# EXTERNAL CHARACTERS OF SIBLING SPECIES TRECHUS OBTUSUS ER. AND T. QUADRISTRIATUS SCHRK. (COLEOPTERA)*



BY

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ABSTRACT

A survey is given of the confusion in the literature about the taxonomic status of *Trechus obtusus* Er. By a quantitative analysis of the external characters mentioned in the literature and by measuring random samples of specimens from The Netherlands, Western Germany, Scandinavia, Czechoslovakia, England and Iceland, it is possible to judge the diagnostic significance of these characters. The only external characters by which *T. obtusus* can be separated from *T. quadristriatus* Schrk. appear to be the width of the temple, and the distance between the supra-orbital setigerous pores and the inner margin of the eye. It is evident that *T. obtusus* and *T. quadristriatus* should be considered distinct species, the former being dimorfic and the latter, macropterous.

## INTRODUