Gryllulus (= Teleogryllus) commodus and oceanicus from various areas of Australia. Chopard's key (p. 408 - 409) for separation of these two species is based entirely upon size, which is not reliable on a qualitative basis. It is thus probable that the locality records of Chopard are not valid for the species under which they are listed, as some of the records listed for oceanicus are undoubtedly of commodus, and vice versa.

The relationship between Strains Qw and Qa is very ambiguous. From the tabulated results (see Table XLI) it seems that there are few differences between the two strains. However, when the shape of the epiproct (see Figs. 22 to 25) is taken into consideration, it is shown clearly that they differ. Moreover, a vast geographic distance(about 1400 miles) is involved between Perth (Western Australia) and Adelaide (South Australia), the respective sources of the two strains. Therefore, it is possible that a series of bio-geographic entities, differing slightly from each other, may exist between the two populations. However, until further genetical and physiological evidence is obtained, it is scarcely possible to clarify the relationship between Qw and Qa.[3]

3. The two strains interbreed freely in the laboratory, producing interfertile hybrids.

It was found that the morphological divergence between Strain Qw and the two New Zealand strains, Qz and Qk, are much greater than those between either Qw and Qa, or Qw and Qc. This, however, is not unexpected, since the islands of New Zealand are widely separated geographically from the Australian continent.

No significant differences are apparent among Strains Qa, Qc and Qz even though the last is geographically isolated from the former two. It was found, however, that Qk differs in certain respects from all three. The considerable morphological divergence between the two New Zealand strains was quite unexpected in view of the fact that only a single species was formerly believed to be involved,[4] and this renders the situation more complex.

It may be assumed that Strain Qz originated as migrants from Australia and is derived from similar ancestors to those that gave rise to Qa and related south-east Australian strains. The South Island strain, Qk, may perhaps have been derived from the same source. After the two New Zealand

4. It was found that the two New Zealand strains, Qk and Qz, can interbreed freely in the laboratory (from data unpublished) and produce fertile hybrids.

strains had existed in different bio-geographic circumstances for a long period of time, morphological divergence would not be unexpected. It is also possible, however, that introduction into the two main islands of New Zealand occurred at different times. The South Island strain, Qk, since it shows greater divergence, could have been introduced at an earlier period of time, or possibly from a non-Australian (i.e. Oceanic) source.

From the above, one can conclude that the Australian and New Zealand crickets, formerly known collectively as Teleogryllus commodus, are made up of at least two different species: T. commodus (Walker) and T. oceanicus (Le Guillou). The name T. commodus should certainly be applied to those crickets from Western Australia (Qw) whence the type of this species was originally described. The name T. oceanicus should be applied to those from Queensland (Qn) and Leroy (1963, 1964a) has correctly used T. oceanicus to refer to a population from Brisbane, Queensland.

Strains Qa, Qc and Qz should be treated either as distinct bio-geographic entities of T. commodus or, as suggested by Bigelow (1962), the name servillei (Saussure, 1877) should be reapplied to these eastern populations. If the latter course of action were adopted, available evidence would indicate only subspecific status for the eastern forms.

The position of Strain Qk is the most difficult to determine. It appears reasonable to treat it as a geographic isolation product of the "servillei" group of *T. commodus* which has now attained, or is in the process of attaining the status of a distinct subspecies. This hypothesis will require substantiation by genetical and physiological experimentation such as that at present in progress at Macdonald College of McGill University.

VI. SUMMARY

The morphology of six populations of *Teleogryllus*, the common "black" field crickets, from different geographic areas of Australia and New Zealand were compared by means of mathematical methods. These populations are designated Qa, Qw, Qn, Qc, Qk and Qz.

Statistically, it is shown that the Qn strain from Queensland is morphologically quite different from the others. The morphology of the sound-producing organs in the Qn strain is very similar to the Hawaiian species which is apparently correctly called *Teleogryllus oceanicus* (Le Guillou). In this character the Qn strain is also very similar to the Pacific Island (Tahiti) population of Leroy (1964b) and presumably identical with her Queensland material. Hence, the name *T. oceanicus* is applicable to Strain Qn.

The population Qw from Western Australia whence *Teleogryllus commodus* (Walker) was originally described, is different from the South Australia population (Qa) in certain minor morphological aspects. Therefore, if these populations should prove to be distinct, the Qw not the Qa population would be referable to true *T. commodus* (Walker).

Since there are no significant differences between strains Qa, Qc (from Victoria) and Qz (from North Island, New

Zealand), it is reasonable to assume that they represent a series of closely related bio-geographic products of Qw, to which the name servillei (Saussure) might be applied in a sub-specific sense.

The Ok strain (from South Island, New Zealand) is believed to be a divergent member of the south-east Australian group. Both genetical and physiological evidence now being accumulated is necessary to clarify the position.

An interesting secondary observation is that in all strains except Qa, the female tympanum is longer or narrower than in the male, although the reason for this is unknown.

BIBLIOGRAPHY

*Alder, H. L. and Roessler, E. B. 1960.

"Introduction to Probability and Statistics". W. H. Freeman and Company, San Francisco and London.

*Alexander, R. D. 1957.

The taxonomy of the field crickets of the eastern United States (Orthoptera: Gryllidae: Acheta). Ann. Ent. Soc. Amer. 50:584-602.

Beirne, B. P. 1955.

"Collecting, Preparing and Preserving Insects". Science Service, Entomology Division, Canada Department of Agriculture.

*Bigelow, R. S. 1960.

Interspecific hybrids and speciation in the genus Acheta (Orthoptera: Gryllidae). Canad. J. Zool. 38:509-524.

Bigelow, R. S. 1962.

Factors affecting development rates and diapause in field crickets. Evol. 16:396-406.

Bigelow, R. S. and Cochaux, P. 1962.

Intersterility and diapause differences between geographical populations of Teleogryllus commodus (Walker) (Orthoptera: Gryllidae). Aust. J. Zool. 10:360-366.

Browning, T. O. 1952a.

The influence of temperature in the completion of diapause in the eggs of Gryllulus commodus (Walker). Aust. J. Sci. Res. B5:112-127.

Browning, T. O. 1952b.

On the rate of completion of diapause development at constant temperatures in the eggs of Gryllulus commodus (Walker).
Aust. J. Sci. Res. B5:344-353.

Chopard, L. 1924.

Gryllides de Juan-Fernandez et de l'île de Pâques.
In. Skottsberg, C. (Ed.). The Natural History of Juan Fernandez and Easter Island. Uppsala. 3:321-323.

Chopard, L. 1951.

A revision of the Australian Grylloidea.
Rec. S. Aust. Mus. 9:410.

*Chopard, L. 1961.

Les divisions du genre Gryllus basees sur l'etude de l'appareil copulateur (Ortho., Gryllidae).
Eos, Madr. 37:267-287.

Cochaux, P. 1964.

Croisements introspecifiques et specification chez quelques gryllides des genres Gryllus et Teleogryllus (Orthoptera: Gryllidae).
Canad. J. Zool. 43:105-124.

*Corbel, J. C. 1963.

Caractéres spécifiques du champ dorsal élytral des mâles de quelques Gryllus.
Bull. Biol. Fr. Belg. XCVII:531-550.

*Dobzhansky, T. 1951.

"Genetics and the Origin of Species".
Columbia University Press, New York.

Hogan, T. W. 1960.

The onset and duration of diapause in eggs of Acheta commodus (Walker) (Orthoptera).
Aust. J. Sci. 13:14-29.

*Huxley, J. S. 1932.

"Probelms of Relative Growth". Dial Press, New York.

Leroy, Y. 1963.

Etude du chant de deux espéces de Grillons et de leur hybrids (Gryllus commodus Walker, Gryllus oceanicus Le Guillou, Orthopterés).
C. R. Acad. Sc. 256:268-270.

Leroy, Y. 1964a.

Transmission du paramétre fréquence dans le signal acoustique des hybrides F_1 et P X F_1, de deux Grillons: Teleogryllus commodus Walker et T. oceanicus Le Guillou (Orthoptéres, Ensiféres).
C. R. Acad. Sc. 259:892-895.

Leroy, Y. 1964b.

La signalisation acoustique chez les gryllides.
Ann. Biol. III, (9-10):400-428.

*Masaki, S. 1960.

Thermal relations of diapause in the eggs of certain crickets (Orthoptera: Gryllidae).
Bull. Fac. Agric. Hirosaki Univ. 6:5-20.

*Masaki, S. 1965.

Geographic variation in the intrinsic incubation period: A physiological cline in the Emma field cricket (Orthoptera: Gryllidae: Teleogryllus).
Bull. Fac. Agric. Hirosaki Univ. 11:59-90.

*Ohmachi, F. and Masaki, S. 1964.

Interspecific crossing and development of hybrids between the Japanese species of Teleogryllus (Orthoptera: Gryllidae). Evol. 18:405-416.

*Randell, R. L. and Kevan, D. K. McE. 1963.

Research on field and house crickets (Orthoptera: Gryllidae: Gryllinae) at Macdonald College. Ann. Ent. Soc. Que. 8:102-107.

*Randell, R. L. 1964.

The male genitalia in Gryllinae (Orthoptera: Gryllidae) and a tribal revision. Canad. Ent. 96:1565-1607.

*Snodgrass, R. E. 1935.

"Principles of Insect Morphology". McGraw-Hill Book Company, New York and London.

Steel, R. G. D. and Torrie, J. H. 1960.

"Principles and Procedures of Statistics". McGraw-Hill Book Company, New York, Toronto and London .

The references marked with an asterisk (*) have been consulted during the present work, but are not cited in the text.

TABLES

From I to XLI

TABLE I. RATIO OF LENGTH/WIDTH OF BODY IN SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	4.986	119		
Treatments	1.460	11		
Strains	1.092	5	0.218	7.03**
Sexes	0.089	1	0.089	2.87
Sex X Strain	0.279	5	0.056	1.81
Replications	0.432	9	0.048	1.55
Errors	3.094	99	0.031	

1. From Steel & Torrie (1960: 194 - 211).

**: Highly significant, based on 0.01 level.

TABLE II. COMPARISON OF SAMPLE MEANS OF RATIO OF LENGTH/ WIDTH OF BODY OF SIX <u>TELEOGRYLLUS</u> STRAINS

Compared Strains	Sex: Male $\bar{d}$[1]	$S_{\bar{d}}$[2]	Calc.val.[3]	Female $\bar{d}$	$S_{\bar{d}}$	Calc.val.
Qa - Qw	0.019	0.066	0.288	0.066	0.102	0.647
Qa - Qn	0.132	0.052	2.538*	0.351	0.117	3.000**
Qa - Qk	0.029	0.043	0.674	0.223	0.128	1.742
Qa - Qz	0.164	0.050	3.280**	0.060	0.110	0.545
Qa - Qc	0.074	0.054	1.370	0.214	0.123	1.740
Qw - Qn	0.151	0.068	2.221*	0.285	0.076	3.750**
Qw - Qk	0.048	0.062	0.774	0.157	0.091	1.725
Qw - Qz	0.145	0.067	2.164*	0.006	0.065	0.092
Qw - Qc	0.055	0.070	0.786	0.148	0.085	1.741
Qn - Qk	0.103	0.047	2.191*	0.128	0.107	1.196
Qn - Qz	0.296	0.053	5.585**	0.291	0.086	3.384**
Qn - Qc	0.206	0.057	3.614**	0.137	0.102	1.343
Qk - Qz	0.193	0.044	4.386**	0.163	0.100	1.630
Qk - Qc	0.103	0.049	2.102*	0.009	0.114	0.079
Qz - Qc	0.090	0.055	1.636	0.154	0.094	1.638

1. $\bar{d}$: difference between two sample means.
2. $S_{\bar{d}}$: sample standard deviation, calculated by equation: $S_{\bar{d}} = (2S^2/n)^{\frac{1}{2}}$, where S^2 obtanied by equation: $S^2 = [(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2]/[(n_1 - 1) + (n_2 - 1)]$, $n = n_1 = n_2 = 10$ = sample size of each strain, assuming $\mu_1 = \mu_2$, $\sigma_1^2 = \sigma_2^2$.
3. T-value, calculated by equation: $t = \bar{d}/S_{\bar{d}}$.

*: Significant, based on 0.05 level, df = 18.
**: Highly significant, based on 0.01 level, df = 18.

TABLE III. RATIO OF LENGTH/WIDTH OF BODY OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	3.654	0.106	3.548 - 3.760	0.034	3.543 - 3.765
	Female	10	3.877	0.303	3.574 - 4.180	0.096	3.565 - 4.189
Qw	Male	10	3.673	0.178	3.495 - 3.851	0.056	3.491 - 3.855
	Female	10	3.811	0.113	3.698 - 3.924	0.036	3.694 - 3.928
Qn	Male	10	3.522	0.124	3.398 - 3.646	0.039	3.395 - 3.649
	Female	10	3.526	0.212	3.314 - 3.738	0.067	3.308 - 3.744
Qk	Male	10	3.625	0.083	3.542 - 3.708	0.026	3.541 - 3.709
	Female	10	3.654	0.265	3.389 - 3.919	0.084	3.381 - 3.927
Qz	Male	10	3.818	0.113	3.705 - 3.931	0.036	3.701 - 3.935
	Female	10	3.817	0.170	3.647 - 3.987	0.054	3.641 - 3.993
Qc	Male	10	3.728	0.133	3.595 - 3.861	0.042	3.592 - 3.864
	Female	10	3.663	0.244	3.419 - 3.907	0.077	3.413 - 3.913

1. $\mu = \bar{x} \pm t_{.01} \times S_{\bar{x}}$, df = 9, based on 0.01 level.

TABLE IV. LENGTH AND WIDTH OF BODY IN SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Sex	Specimens Measured	Mean of Length	Range of Measurements	Mean of Width	Range of Measurements
Qa	Male	10	25.460	24.00 - 27.10	6.970	6.50 - 7.60
	Female	10	24.840	18.00 - 27.50	6.400	5.50 - 7.00
Qw	Male	10	24.020	23.10 - 25.00	6.550	6.00 - 6.95
	Female	10	23.940	21.50 - 26.50	6.290	5.70 - 7.00
Qn	Male	10	24.240	21.50 - 26.90	6.880	6.50 - 7.50
	Female	10	24.000	21.50 - 28.00	6.800	6.50 - 7.50
Qk	Male	10	24.670	20.50 - 26.10	6.800	5.90 - 7.05
	Female	10	23.770	20.00 - 28.50	6.500	5.80 - 7.00
Qz	Male	10	24.735	22.10 - 28.00	6.480	5.80 - 7.20
	Female	10	25.080	23.00 - 29.00	6.570	6.00 - 7.20
Qc	Male	10	24.370	19.00 - 27.50	6.545	5.10 - 7.80
	Female	10	22.950	19.50 - 27.00	6.260	5.70 - 7.00

TABLE V. RATIO OF LENGTH/WIDTH OF FRONS OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	0.866	119		
Treatments	0.604	11		
Strains	0.465	5	0.0930	37.20**
Sexes	0.099	1	0.0990	39.60**
Sex X Strain	0.040	5	0.0080	3.20**
Replications	0.013	9	0.0014	0.56
Errors	0.249	99	0.0025	

1. Refer to foot-note in Table I.

*: Significant, based on 0.05 level.

**: Highly significant, based on 0.01 level.

TABLE VI. COMPARISON OF SAMPLE MEANS OF RATIO OF LENGTH/ WIDTH OF FRONS OF SIX <u>TELEOGRYLLUS</u> STRAINS

Compared Strains	Male $\bar{d}$ [1]	Male $S_{\bar{d}}$ [2]	Male Calc.val. [3]	Female $\bar{d}$	Female $S_{\bar{d}}$	Female Calc.val.
Qa - Qw	0.152	0.016	9.500**	0.179	0.020	8.950**
Qa - Qn	0.014	0.021	0.667	0.116	0.018	6.444**
Qa - Qk	0.055	0.016	3.438**	0.010	0.028	0.357
Qa - Qz	0.043	0.023	1.870	0.034	0.020	1.700
Qa - Qc	0.005	0.014	0.357	0.053	0.022	2.409*
Qw - Qn	0.138	0.024	5.750**	0.063	0.016	3.938**
Qw - Qk	0.207	0.020	10.350**	0.189	0.026	7.269**
Qw - Qz	0.109	0.026	4.192**	0.145	0.018	8.056**
Qw - Qc	0.149	0.018	8.278**	0.126	0.021	6.000**
Qn - Qk	0.069	0.024	2.875*	0.126	0.025	5.040**
Qn - Qz	0.029	0.029	1.000	0.082	0.016	5.125**
Qn - Qc	0.009	0.022	0.409	0.063	0.019	3.316**
Qk - Qz	0.098	0.026	3.769**	0.044	0.026	1.692
Qk - Qc	0.060	0.018	3.333**	0.063	0.028	2.250*
Qz - Qc	0.038	0.025	1.520	0.019	0.021	0.905

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE VII. RATIO OF LENGTH/WIDTH OF FRONS OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	1.654	0.026	1.628 - 1.680	0.008	1.628 - 1.680
	Female	10	1.632	0.048	1.584 - 1.680	0.015	1.538 - 1.681
Qw	Male	10	1.502	0.044	1.458 - 1.546	0.014	1.456 - 1.548
	Female	10	1.453	0.040	1.413 - 1.493	0.013	1.411 - 1.495
Qn	Male	10	1.640	0.061	1.579 - 1.701	0.019	1.578 - 1.702
	Female	10	1.516	0.033	1.483 - 1.549	0.010	1.484 - 1.548
Qk	Male	10	1.709	0.045	1.664 - 1.754	0.014	1.663 - 1.755
	Female	10	1.642	0.074	1.568 - 1.716	0.023	1.567 - 1.717
Qz	Male	10	1.611	0.068	1.543 - 1.679	0.022	1.539 - 1.683
	Female	10	1.598	0.042	1.556 - 1.640	0.013	1.556 - 1.640
Qc	Male	10	1.649	0.038	1.611 - 1.687	0.012	1.610 - 1.688
	Female	10	1.579	0.049	1.530 - 1.628	0.016	1.527 - 1.631

1. Refer to foot-note in Table III.

TABLE VIII. LENGTH AND WIDTH OF FRONS IN SIX <u>TELEOGRYLLUS</u> STRAINS (mm)

Strain	Sex	Specimens Measured	Mean of Length	Range of Measurements	Mean of Width	Range of Measurements
Qa	Male	10	2.580	2.300 - 2.850	1.560	1.400 - 1.700
	Female	10	2.440	2.300 - 2.700	1.495	1.400 - 1.650
Qw	Male	10	2.370	2.200 - 2.500	1.580	1.450 - 1.700
	Female	10	2.180	2.000 - 2.400	1.500	1.400 - 1.650
Qn	Male	10	2.595	2.300 - 2.900	1.580	1.450 - 1.700
	Female	10	2.380	2.250 - 2.500	1.570	1.500 - 1.650
Qk	Male	10	2.565	2.350 - 2.750	1.500	1.400 - 1.600
	Female	10	2.475	2.200 - 2.700	1.510	1.350 - 1.700
Qz	Male	10	2.310	2.100 - 2.650	1.435	1.300 - 1.600
	Female	10	2.285	2.150 - 2.650	1.430	1.350 - 1.650
Qc	Male	10	2.450	2.150 - 2.650	1.485	1.350 - 1.600
	Female	10	2.345	2.150 - 2.600	1.485	1.400 - 1.600

TABLE IX. RATIO OF WIDTH/LENGTH OF PRONOTUM OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	1.746	119		
Treatments	0.976	11		
Strains	0.550	5	0.1100	15.94**
Sexes	0.367	1	0.3670	53.19**
Sex X Strain	0.059	5	0.0118	1.71
Replications	0.086	9	0.0096	1.39
Errors	0.684	99	0.0069	

1. Refer to foot-note in Table I.

**: Highly significant, based on 0.01 level.

TABLE X. COMPARISON OF SAMPLE MEANS OF RATIO OF WIDTH/ LENGTH OF PRONOTUM OF SIX _TELEOGRYLLUS_ STRAINS

Compared Strains	Male $\bar{d}$ [1]	Male $S_{\bar{d}}$ [2]	Male Calc.val. [3]	Female $\bar{d}$	Female $S_{\bar{d}}$	Female Calc.val.
Qa - Qw	0.093	0.030	3.100**	0.087	0.027	3.222**
Qa - Qn	0.177	0.038	4.658**	0.093	0.035	2.657*
Qa - Qk	0.059	0.039	1.513	0.029	0.029	1.000
Qa - Qz	0.042	0.032	1.312	0.072	0.033	2.182*
Qa - Qc	0.008	0.048	0.167	0.002	0.032	0.062
Qw - Qn	0.270	0.041	6.585**	0.180	0.030	6.000**
Qw - Qk	0.152	0.042	3.619**	0.116	0.022	5.273**
Qw - Qz	0.135	0.035	3.857**	0.015	0.028	0.536
Qw - Qc	0.101	0.050	2.020	0.085	0.026	3.269**
Qn - Qk	0.118	0.048	2.458*	0.064	0.031	2.064
Qn - Qz	0.135	0.042	3.214**	0.165	0.035	4.714**
Qn - Qc	0.169	0.055	3.073**	0.095	0.034	2.794*
Qk - Qz	0.017	0.044	0.386	0.101	0.029	3.607**
Qk - Qc	0.051	0.056	0.911	0.031	0.028	1.107
Qz - Qc	0.034	0.051	0.667	0.070	0.033	2.121*

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XI. RATIO OF WIDTH/LENGTH OF PRONOTUM OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	2.964	0.057	2.907 - 3.021	0.018	2.906 - 3.022
	Female	10	2.892	0.072	2.820 - 2.964	0.023	2.817 - 2.967
Qw	Male	10	2.871	0.075	2.796 - 2.946	0.024	2.793 - 2.949
	Female	10	2.805	0.045	2.760 - 2.850	0.014	2.759 - 2.851
Qn	Male	10	3.141	0.105	3.036 - 3.246	0.033	3.034 - 3.248
	Female	10	2.985	0.082	2.903 - 3.067	0.026	2.901 - 3.069
Qk	Male	10	3.023	0.110	2.913 - 3.133	0.035	2.909 - 3.137
	Female	10	2.921	0.053	2.868 - 2.974	0.017	2.866 - 2.976
Qz	Male	10	3.006	0.082	2.924 - 3.088	0.026	2.922 - 3.090
	Female	10	2.820	0.077	2.743 - 2.897	0.024	2.742 - 2.898
Qc	Male	10	2.972	0.138	2.834 - 3.110	0.044	2.829 - 3.115
	Female	10	2.890	0.071	2.819 - 2.961	0.022	2.818 - 2.962

1. Refer to foot-note in Table III.

TABLE XII. WIDTH AND LENGTH OF PRONOTUM IN SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Sex	Specimens Measured	Mean of Width	Range of Measurements	Mean of Length	Range of Measurements
Qa	Male	10	11.160	9.500 - 12.300	3.765	3.250 - 4.150
	Female	10	10.970	9.800 - 12.500	3.795	3.500 - 4.400
Qw	Male	10	10.350	9.300 - 11.600	3.605	3.250 - 4.000
	Female	10	10.310	8.900 - 11.200	3.675	3.150 - 3.950
Qn	Male	10	11.090	10.300 - 12.200	3.535	3.300 - 4.100
	Female	10	11.240	10.500 - 11.900	3.750	3.550 - 4.050
Qk	Male	10	10.970	10.000 - 12.000	3.630	3.400 - 3.800
	Female	10	11.000	9.400 - 11.800	3.765	3.300 - 4.050
Qz	Male	10	10.680	10.000 - 12.500	3.555	3.300 - 4.150
	Female	10	9.785	9.000 - 11.600	3.470	3.250 - 4.000
Qc	Male	10	10.670	9.600 - 12.300	3.590	3.200 - 3.850
	Female	10	10.300	9.500 - 11.900	3.565	3.350 - 4.200

TABLE XIII. NUMBER OF PEGS ON STRIDULATORY VEINS OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	125,266.00	119		
Treatments	112,356.10	11		
Strains	111,774.80	5	22,354.96	217.04**
Tegmina	452.00	1	452.00	4.38*
Tegmen X Straun	129.30	5	25.86	0.25
Replications	2,712.90	9	301.43	2.93**
Errors	10,197.00	99	103.00	

1. Refer to foot-note in Table I.

*: Significant, based on 0.05 level.

**: Highly significant, based on 0.01 level.

TABLE XIV. COMPARISON OF SAMPLE MEANS OF NUMBER OF PEGS ON STRIDULATORY VEINS OF SIX TELEOGRYLLUS STRAINS

	Tegmen					
	Right			Left		
Compared Strains	$\bar{d}$ [1]	$S_{\bar{d}}$ [2]	Calc.val. [3]	$\bar{d}$	$S_{\bar{d}}$	Calc.val.
Qa - Qw	1.300	3.066	0.424	3.000	3.550	0.845
Qa - Qn	79.000	5.701	13.857**	75.100	6.648	11.297**
Qa - Qk	3.500	5.187	0.675	6.300	4.648	1.355
Qa - Qz	4.400	3.728	1.180	11.100	4.074	2.725*
Qa - Qc	6.600	3.701	1.783	8.800	4.012	2.193*
Qw - Qn	80.300	5.441	14.758**	78.100	6.086	12.833**
Qw - Qk	2.200	4.899	0.449	3.300	3.795	0.870
Qw - Qz	3.100	3.178	0.975	8.100	3.073	2.636*
Qw - Qc	5.300	3.286	1.613	5.800	2.990	1.940
Qn - Qk	82.500	6.856	12.033**	81.400	6.784	11.999**
Qn - Qz	83.400	5.831	14.303**	86.200	6.406	13.456**
Qn - Qc	85.600	5.822	14.703**	83.900	6.367	13.177**
Qk - Qz	0.900	5.329	0.169	4.800	4.290	1.119
Qk - Qc	3.100	5.310	0.584	2.500	4.231	0.591
Qz - Qc	2.200	3.912	0.562	2.300	3.592	0.640

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XV. NUMBER OF PEGS ON STRIDULATORY VEINS OF SIX *TELEOGRYLLUS* STRAINS (MALES)

Strain	Tegmen	Specimens Measured[2]	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Right	10	178.5	7.849	170.7 - 186.3	2.482	170.4 - 186.6
	Left	10	177.5	9.945	167.6 - 187.4	3.145	167.3 - 187.7
Qw	Right	10	177.2	5.831	171.4 - 183.0	1.800	171.4 - 183.0
	Left	10	174.5	5.215	169.3 - 179.7	1.649	169.1 - 179.9
Qn	Right	10	257.5	16.220	241.3 - 273.7	5.130	240.8 - 274.2
	Left	10	252.6	18.524	234.1 - 271.1	5.858	233.6 - 271.6
Qk	Right	10	175.0	14.390	160.6 - 189.4	4.551	160.2 - 189.8
	Left	10	171.2	10.820	160.4 - 182.0	3.422	160.1 - 182.3
Qz	Right	10	174.1	8.786	165.3 - 182.9	2.779	165.1 - 183.1
	Left	10	166.4	8.198	158.2 - 174.6	2.593	158.0 - 174.8
Qc	Right	10	171.9	8.683	163.2 - 180.6	2.746	163.0 - 180.8
	Left	10	168.7	7.887	160.8 - 176.6	2.494	160.6 - 176.8

1. Refer to foot-note in Table III.

2. Both tegmina were calculated from same individual.

TABLE XVI RATIO OF TIBIA/FEMUR OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	0.181	239		
Treatments	0.055	23		
Strains	0.047	5	0.0094	15.67**
Sexes	0.000	1	0.0000	0.00
Sides	0.000	1	0.0000	0.00
Sex X Strain	0.005	5	0.0010	1.67
Sex X Side	0.001	1	0.0010	1.67
Side X Strain	0.001	5	0.0002	0.33
Sex X Side X Strain	0.001	5	0.0002	0.33
Replications	0.006	9	0.0007	1.17
Errors	0.120	207	0.0006	

1. Refer to foot-note in Table I.

**: Highly significant, based on 0.01 level.

TABLE XVII. COMPARISON OF SAMPLE MEANS OF RATIO OF TIBIA/FEMUR OF SIX *TELEOGRYLLUS* STRAINS (AN AVERAGE OF TWO SIDES OF FORE-LEGS)

Compared Strains	Sex					
	Male			Female		
	$\bar{d}$ [1]	$S_{\bar{d}}$ [2]	Calc.val. [3]	$\bar{d}$	$S_{\bar{d}}$	Calc.val.
Qa - Qw	0.010	0.009	1.111	0.014	0.009	1.556
Qa - Qn	0.032	0.009	3.556**	0.030	0.009	3.333**
Qa - Qk	0.008	0.010	0.800	0.032	0.010	3.200**
Qa - Qz	0.006	0.010	0.600	0.007	0.010	0.700
Qa - Qc	0.002	0.012	0.167	0.005	0.010	0.500
Qw - Qn	0.042	0.007	6.000**	0.044	0.010	4.400**
Qw - Qk	0.018	0.008	2.250*	0.046	0.011	4.182**
Qw - Qz	0.016	0.008	2.000	0.021	0.011	1.909
Qw - Qc	0.012	0.010	1.200	0.019	0.011	1.727
Qn - Qk	0.024	0.008	3.000**	0.002	0.011	0.182
Qn - Qz	0.026	0.008	3.250**	0.023	0.011	2.091
Qn - Qc	0.030	0.010	3.000**	0.025	0.011	2.273*
Qk - Qz	0.002	0.008	0.250	0.025	0.011	2.273*
Qk - Qc	0.006	0.011	0.545	0.027	0.011	2.454*
Qz - Qc	0.004	0.011	0.364	0.002	0.011	0.182

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XVIII. RATIO OF TIBIA/FEMUR OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$ [2]	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean [1]
Qa	Male	10	1.006	0.026	0.980 - 1.032	0.008	0.980 - 1.032
	Female	10	1.007	0.018	0.989 - 1.025	0.006	0.987 - 1.027
Qw	Male	10	1.016	0.015	1.001 - 1.031	0.005	1.000 - 1.032
	Female	10	1.021	0.021	1.000 - 1.042	0.007	0.998 - 1.044
Qn	Male	10	0.974	0.015	0.959 - 0.989	0.005	0.958 - 0.990
	Female	10	0.977	0.021	0.956 - 0.998	0.007	0.954 - 1.000
Qk	Male	10	0.998	0.018	0.980 - 1.016	0.006	0.978 - 1.018
	Female	10	0.975	0.026	0.949 - 1.001	0.008	0.949 - 1.001
Qz	Male	10	1.000	0.018	0.982 - 1.018	0.006	0.980 - 1.020
	Female	10	1.000	0.026	0.974 - 1.026	0.008	0.974 - 1.026
Qc	Male	10	1.004	0.028	0.976 - 1.032	0.009	0.975 - 1.033
	Female	10	1.002	0.024	0.978 - 1.026	0.008	0.976 - 1.028

1. Refer to foot-note in Table III.

2. $\bar{x}$ is an average of both fore-legs.

TABLE XIX. LENGTH OF TIBIA AND FEMUR OF FORE-LEG IN SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Sex	Specimens Measured	Mean of Tibia	Range of Measurements	Mean of Femur	Range of Measurements
Qa	Male	10	4.425	4.000 - 4.800	4.398	3.850 - 4.750
	Female	10	4.312	4.100 - 4.450	4.290	4.100 - 4.500
Qw	Male	10	4.432	4.000 - 4.750	4.358	3.950 - 4.700
	Female	10	4.382	4.050 - 4.750	4.292	4.050 - 4.550
Qn	Male	10	4.330	3.750 - 5.150	4.450	3.950 - 5.150
	Female	10	4.128	3.800 - 4.450	4.225	4.000 - 4.450
Qk	Male	10	4.180	3.650 - 4.700	4.185	3.750 - 4.650
	Female	10	4.008	3.500 - 4.300	4.110	3.650 - 4.550
Qz	Male	10	4.042	3.800 - 4.300	4.038	3.850 - 4.200
	Female	10	3.915	3.650 - 4.400	3.920	3.650 - 4.450
Qc	Male	10	4.268	3.850 - 4.650	4.252	4.000 - 4.550
	Female	10	4.170	3.800 - 4.650	4.165	3.850 - 4.650

TABLE XX. RATIO OF LONGITUDINAL/TRANSVERSE DIAMETER OF TYMPANA OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	14.681	239		
Treatments	6.531	23		
Strains	5.677	5	1.135	30.68**
Sexes	0.377	1	0.377	10.19**
Sides	0.004	1	0.004	0.11
Sex X Strain	0.272	5	0.054	1.46
Sex X Side	0.000	1	0.000	0.00
Side X Strain	0.066	5	0.013	0.35
Sex X Side X Strain	0.135	5	0.027	0.73
Replications	0.535	9	0.059	1.60
Errors	7.615	207	0.037	

1. Refer to foot-note in Table I.

**: Highly significant, based on 0.01 level.

TABLE XXI. COMPARISON OF SAMPLE MEANS OF RATIO OF LONGITUDINAL/TRANSVERSE DIAMETER OF TYMPANA OF SIX *TELEOGRYLLUS* STRAINS (AN AVERAGE OF TWO SIDES)

Compared Strains	Male $\bar{d}$ [1]	Male $S_{\bar{d}}$ [2]	Male Calc.val. [3]	Female $\bar{d}$	Female $S_{\bar{d}}$	Female Calc.val.
Qa - Qw	0.126	0.048	2.635*	0.103	0.104	0.990
Qa - Qn	0.334	0.080	4.175**	0.254	0.079	3.215**
Qa - Qk	0.424	0.055	7.709**	0.329	0.084	3.917**
Qa - Qz	0.119	0.067	1.776	0.023	0.081	0.284
Qa - Qc	0.039	0.056	0.696	0.042	0.101	0.416
Qw - Qn	0.208	0.078	2.667*	0.357	0.083	4.301**
Qw - Qk	0.298	0.051	5.843**	0.432	0.088	4.909**
Qw - Qz	0.007	0.065	0.108	0.080	0.085	0.941
Qw - Qc	0.087	0.053	1.642	0.061	0.104	0.586
Qn - Qk	0.090	0.082	1.098	0.075	0.056	1.339
Qn - Qz	0.215	0.091	2.363*	0.277	0.051	5.431**
Qn - Qc	0.295	0.083	3.554**	0.296	0.079	3.747**
Qk - Qz	0.305	0.070	4.357**	0.352	0.059	5.966**
Qk - Qc	0.385	0.059	6.525**	0.371	0.084	4.417**
Qz - Qc	0.080	0.071	1.127	0.019	0.081	0.235

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XXII. RATIO OF LONGITUDINAL/TRANSVERSE DIAMETER OF TYMPANA OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$[2]	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	3.206	0.115	3.091 - 3.321	0.036	3.089 - 3.323
	Female	10	3.182	0.223	2.959 - 3.405	0.071	2.951 - 3.413
Qw	Male	10	3.080	0.098	2.982 - 3.178	0.031	2.979 - 3.181
	Female	10	3.285	0.239	3.046 - 3.524	0.076	3.038 - 3.532
Qn	Male	10	2.872	0.225	2.647 - 3.097	0.071	2.641 - 3.103
	Female	10	2.928	0.109	2.819 - 3.037	0.034	2.817 - 3.039
Qk	Male	10	2.782	0.129	2.653 - 2.911	0.041	2.649 - 2.915
	Female	10	2.853	0.142	2.711 - 2.995	0.045	2.707 - 2.999
Qz	Male	10	3.087	0.179	2.908 - 3.266	0.057	2.902 - 3.272
	Female	10	3.205	0.121	3.084 - 3.326	0.038	3.081 - 3.329
Qc	Male	10	3.167	0.135	3.032 - 3.302	0.043	3.027 - 3.307
	Female	10	3.224	0.224	3.000 - 3.448	0.071	2.993 - 3.455

1. Refer to foot-note in Table III.

2. $\bar{x}$ is an average of both tympana (right and left).

TABLE XXIII. LENGTH OF LONGITUDINAL AND TRANSVERSE DIAMETERS OF TYMPANA IN SIX <u>TELEOGRYLLUS</u> STRAINS (AN AVERAGE OF TWO SIDES, 1 unit = 0.015 mm)

Strain	Sex	Specimens Measured	Mean of Long. Diam.	Range of Measurements	Mean of Trans. Diam.	Range of Measurements
Qa	Male	10	65.000	60.00 - 73.00	20.300	19.00 - 21.00
	Female	10	64.925	60.00 - 70.00	20.475	18.00 - 23.00
Qw	Male	10	86.500	63.00 - 72.00	22.250	20.00 - 24.00
	Female	10	72.650	62.00 - 80.00	22.200	20.00 - 24.00
Qn	Male	10	62.075	51.50 - 70.00	21.700	18.00 - 25.00
	Female	10	60.900	53.50 - 66.00	20.825	18.00 - 22.00
Qk	Male	10	62.850	53.00 - 72.00	22.525	20.00 - 25.00
	Female	10	62.850	57.00 - 68.00	22.075	20.00 - 24.00
Qz	Male	10	64.000	59.00 - 69.00	20.800	17.00 - 23.00
	Female	10	64.625	59.00 - 71.00	20.200	18.00 - 22.00
Qc	Male	10	62.350	43.00 - 70.00	19.700	15.00 - 22.00
	Female	10	65.625	60.00 - 76.00	20.400	18.50 - 22.00

TABLE XXIV. RATIO OF LENGTH/WIDTH OF ECTOPARAMERE OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	5.119	59		
Strains	2.739	5	0.548	15.22**
Replications	0.742	9	0.082	2.28*
Errors	1.638	45	0.036	

TABLE XXV. RATIO OF MEASUREMENTS[2] OF SECOND VALVIFER OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	0.336	59		
Strains	0.116	5	0.0232	5.95**
Replications	0.046	9	0.0051	1.31
Errors	0.174	45	0.0039	

1. From Steel and Torrie (1960: 134 - 137).
2. Refer to Fig. 20.
*: Significant, based on 0.05 level.
**: Highly significant, based on 0.01 level.

TABLE XXVI. COMPARISON OF SAMPLE MEANS OF RATIO OF LENGTH/ WIDTH OF ECTOPARAMERES AND RATIO OF MEASUREMENTS OF SECOND VALVIFER OF SIX *TELEOGRYLLUS* STRAINS

Compared Strains	Sex: Male $\bar{d}$ [1]	Male $S_{\bar{d}}$ [2]	Male Calc.val. [3]	Female $\bar{d}$	Female $S_{\bar{d}}$	Female Calc.val.
Qa - Qw	0.011	0.099	0.111	0.001	0.025	0.040
Qa - Qn	0.586	0.104	5.635**	0.102	0.023	4.435**
Qa - Qk	0.024	0.086	0.279	0.059	0.030	1.967
Qa - Qz	0.005	0.076	0.066	0.109	0.033	3.303**
Qa - Qc	0.112	0.093	1.204	0.071	0.025	2.840*
Qw - Qn	0.597	0.113	5.283**	0.103	0.022	4.682**
Qw - Qk	0.035	0.096	0.365	0.060	0.029	2.069
Qw - Qz	0.006	0.088	0.068	0.110	0.033	3.333**
Qw - Qc	0.123	0.103	1.194	0.072	0.024	3.000**
Qn - Qk	0.562	0.101	5.564**	0.043	0.028	1.536
Qn - Qz	0.591	0.093	5.523**	0.007	0.031	0.226
Qn - Qc	0.474	0.107	4.430**	0.031	0.022	1.409
Qk - Qz	0.029	0.072	0.403	0.050	0.037	1.351
Qk - Qc	0.088	0.089	0.989	0.012	0.030	0.400
Qz - Qc	0.117	0.080	1.462	0.038	0.033	1.152

1, 2, and 3 refer to foot-notes in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XXVII. RATIO OF LENGTH/WIDTH OF ECTOPARAMERE AND OF MEASUREMENTS[2] OF SECOND VALVIFER OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	3.516	0.198	3.318 - 3.714	0.063	3.311 - 3.721
	Female	10	1.473	0.057	1.416 - 1.530	0.018	1.415 - 1.531
Qw	Male	10	3.505	0.243	3.262 - 3.748	0.077	3.255 - 3.755
	Female	10	1.474	0.053	1.421 - 1.527	0.017	1.419 - 1.529
Qn	Male	10	4.102	0.262	3.840 - 4.364	0.083	3.832 - 4.372
	Female	10	1.371	0.046	1.325 - 1.417	0.015	1.324 - 1.418
Qk	Male	10	3.540	0.184	3.356 - 3.724	0.058	3.352 - 3.728
	Female	10	1.414	0.076	1.338 - 1.490	0.024	1.336 - 1.498
Qz	Male	10	3.511	0.133	3.378 - 3.644	0.042	3.375 - 3.647
	Female	10	1.364	0.088	1.276 - 1.452	0.028	1.274 - 1.454
Qc	Male	10	3.628	0.215	3.413 - 3.843	0.068	3.407 - 3.849
	Female	10	1.402	0.054	1.348 - 1.456	0.017	1.346 - 1.458

1. Refer to foot-note in Table III.

2. Refer to Fig. 20.

TABLE XXVIII. LENGTH AND WIDTH OF ECTOPARAMERES IN MALES OF SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Specimens Measured	Mean of Length	Range of Measurements	Mean of Width	Range of Measurements
Qa	10	1.210	1.100 - 1.350	0.345	0.300 - 0.400
Qw	10	1.170	1.100 - 1.300	0.335	0.300 - 0.350
Qn	10	1.350	1.250 - 1.500	0.330	0.300 - 0.350
Qk	10	1.220	1.150 - 1.300	0.345	0.300 - 0.350
Qz	10	1.245	1.100 - 1.400	0.355	0.300 - 0.400
Qc	10	1.270	1.150 - 1.400	0.350	0.350 - 0.350

TABLE XXIX. LENGTH OF MEASUREMENTS[1] OF SECOND VALVIFER IN FEMALES OF SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Specimens Measured	Mean of AB	Range of Measurements	Mean of AC	Range of Measurements
Qa	10	1.765	1.650 - 1.850	1.200	1.050 - 1.300
Qw	10	1.760	1.650 - 1.850	1.195	1.100 - 1.250
Qn	10	1.590	1.450 - 1.700	1.160	1.100 - 1.250
Qk	10	1.645	1.550 - 1.750	1.165	1.100 - 1.200
Qz	10	1.615	1.400 - 1.750	1.185	1.100 - 1.300
Qc	10	1.605	1.500 - 1.700	1.145	1.100 - 1.200

1. Refer to Fig. 20.

TABLE XXX. RATIO OF EPIPROCT MEASUREMENTS[2] OF SIX *TELEOGRYLLUS* STRAINS (MALE)

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	0.200	59		
Strains	0.128	5	0.0256	18.29**
Replications	0.007	9	0.0008	0.57
Errors	0.065	45	0.0014	

TABLE XXXI. RATIO OF EPIPROCT MEASUREMENTS[2] OF SIX *TELEOGRYLLUS* STRAINS (FEMALE)

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	0.150	59		
Strains	0.093	5	0.0186	16.91**
Replications	0.009	1	0.0010	0.91
Errors	0.048	45	0.0011	

1. Refer to foot-note in Table XXV.
2. Refer to Fig. 21.

**: Highly significant, based on 0.01 level.

TABLE XXXII. COMPARISON OF SAMPLE MEANS OF RATIO OF EPIPROCT MEASUREMENTS OF SIX *TELEOGRYLLUS* STRAINS

Compared Strains	Sex: Male $\bar{d}$ [1]	$S_{\bar{d}}$ [2]	Calc.val. [3]	Female $\bar{d}$	$S_{\bar{d}}$	Calc.val.
Qa - Qw	0.056	0.018	3.111**	0.005	0.014	0.357
Qa - Qn	0.133	0.014	9.500**	0.110	0.013	8.462**
Qa - Qk	0.042	0.014	3.000**	0.007	0.017	0.412
Qa - Qz	0.002	0.015	0.133	0.007	0.014	0.500
Qa - Qc	0.074	0.019	3.895**	0.018	0.014	1.286
Qw - Qn	0.077	0.016	4.812**	0.115	0.012	9.583**
Qw - Qk	0.014	0.016	0.875	0.012	0.017	0.706
Qw - Qz	0.058	0.017	3.412**	0.012	0.014	0.857
Qw - Qc	0.018	0.020	0.900	0.023	0.013	1.769
Qn - Qk	0.091	0.013	7.000**	0.106	0.016	6.438**
Qn - Qz	0.135	0.013	10.385**	0.103	0.013	7.923**
Qn - Qc	0.059	0.018	3.278**	0.092	0.012	7.667**
Qk - Qz	0.044	0.013	3.385**	0.000	0.017	0.000
Qk - Qc	0.032	0.018	1.778	0.011	0.017	0.647
Qz - Qc	0.076	0.018	4.222**	0.011	0.014	0.766

1, 2, and 3 refer to foot-note in Table II.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XXXIII. RATIO OF EPIPROCT MEASUREMENTS[2] OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	10	1.034	0.036	0.998 - 1.070	0.0114	0.997 - 1.071
	Female	10	1.070	0.032	1.038 - 1.102	0.0101	1.037 - 1.103
Qw	Male	10	1.090	0.042	1.048 - 1.132	0.0133	1.047 - 1.133
	Female	10	1.065	0.030	1.035 - 1.095	0.0095	1.034 - 1.096
Qn	Male	10	1.167	0.028	1.139 - 1.195	0.0089	1.138 - 1.196
	Female	10	1.180	0.024	1.156 - 1.204	0.0076	1.155 - 1.205
Qk	Male	10	1.076	0.028	1.048 - 1.104	0.0089	1.047 - 1.105
	Female	10	1.077	0.044	1.033 - 1.121	0.0139	1.032 - 1.122
Qz	Male	10	1.032	0.032	1.000 - 1.064	0.0101	0.999 - 1.065
	Female	10	1.077	0.033	1.044 - 1.110	0.0104	1.043 - 1.111
Qc	Male	10	1.108	0.048	1.060 - 1.156	0.0152	1.059 - 1.157
	Female	10	1.088	0.030	1.058 - 1.118	0.0095	1.057 - 1.119

1. Refer to foot-note in Table III.

2. Refer to Fig. 21.

TABLE XXXIV. LENGTH AND WIDTH OF EPIPROCT IN SIX *TELEOGRYLLUS* STRAINS (mm)

Strain	Sex	Specimens Measured	Mean of Length	Range of Measurements	Mean of Width	Range of Measurements
Qa	Male	10	1.845	1.600 - 1.950	1.785	1.650 - 2.000
	Female	10	1.715	1.650 - 1.900	1.605	1.500 - 1.850
Qw	Male	10	1.870	1.700 - 1.950	1.720	1.500 - 1.900
	Female	10	1.740	1.600 - 1.900	1.635	1.450 - 1.800
Qn	Male	10	2.065	1.950 - 2.150	1.770	1.650 - 1.850
	Female	10	1.875	1.800 - 2.000	1.590	1.500 - 1.700
Qk	Male	10	1.920	1.750 - 2.050	1.785	1.700 - 1.950
	Female	10	1.780	1.650 - 1.900	1.655	1.550 - 1.800
Qz	Male	10	1.845	1.700 - 1.950	1.790	1.650 - 1.900
	Female	10	1.695	1.600 - 1.900	1.575	1.450 - 1.750
Qc	Male	10	1.835	1.750 - 2.000	1.660	1.500 - 1.850
	Female	10	1.810	1.650 - 1.900	1.645	1.550 - 1.750

TABLE XXXV. NUMBER OF DENTICLES ON PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	29,999.09	4319		
Strains	1,151.19	5	230.24	89.59**
Sexes	6.79	1	6.79	2.64
Individuals	3,258.49	59	55.23	21.49**
Rows	14,509.70	11	1,319.06	513.25**
Columns	19.09	5	3.82	1.49
Replications	178.19	4	44.55	17.33**
Errors	10,875.64	4234	2.59	

1. Refer to foot-note in Table I.

**: Highly significant, based on 0.01 level.

TABLE XXXVI. COMPARISON OF SAMPLE MEANS OF NUMBER OF DENTICLES ON PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS (AN AVERAGE OF EACH TOOTH IN EACH ROW OF TEETH)

Compared Strains	Calculated *t*-value[1]					
	Row I	Row II	Row III	Row IV	Row V	Row VI
Qa - Qw	2.642**	1.141	0.232	0.377	0.535	0.963
Qa - Qn	0.786	2.119*	2.392*	1.984*	0.073	2.189*
Qa - Qk	1.769	4.596**	7.061**	9.988**	10.532**	6.855**
Qa - Qz	4.422**	1.145	2.777**	3.832**	4.458**	2.342*
Qa - Qc	2.012*	1.956	1.835	3.634**	5.507**	4.832**
Qw - Qn	3.734**	0.964	2.938**	3.058**	0.658	3.922**
Qw - Qk	4.331**	5.874**	7.563**	12.951**	11.643**	7.328**
Qw - Qz	1.786	0.000	2.830**	4.167**	4.457**	1.870
Qw - Qc	0.699	0.990	1.841	4.315**	5.845**	4.990**
Qn - Qk	1.141	7.198**	9.368**	13.548**	11.290**	9.960**
Qn - Qz	5.846**	0.943	4.856**	5.761**	4.717**	4.429**
Qn - Qc	3.048**	0.248	4.329**	6.235**	5.976**	8.039**
Qk - Qz	6.038**	5.791**	3.557**	4.166**	4.306**	3.647**
Qk - Qc	3.756**	6.141**	5.535**	6.844**	5.633**	2.636**
Qz - Qc	2.562*	0.976	1.268	0.987	0.060	1.650

1. Refer to foot-notes 1, 2, and 3 in Table II.

*: Significant, based on 0.05 level, df = 118.

**: Highly significant, based on 0.01 level, df = 118.

TABLE XXXVI. Continued

	Calculated *t*-value[1]					
Compared Strains	Row VII	Row VIII	Row IX	Row X	Row XI	Row XII
Qa - Qw	1.299	1.051	0.132	1.415	1.853	0.865
Qa - Qn	3.664**	2.652**	1.769	0.694	0.814	0.122
Qa - Qk	5.932**	5.703**	6.302**	4.243**	0.933	2.346*
Qa - Qz	1.909	1.576	2.374*	1.801	0.707	1.083
Qa - Qc	4.057**	2.374*	3.169**	2.237*	1.185	1.549
Qw - Qn	5.505**	4.279**	1.982*	0.714	2.349*	0.742
Qw - Qk	4.962**	5.480**	7.612**	6.971**	0.188	3.385**
Qw - Qz	0.877	0.836	3.233**	3.496**	0.590	2.128*
Qw - Qc	3.012**	1.596	3.855**	4.592**	2.941**	0.820
Qn - Qk	10.798**	9.362**	8.871**	5.417**	1.453	2.491*
Qn - Qz	5.184**	3.977**	4.259**	2.598*	1.298	1.227
Qn - Qc	8.263**	5.558**	5.298**	3.275**	0.252	1.444
Qk - Qz	3.170**	3.212**	3.528**	2.128*	0.269	1.469
Qk - Qc	1.638	3.623**	3.108**	2.423*	1.734	3.803**
Qz - Qc	1.661	0.379	0.618	0.124	1.611	2.700**

TABLE XXXVII. NUMBER OF DENTICLES OF PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS

Strain	Sex	Specimens Measured[2]	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	5	6.747	2.516	4.231 - 9.263	0.133	6.404 - 7.090
	Female	5	6.103	2.173	3.930 - 8.276	0.114	5.809 - 6.397
Qw	Male	5	6.100	2.309	3.791 - 8.409	0.122	5.786 - 6.414
	Female	5	6.608	2.209	4.399 - 8.817	0.116	6.309 - 6.907
Qn	Male	5	6.014	2.076	3.938 - 8.090	0.109	5.733 - 6.295
	Female	5	6.233	2.096	4.137 - 8.329	0.111	5.947 - 6.519
Qk	Male	5	7.753	2.891	4.862 -10.644	0.152	7.361 - 8.145
	Female	5	7.639	3.177	4.462 -10.816	0.168	7.206 - 8.072
Qz	Male	5	6.989	3.038	3.951 -10.027	0.160	6.577 - 7.401
	Female	5	6.419	2.910	3.509 - 9.329	0.153	6.025 - 6.813
Qc	Male	5	6.708	2.553	4.155 - 9.261	0.135	6.360 - 7.056
	Female	5	7.261	2.653	4.608 - 9.814	0.140	6.900 - 7.622

1. Refer to foot-note in Table III, df = 359.

2. Actual sample size is 5 (individuals) X 72 (tooth number for each individual).

TABLE XXXVIII. HEIGHT OF PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS

ANALYSIS OF VARIANCE[1]

SOURCE OF VARIATION	S.S.	df.	M.S.	F-VALUE
Total	458,622	4,319		
Strains	5,930	5	1,186.00	101.80**
Sexes	21	1	21.00	1.80
Individuals	27,899	59	472.86	40.59**
Rows	373,488	11	33,953.45	2,914.46**
Columns	77	5	15.40	1.32
Replications	1,866	4	466.50	40.04**
Errors	49,341	4,234	11.65	

1. Refer to foot-note in Table I.

**: Highly significant, based on 0.01 level.

TABLE XXXIX. COMPARISON OF SAMPLE MEANS OF HEIGHT OF PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS (AN AVERAGE OF EACH TOOTH IN EACH ROW OF TEETH)

	Calculated *t*-value[1]					
Compared Strains	Row I	Row II	Row III	Row IV	Row V	Row VI
Qa - Qw	2.844**	6.538**	4.927**	5.909**	3.545**	3.868**
Qa - Qn	0.450	2.894**	0.577	3.110**	4.338**	5.430**
Qa - Qk	0.785	2.671**	6.078**	5.008**	1.429	0.422
Qa - Qz	4.104**	3.724**	0.815	0.714	1.372	3.342**
Qa - Qc	2.884**	6.713**	3.283**	3.267**	3.551**	3.125**
Qw - Qn	3.544**	8.501**	5.929**	3.211**	0.814	1.679
Qw - Qk	3.692**	7.823**	10.421**	11.077**	6.983**	3.839**
Qw - Qz	1.257	2.190*	5.116**	5.668**	2.674**	0.292
Qw - Qc	0.134	0.477	1.273	2.672**	1.616	0.630
Qn - Qk	0.378	0.187	12.261**	8.534**	6.396**	5.670**
Qn - Qz	5.116**	5.760**	0.398	3.314**	2.145*	1.788
Qn - Qc	3.638**	8.571**	4.048**	0.363	0.852	2.202*
Qk - Qz	5.000**	5.382**	4.541**	3.508**	2.682**	3.225**
Qk - Qc	3.772**	7.957**	8.543**	8.397**	5.484**	2.992**
Qz - Qc	1.544	2.565*	3.669**	3.464**	1.522	0.300

1. Refer to foot-notes 1, 2, and 3 in Table II.

*: Significant, based on 0.05 level, df = 118.

**: Highly significant, based on 0.01 level, df = 118.

TABLE XXXIX. Continued

Compared Strains	Calculated *t*-value[1]					
	Row VII	Row VIII	Row IX	Row X	Row XI	Row XII
Qa - Qw	4.071**	2.180*	2.188*	1.094	0.123	0.164
Qa - Qn	6.034**	3.673**	4.226**	3.689**	3.006**	2.249*
Qa - Qk	1.983*	1.041	0.089	2.826**	3.803**	3.317**
Qa - Qz	3.816**	3.182**	2.376*	3.316**	3.693**	2.299*
Qa - Qc	3.648**	3.276**	4.821**	7.250**	6.662**	0.682
Qw - Qn	2.330*	1.765	2.000*	2.567*	3.261**	2.743**
Qw - Qk	2.132*	1.292	1.952	1.754	3.945**	3.913**
Qw - Qz	0.147	1.455	0.285	2.164*	4.016**	2.791**
Qw - Qc	0.139	1.483	2.934**	6.171**	7.252**	0.956
Qn - Qk	4.263**	3.013**	3.840**	0.723	0.947	1.454
Qn - Qz	1.859	0.000	1.614	0.480	0.463	0.084
Qn - Qc	1.742	0.061	1.280	3.764**	2.995**	1.908
Qk - Qz	2.033*	2.507*	2.146*	0.280	0.583	1.360
Qk - Qc	1.929	2.596*	4.484**	4.335**	1.559	3.206**
Qz - Qc	0.000	0.052	2.581*	4.300**	2.740**	1.969

TABLE XL. HEIGHT OF PROVENTRICULAR TEETH OF SIX *TELEOGRYLLUS* STRAINS (1 unit = 0.0063 mm)

Strain	Sex	Specimens Measured[2]	$\bar{x}$	s	Range of Individuals	$S_{\bar{x}}$	Range of Mean[1]
Qa	Male	5	21.853	10.103	11.750 - 31.956	0.535	20.475 - 23.231
	Female	5	22.031	10.250	11.781 - 32.281	0.540	20.640 - 23.422
Qw	Male	5	17.886	8.734	9.152 - 26.620	0.460	16.701 - 19.071
	Female	5	21.375	9.546	11.829 - 30.921	0.503	20.079 - 22.671
Qn	Male	5	21.122	9.758	11.364 - 30.880	0.514	19.798 - 22.446
	Female	5	19.219	9.166	10.053 - 28.385	0.483	17.975 - 20.463
Qk	Male	5	22.017	10.977	11.040 - 32.994	0.579	20.525 - 23.509
	Female	5	22.022	11.700	10.322 - 33.722	0.623	20.417 - 23.627
Qz	Male	5	20.589	10.892	9.697 - 31.481	0.574	19.110 - 22.068
	Female	5	19.386	10.683	8.703 - 30.069	0.563	17.936 - 20.836
Qc	Male	5	18.708	10.310	8.398 - 29.018	0.544	17.307 - 20.109
	Female	5	18.975	10.073	8.902 - 29.048	0.531	17.607 - 20.343

1. Refer to foot-note in Table III, df = 359.

2. Refer to foot-note in Table XXXVII.

TABLE XLI. SUMMARY OF RESULTS OBTAINED IN TABLES[1] OF COMPARISON OF SAMPLE MEANS

Compared Strains	Ratio of Body Measurements		Ratio of Frons Measurements		Ratio of Pronotum Measurements	
	Male	Female	Male	Female	Male	Female
Qa - Qw	0.288[2]	0.647	9.500**	8.950**	3.100**	3.222**
Qa - Qn	2.538*	3.000**	0.667	6.444**	4.658**	2.657*
Qa - Qk	0.674	1.742	3.438**	0.357	1.513	1.000
Qa - Qz	3.280**	0.545	1.870	1.700	1.312	2.182*
Qa - Qc	1.370	1.740	0.357	2.409*	0.167	0.062
Qw - Qn	2.221*	3.750**	5.750**	3.938**	6.585**	6.000**
Qw - Qk	0.774	1.725	10.350**	7.269**	3.619**	5.273**
Qw - Qz	2.164*	0.092	4.192**	8.056**	3.857**	0.536
Qw - Qc	0.786	1.741	8.278**	6.000**	2.020	3.269**
Qn - Qk	2.191*	1.196	2.875*	5.040**	2.458*	2.064*
Qn - Qz	5.585**	3.384**	1.000	5.125**	3.214**	4.714**
Qn - Qc	3.614**	1.343	0.409	3.316**	3.073	2.794*
Qk - Qz	4.386**	1.630	3.769**	1.692	0.386	3.607**
Qk - Qc	2.102*	0.079	3.333**	2.250*	0.911	1.107
Qz - Qc	1.636	1.638	1.520	0.905	0.667	2.121*

1. From Tables II, VI, X, XIV, XVII, XXI, XXVI and XXXI.

2. Calculated t-values.

*: Significant, based on 0.05 level, df = 18.

**: Highly significant, based on 0.01 level, df = 18.

TABLE XLI. Continued 1.

Compared Strains	Number of Pegs on Stridulatory Vein		Ratio of Foreleg Measurements		Ratio of Tympanum Measurements	
	Right	Left	Male	Female	Male	Female
Qa - Qw	0.424	0.845	1.111	1.556	2.625*	0.990
Qa - Qn	13.857**	11.297**	3.556**	3.333**	4.175**	3.215**
Qa - Qk	0.675	1.355	0.800	3.200**	7.709**	3.917**
Qa - Qz	1.180	2.725*	0.600	0.700	1.776	0.284
Qa - Qc	1.783	2.193*	0.167	0.500	0.696	0.416
Qw - Qn	14.758**	12.833**	6.000**	4.400**	2.667*	4.301**
Qw - Qk	0.449	0.870	2.250*	4.182**	5.843**	4.909**
Qw - Qz	0.975	2.636*	2.000	1.909	0.108	0.941
Qw - Qc	1.613	1.940	1.200	1.727	1.642	0.586
Qn - Qk	12.033**	11.999**	3.000**	0.182	1.098	1.339
Qn - Qz	14.303**	13.456**	3.250**	2.091	2.363*	5.431**
Qn - Qc	14.703**	13.177**	3.000**	2.273*	3.554**	3.747**
Qk - Qz	0.169	1.119	0.250	2.273*	4.357**	5.966**
Qk - Qc	0.584	0.591	0.545	2.454*	0.525	4.417**
Qz - Qc	0.562	0.640	0.364	0.182	1.127	0.235

TABLE XLI. Continued 2.

Compared Strains	Ratio of Genitalia Measurements		Ratio of Epiproct Measurements	
	Male	Female	Male	Female
Qa - Qw	0.111	0.040	3.111**	0.357
Qa - Qn	5.635**	4.435**	9.500**	8.462**
Qa - Qk	0.279	1.967	3.000**	0.412
Qa - Qz	0.066	3.303**	0.133	0.500
Qa - Qc	1.204	2.840*	3.895**	1.286
Qw - Qn	5.283**	4.682**	4.812**	9.583**
Qw - Qk	0.365	2.069	0.875	0.706
Qw - Qz	0.068	3.333**	3.412**	0.857
Qw - Qc	1.194	3.000**	0.900	1.769
Qn - Qk	5.564**	1.536	7.000**	6.438**
Qn - Qz	5.523**	0.226	10.385**	7.923**
Qn - Qc	4.430**	1.409	3.278**	7.667**
Qk - Qz	0.403	1.351	3.365**	0.000
Qk - Qc	0.983	0.400	1.778	0.647
Qz - Qc	1.462	1.152	4.222**	0.786

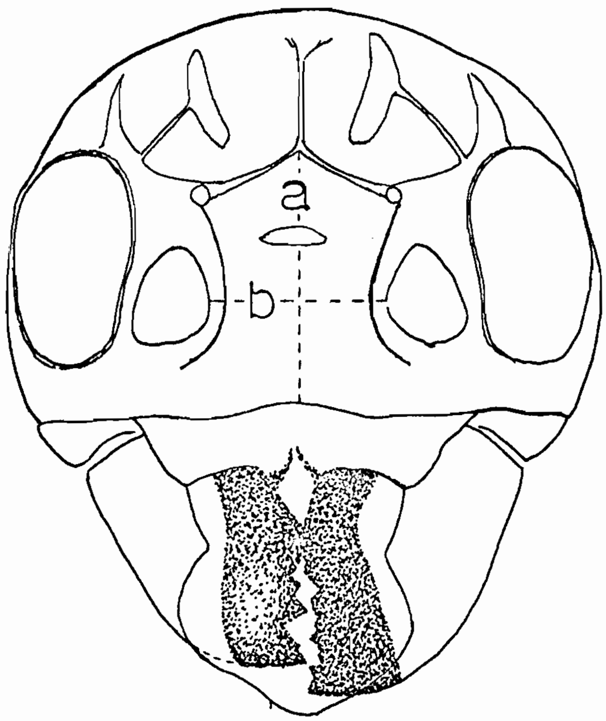
FIGURES

From 1 to 40

Fig. 1. Frontal view of head of Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

a: length of frons

b: width of frons



2.50 mm

Fig. 2. Dorsal view of pronotum, Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

a: length of pronotum

b: width of pronotum (flattened)

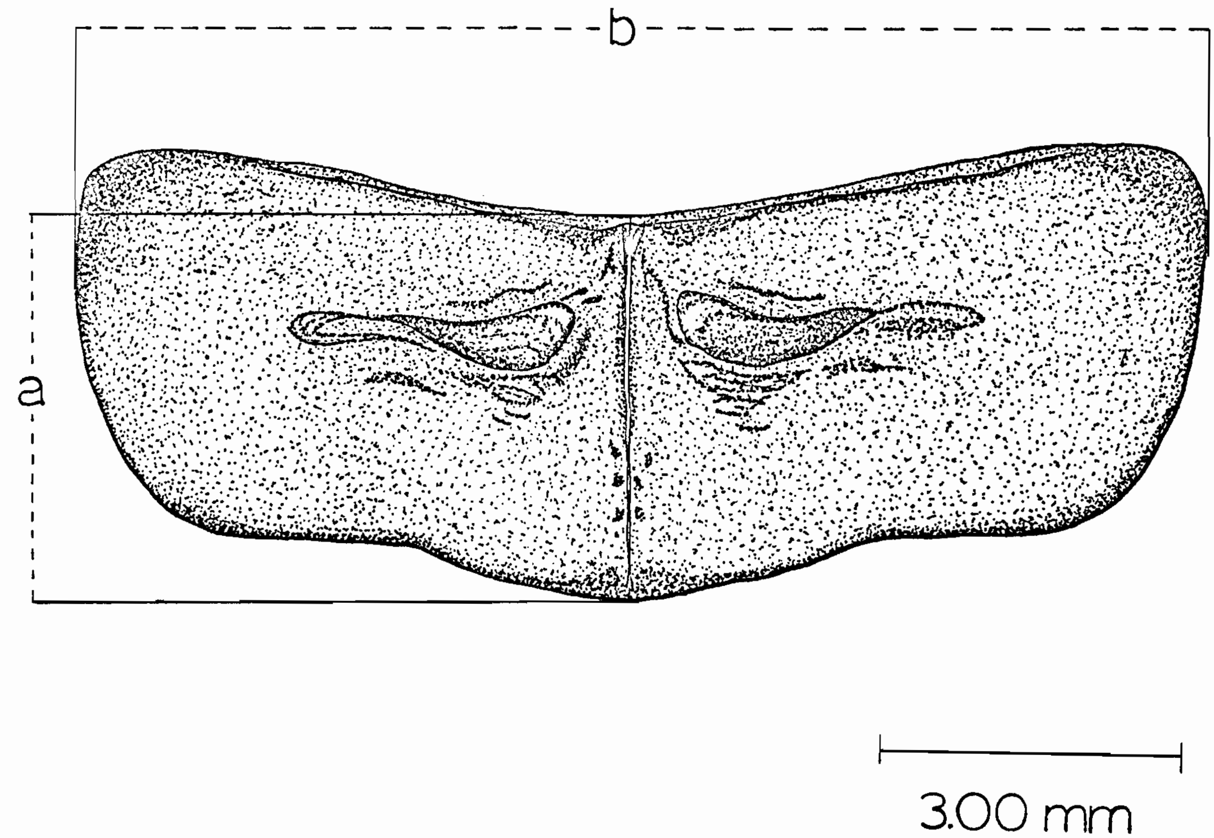
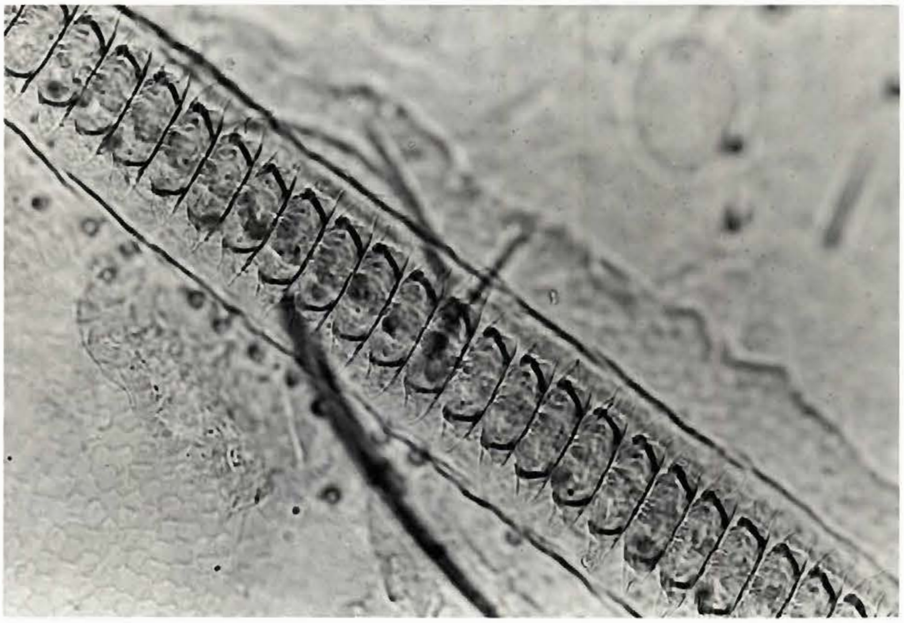

b
a
3.00 mm

Fig. 3. Shape of pegs on stridulatory vein, Qa strain.

Fig. 4. Shape of pegs on stridulatory vein, Qw strain (*Teleogryllus commodus* (Walker)).

Qa

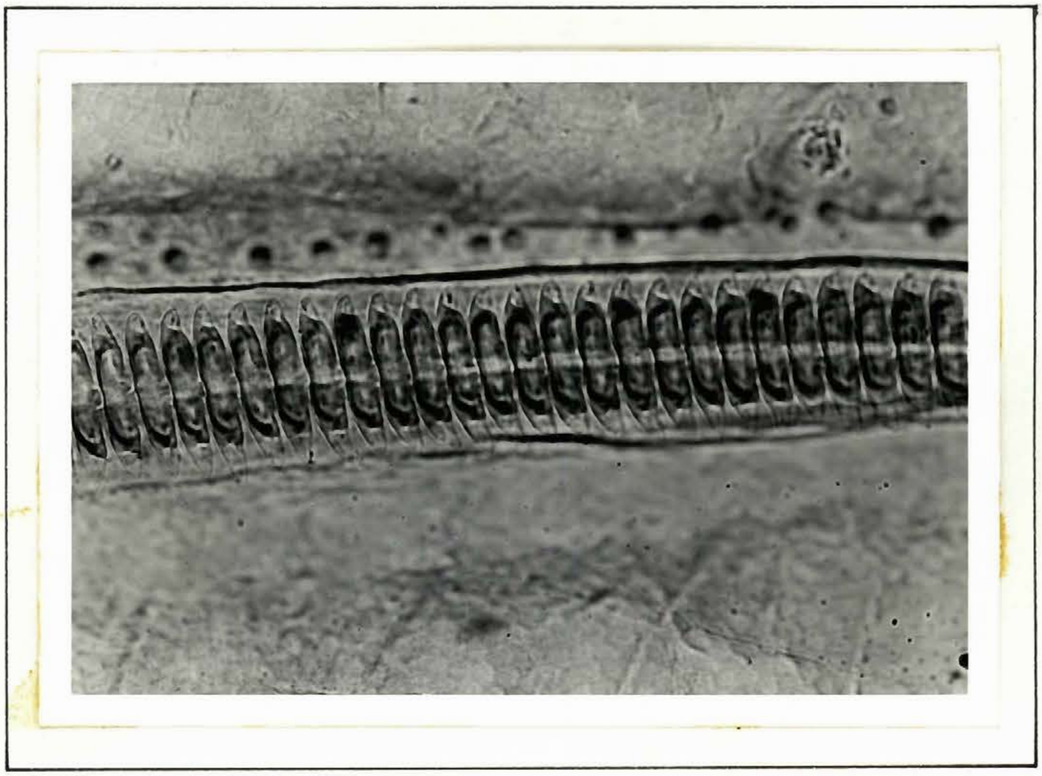


Qw

Fig. 5. Shape of pegs on stridulatory vein, Qn strain (_Teleogryllus oceanicus_ (Le Guillou)).

Fig. 6. Shape of pegs on stridulatory vein, Qk strain.

Qn



QK

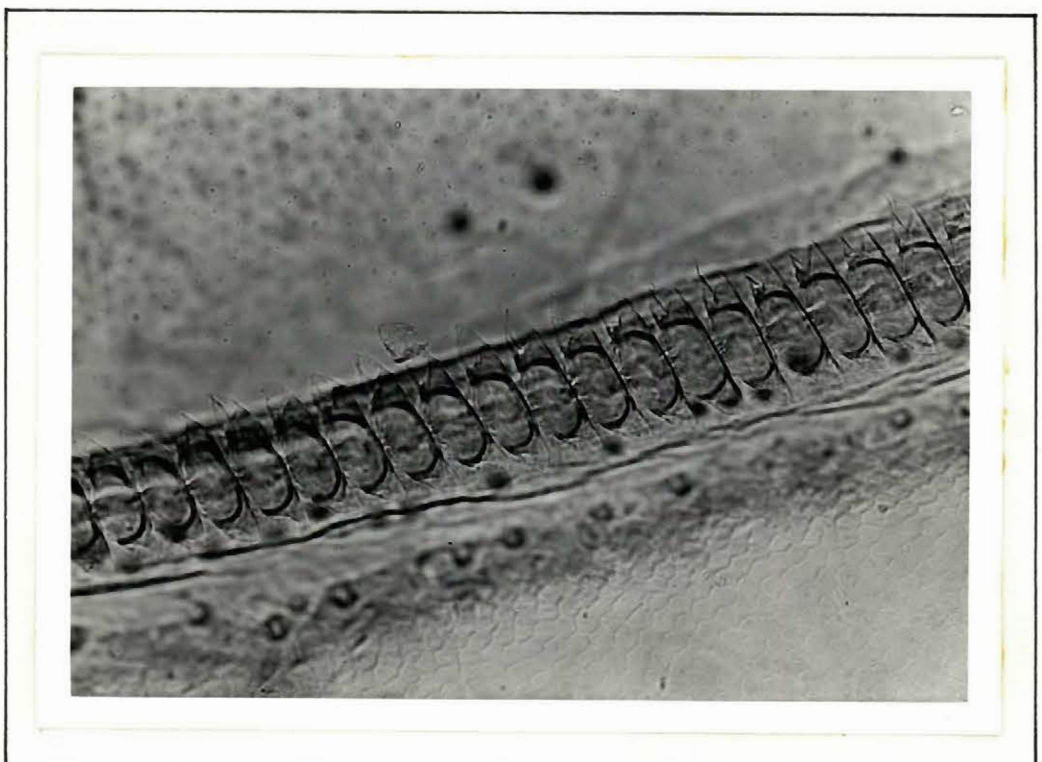
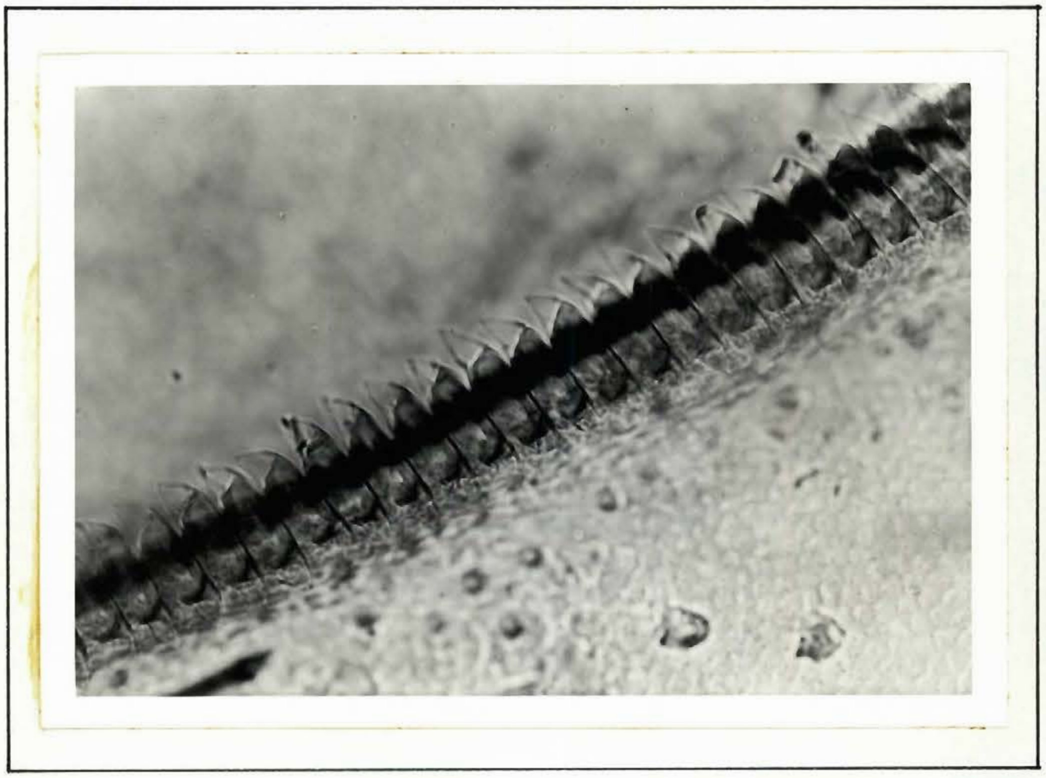


Fig. 7. Shape of pegs on stridulatory vein, Qz strain.

Fig. 8. Shape of pegs on stridulatory vein, Qc strain.

Q2



Qc

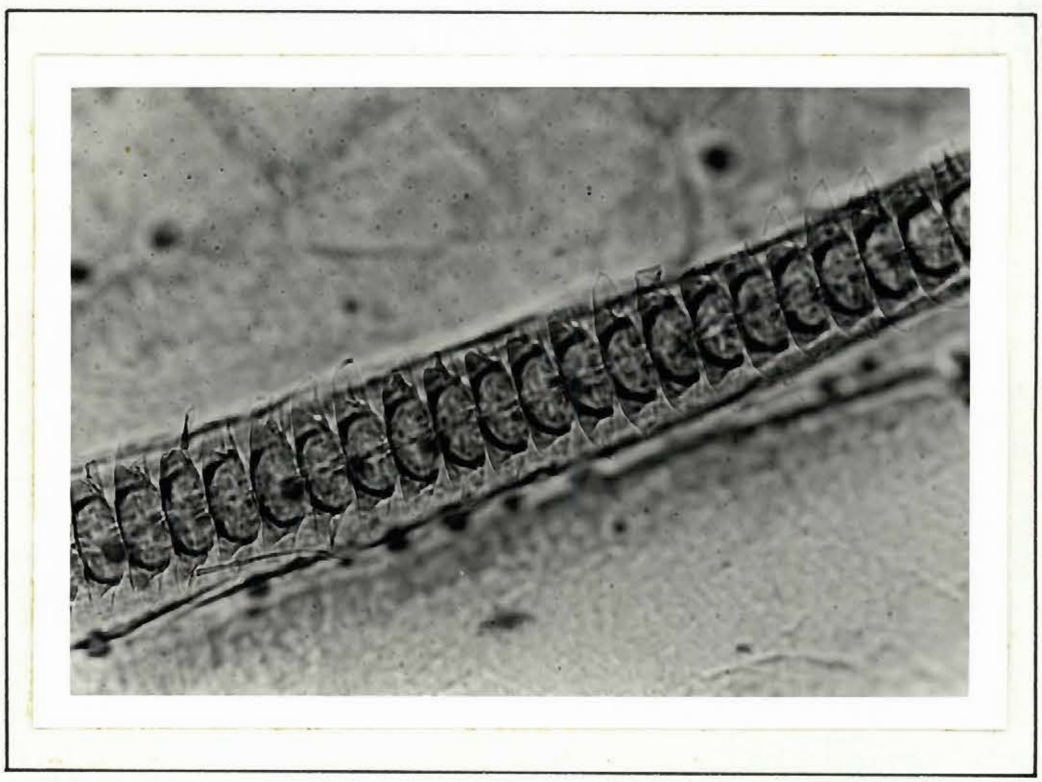


Fig. 9. Shape of pegs on stridulatory vein, *Teleogryllus oceanicus* (Le Guillou), Hawaiian specimen.

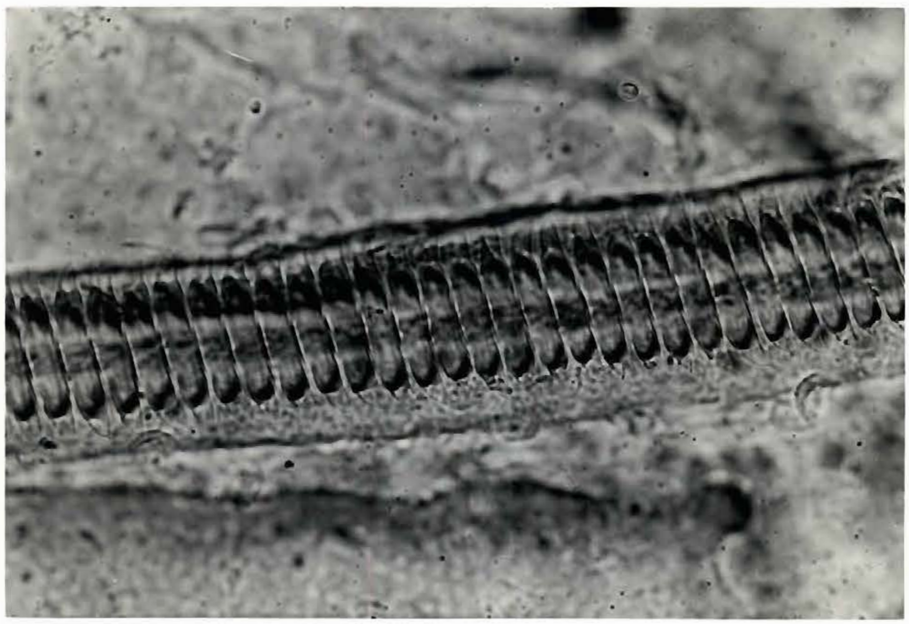


Fig. 10. Shape of tip of tympanum of tegmen, Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

Fig. 11. Shape of tip of tympanum of tegmen, *Teleogryllus oceanicus* (Le Guillou), Hawaiian specimen.

Qn

Ha

Fig. 12. Left foreleg of Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

a: length of femur

b: length of tibia

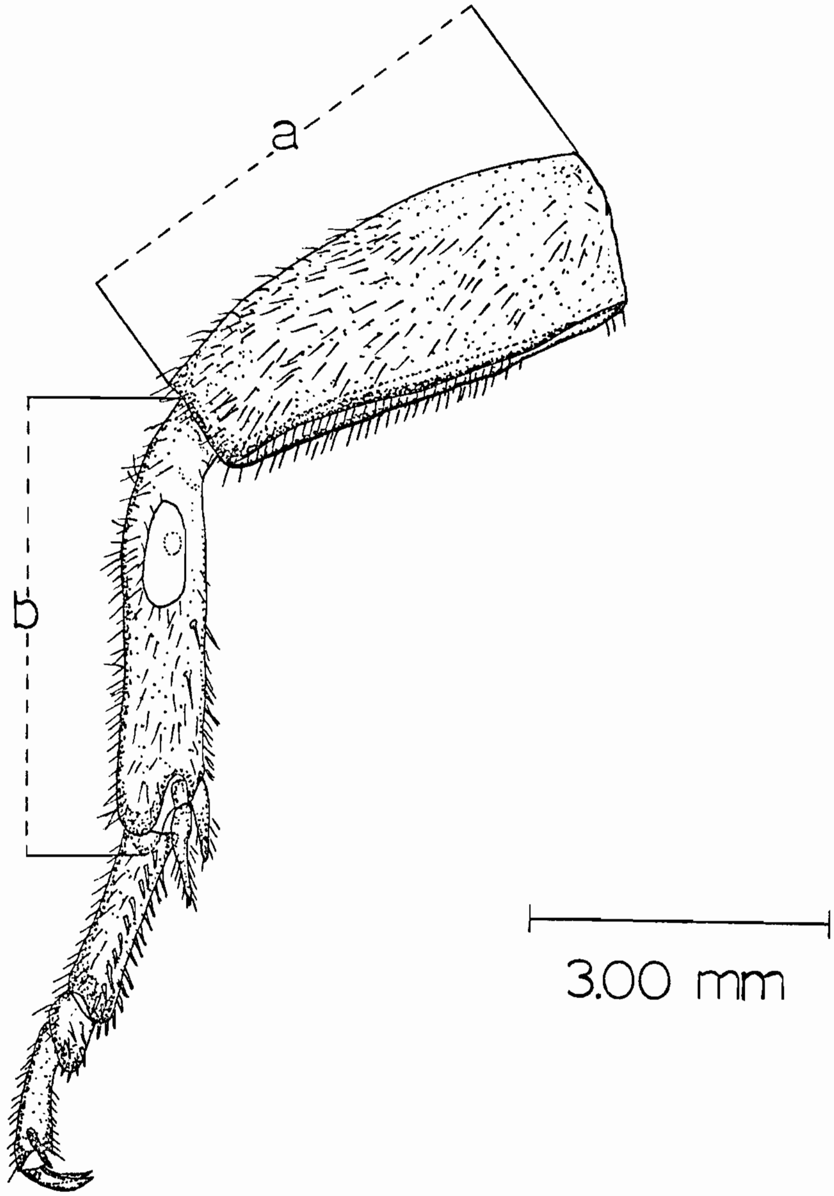

a
b
3.00 mm

Fig. 13. Acoustic organ of Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

a: longitudinal diameter of tympanum

b: transverse diameter of tympanum

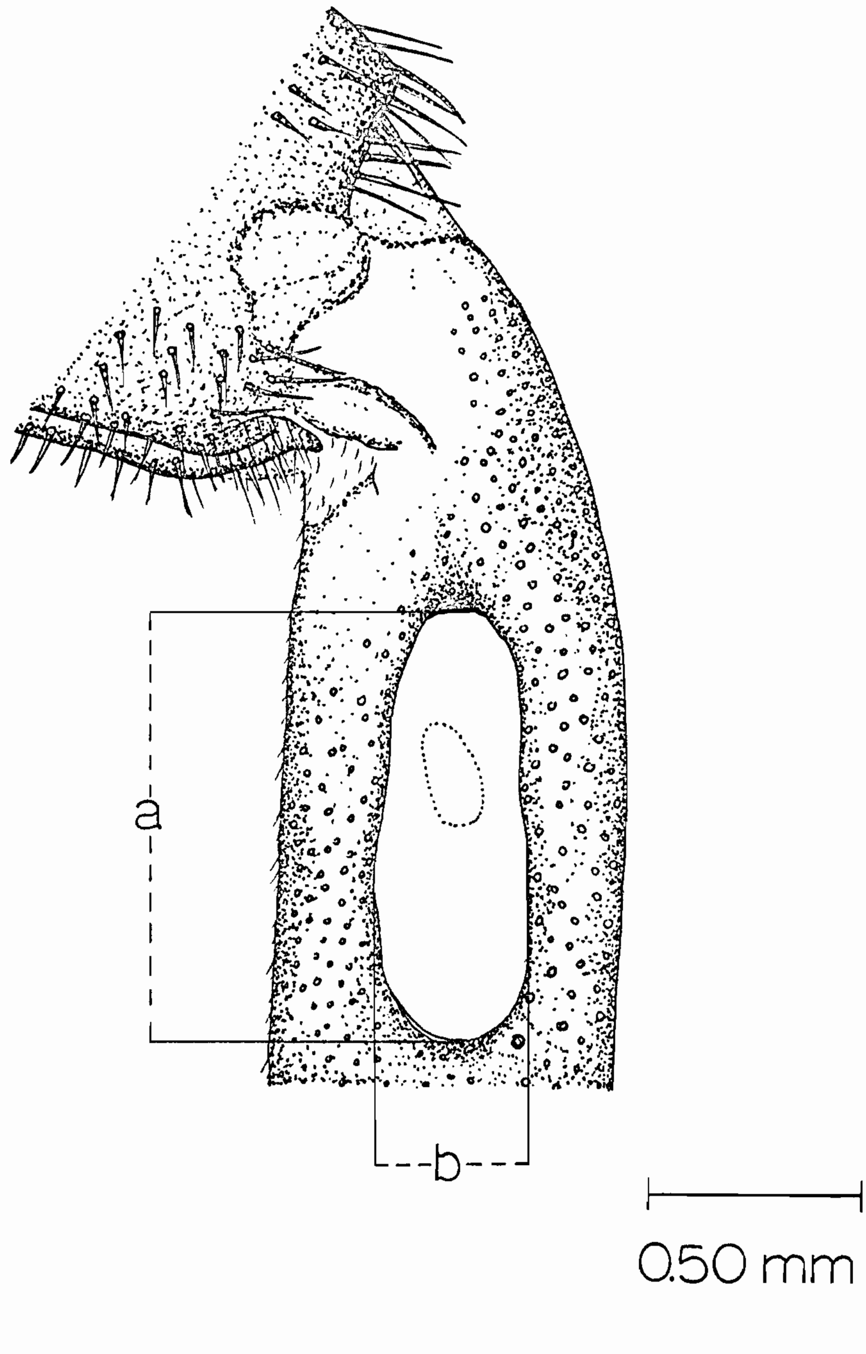
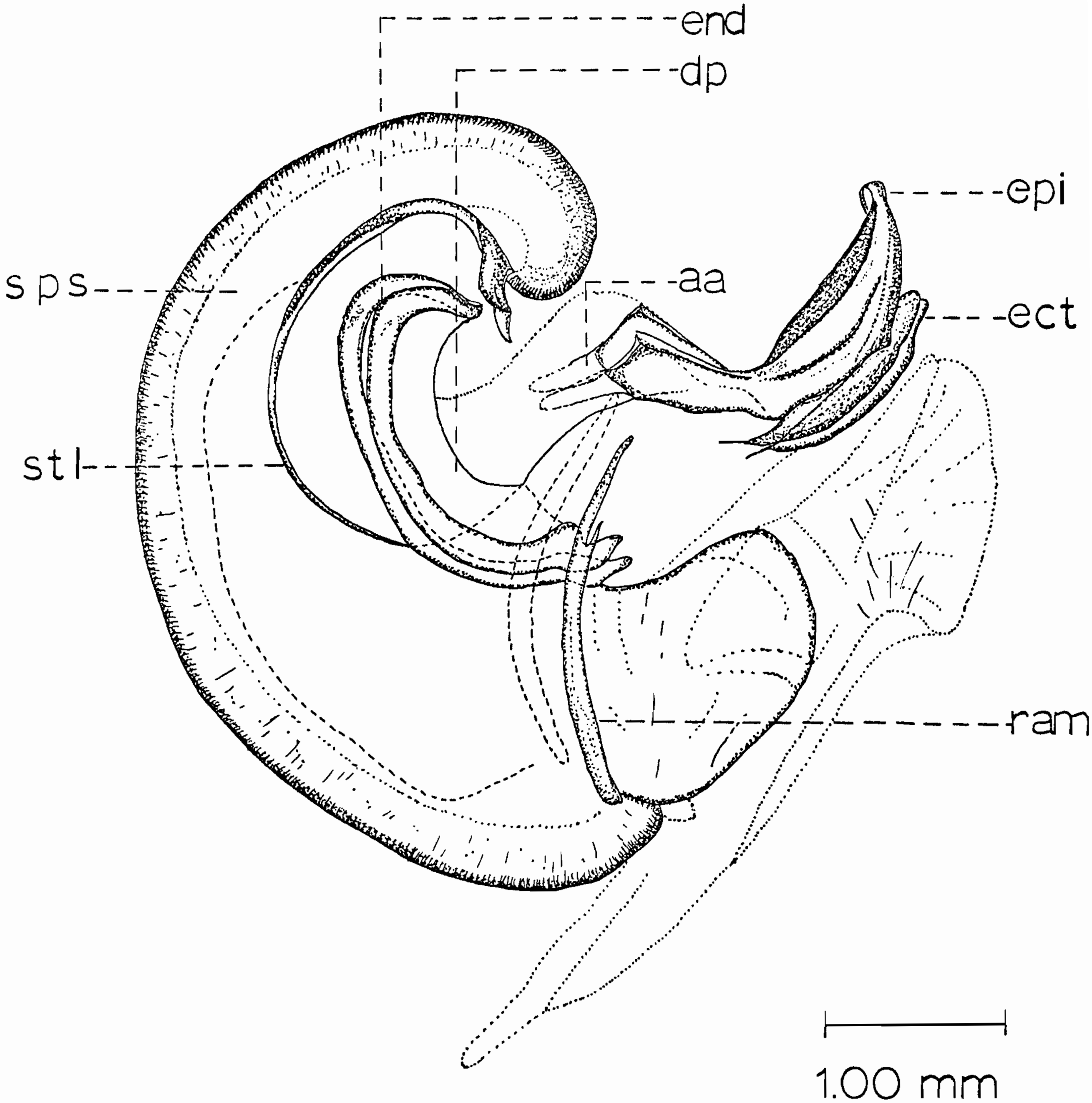

a
b
0.50 mm

Fig. 14. Lateral view of male external genitalia, Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

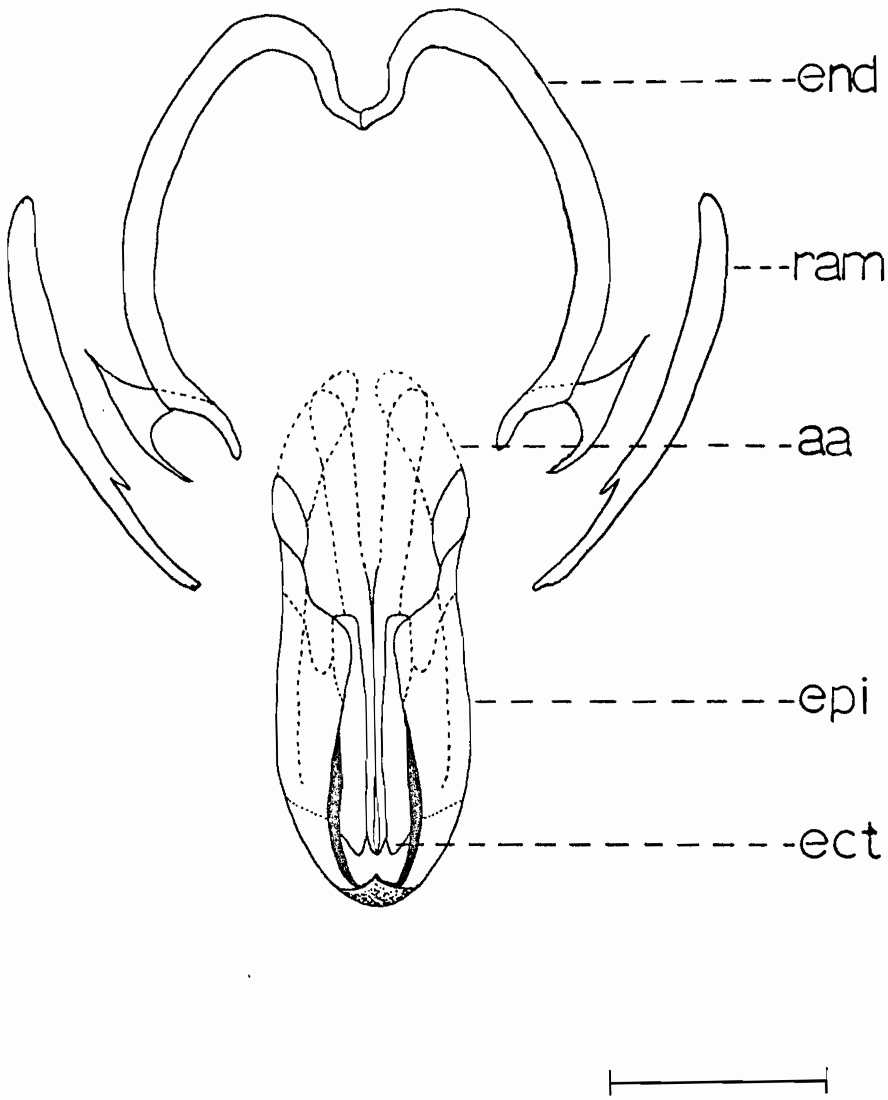
aa: internal anterior apodeme of epiphallus
dp: dorsal pouch
ect: ectoparamere
end: endoparamere
epi: epiphallus
ram: ramus
sps: spermatophore sac
stl: stylet



end
dp
epi
sps
aa
ect
stl
ram
1.00 mm

Fig. 15. Dorsal view of male genitalia of Qn strain (<u>Teleogryllus</u> <u>oceanicus</u> (Le Guillou)) with stylet and spermatophore sac removed.

Lettering as in Fig. 14.



end
ram
aa
epi
ect
1.00 mm

Fig. 16. Ventral view of male genitalia of Qn strain (_Teleogryllus_ _oceanicus_ (Le Guillou)) with stylet and spermatophore sac removed.

Lettering as in Fig. 14.

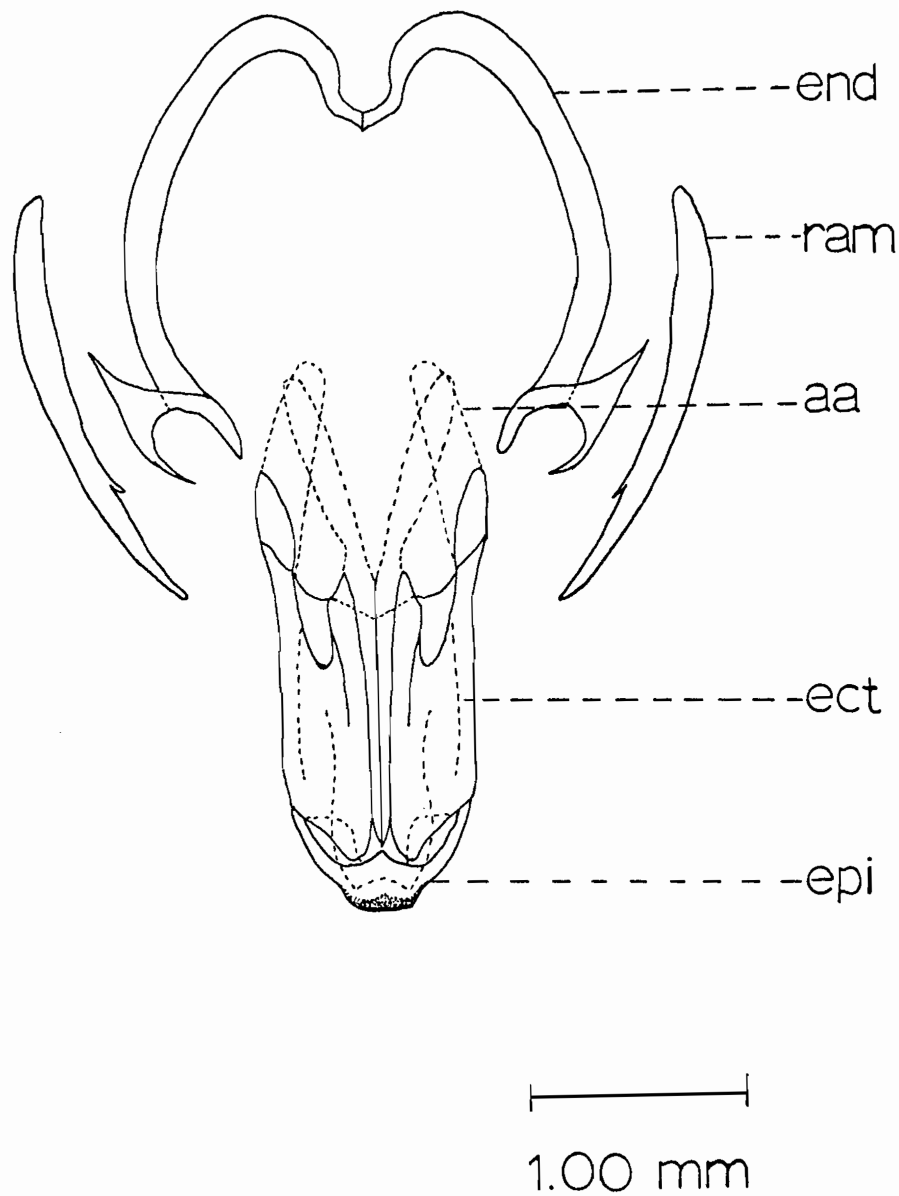

end
ram
aa
ect
epi
1.00 mm

Fig. 17. Dorsal view of epiphallus and rami of Qn strain (_Teleogryllus_ _oceanicus_ (Le Guillou)).

Lettering as in Fig. 14.

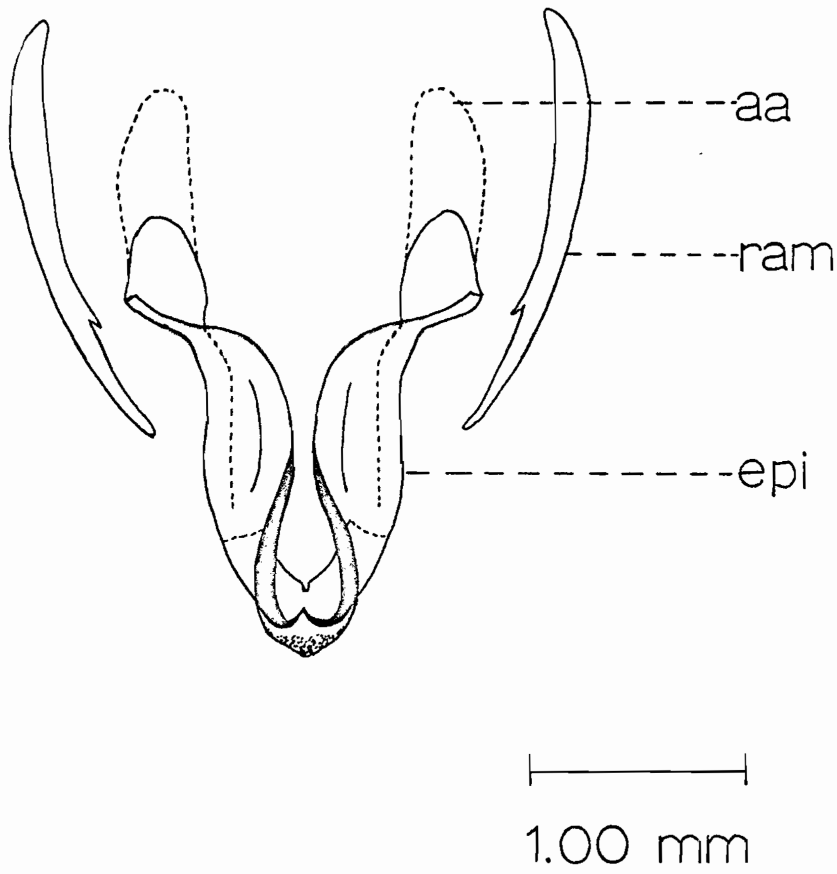
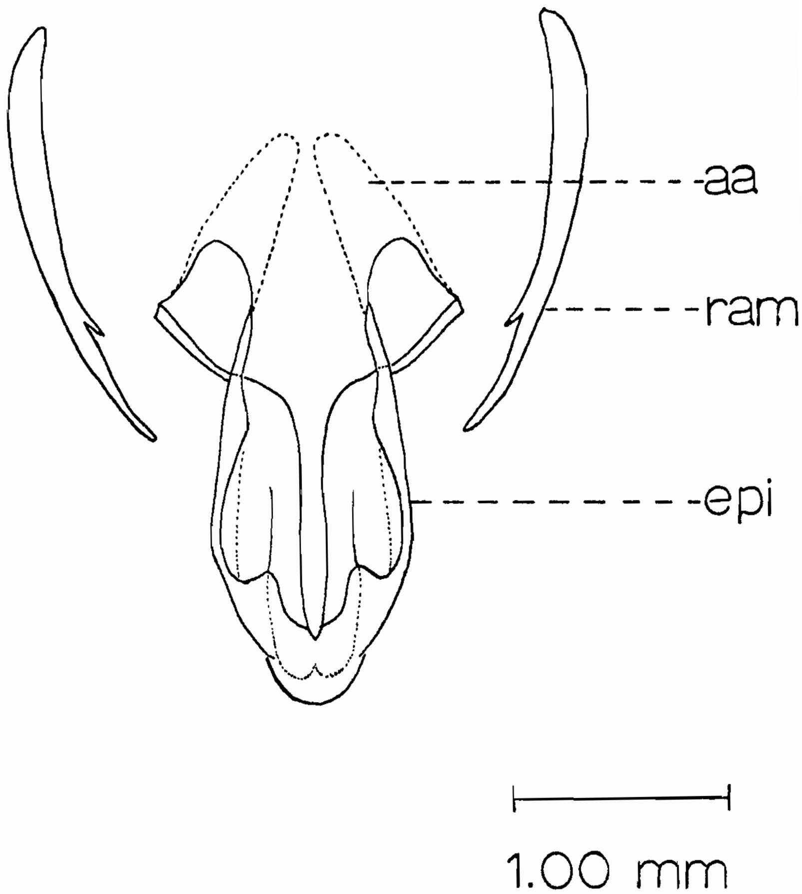

aa
ram
epi
1.00 mm

Fig. 18. Ventral view of epiphallus and rami of Qn strain (_Teleogryllus oceanicus_ (Le Guillou)).

Lettering as in Fig. 14.



aa
ram
epi
1.00 mm

Fig. 19. Dorsal view of ecto- and endo-parameres of Qn strain (_Teleogryllus oceanicus_ (Le Guillou)).

a: length of ectoparamere

b: width of ectoparamere

Other lettering as in Fig. 14.

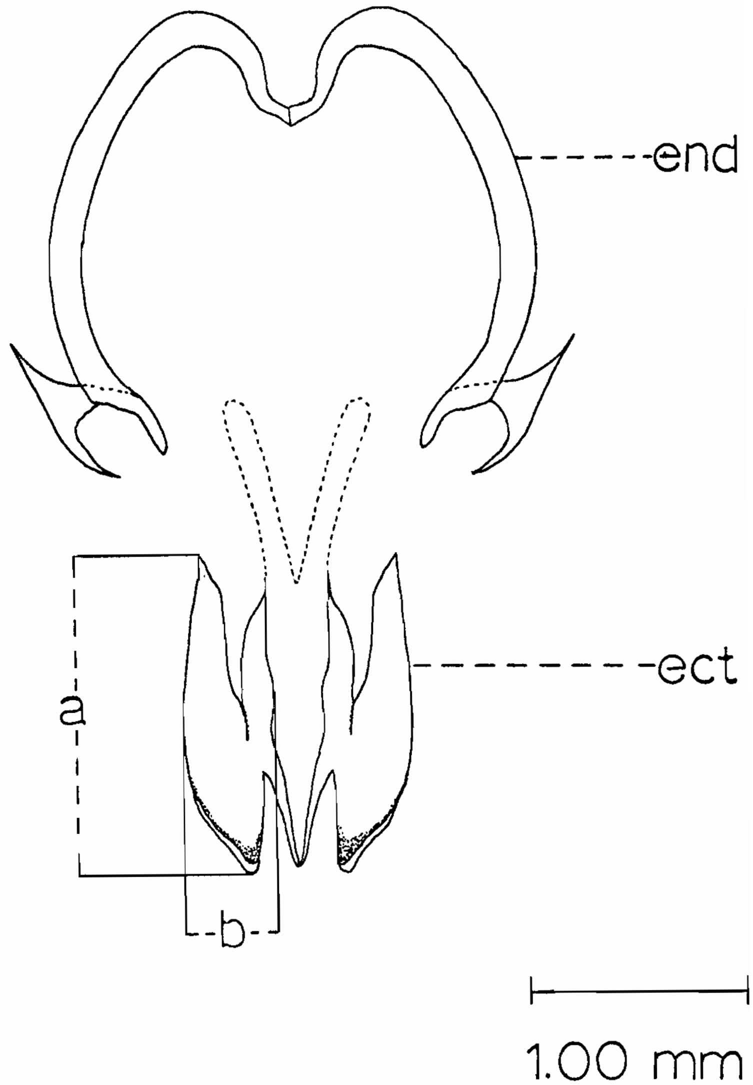

end
ect
a
b
1.00 mm

Fig. 20. Lateral view of female external genitalia of Qn strain (Teleogryllus oceanicus (Le Guillou)).

aa: internal anterior apodeme of second valvifer
cx: connexion between two second valvifers
vl: valvula
vlf: valvifer

AB, AC: measurements of taxonomic characters used in separation of strains.

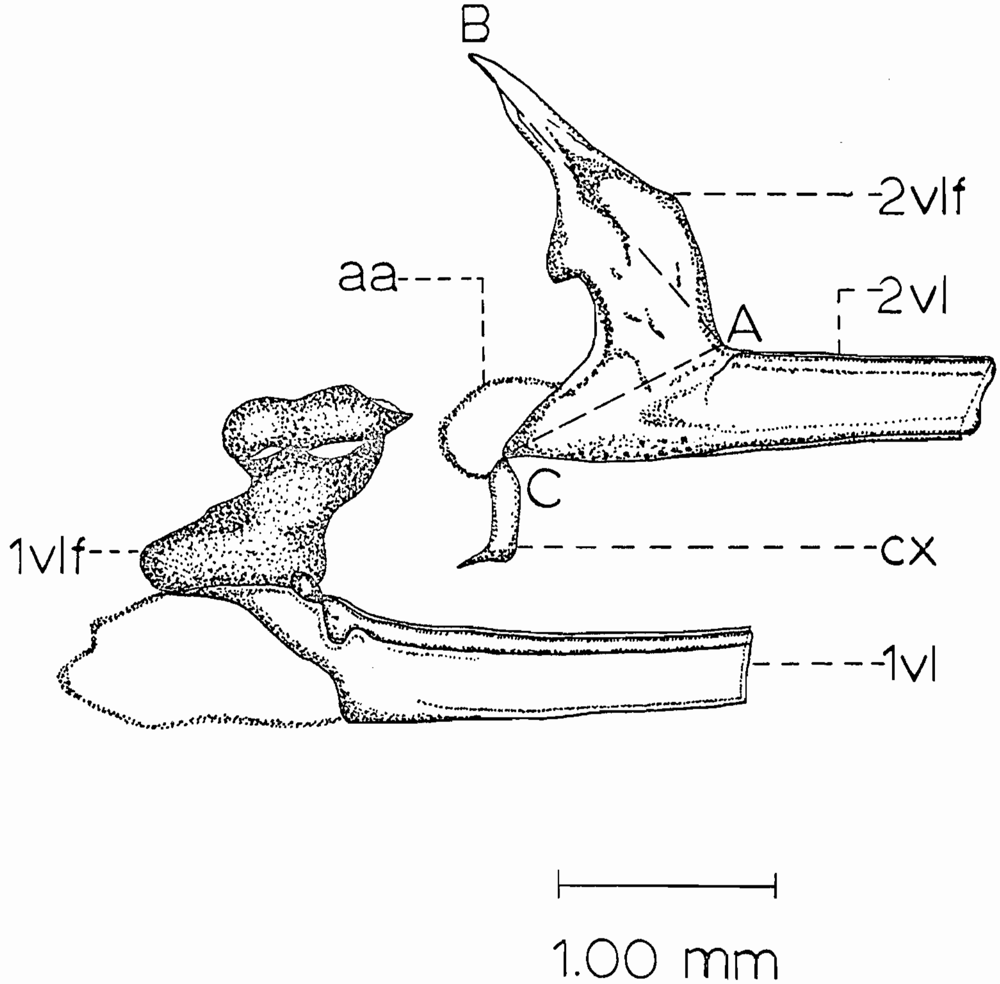

B
2vlf
aa
2vl
A
C
cx
1vlf
1vl
1.00 mm

Fig. 21. Dorsal view of epiproct of Qn strain (Teleogryllus oceanicus (Le Guillou)), male, showing the measured dimensions.

a: length of epiproct

b: width of epiproct

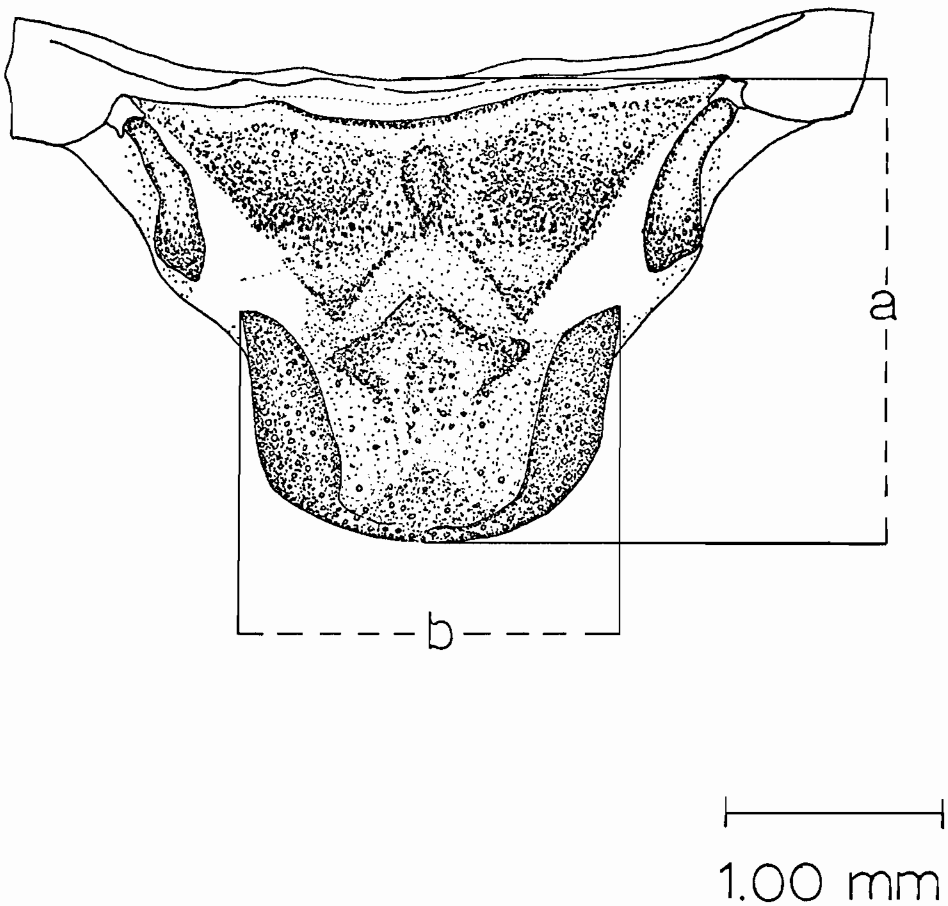

a
b
1.00 mm

Fig. 22. Shape of epiproct, Qa strain, male (X 200).

Fig. 23. Shape of epiproct, Qa strain, female (X 200).

Qa ♂

Qa ♀

Fig. 24. Shape of epiproct, Qw strain (<u>Teleogryllus</u> <u>commodus</u> (Walker)), male (X 200).

Fig. 25. Shape of epiproct, Qw strain (<u>Teleogryllus</u> <u>commodus</u> (Walker)), female (X 200).

Qw ♂

Qw ♀

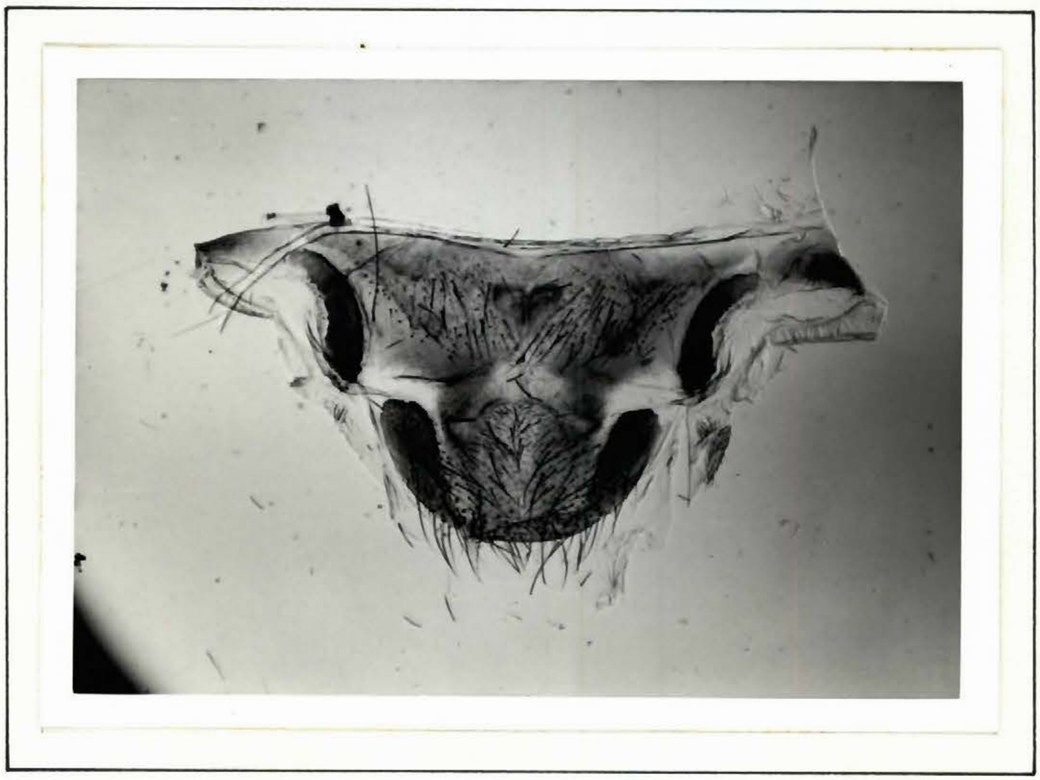
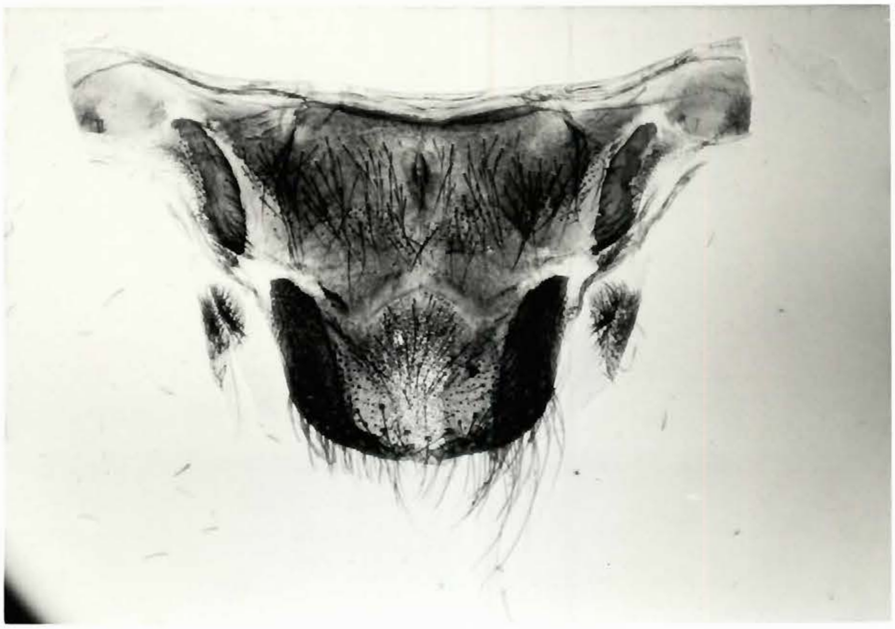


Fig. 26. Shape of epiproct, Qn strain (*Teleogryllus oceanicus* (Le Guillou)), male (X 200).

Fig. 27. Shape of epiproct, Qn strain (*Teleogryllus oceanicus* (Le Guillou)), female (X 200).

Qn ♂



Qn ♀

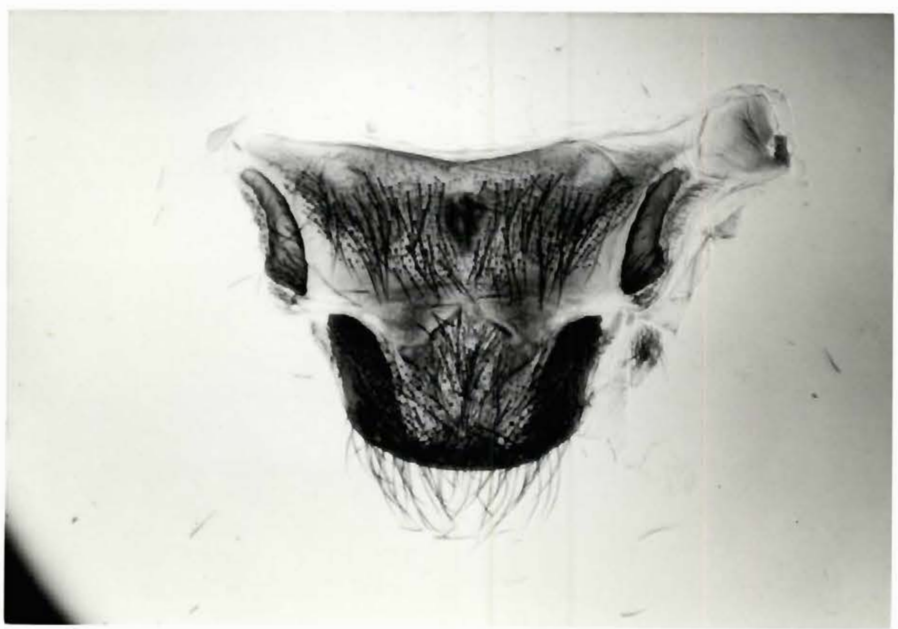
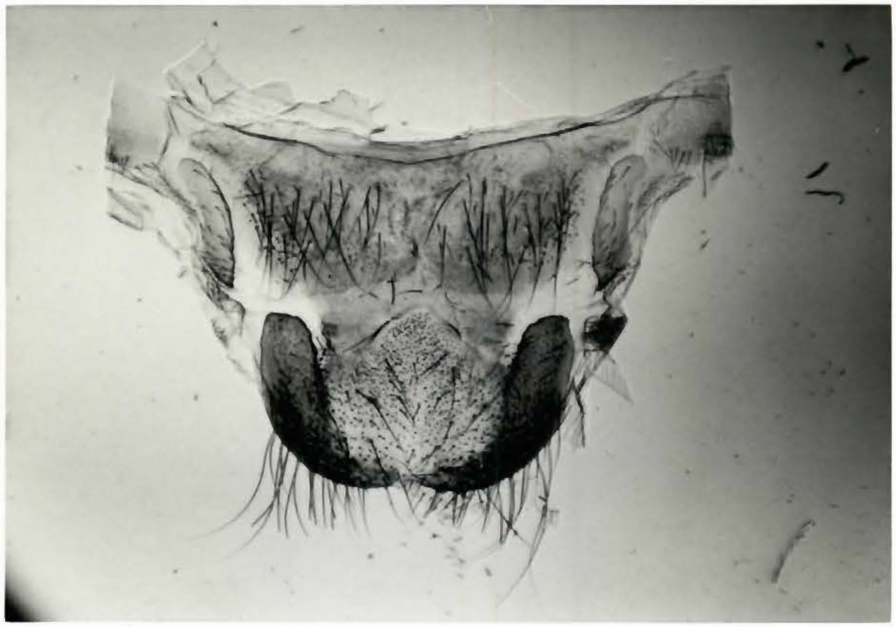


Fig. 28. Shape of epiproct, Qk strain, male (X 200).

Fig. 29. Shape of epiproct, Qk strain, female (X 200).

Q_K ♂



Q_K ♀

Fig. 30. Shape of epiproct, Qz strain, male (X 200).

Fig. 31. Shape of epiproct, Qz strain, female (X 200).

Q2 ♂

Q2 ♀

Fig. 32. Shape of epiproct, Qc strain, male (X 200).

Fig. 33. Shape of epiproct, Qc strain, male (X 200).

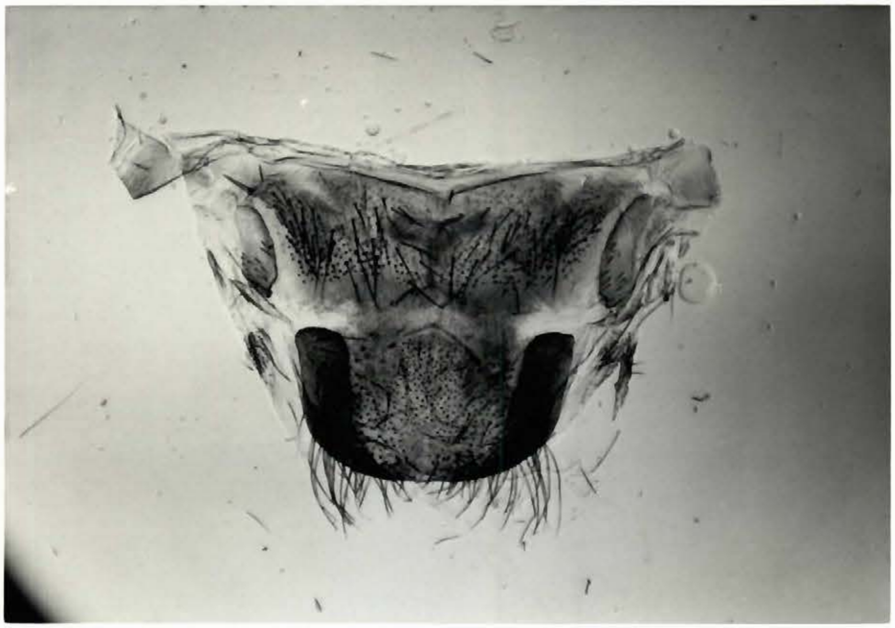
Qc ♂ 1

Qc ♂ 2

Fig. 34. Shape of epiproct, Qc strain, male (X 200).

Fig. 35. Shape of epiproct, Qc strain, male (X 200).

Qc_3 ♂



Qc_4 ♂

Fig. 36. Shape of epiproct, Qc strain, female (X 200).

Fig. 37. Shape of epiproct, Qc strain, female (X 200).

Qc_1 ♀

Qc_2 ♀

Fig. 38. Shape of epiproct, Qc strain, female (X 200).

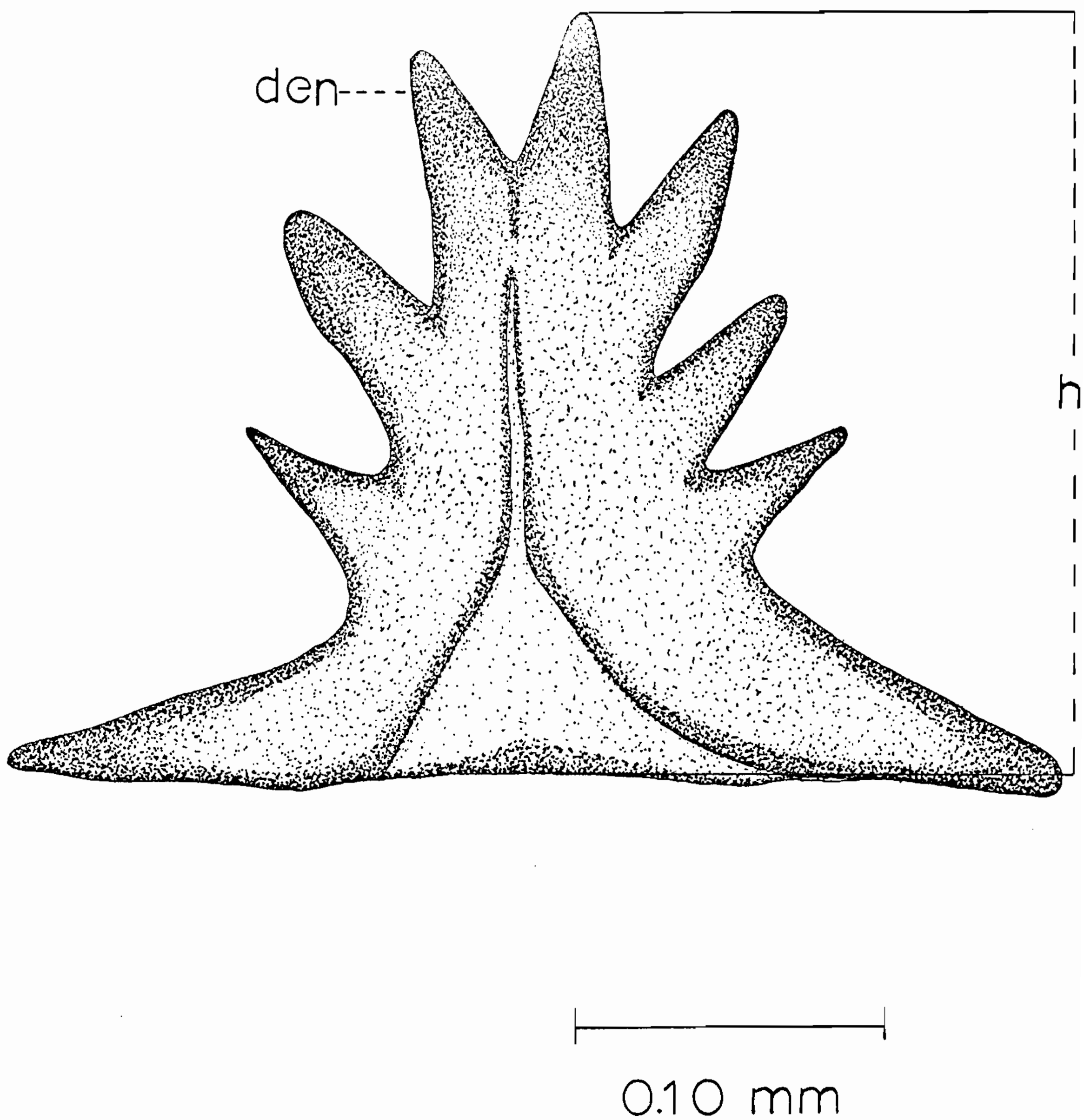
Fig. 39. Shape of epiproct, Qc strain, female (X 200).

Qc3 ♀

Qc4 ♀

Fig. 40. Proventricular tooth of Qn strain (*Teleogryllus oceanicus* (Le Guillou)).

den: denticle
h: height of tooth



den
h
0.10 mm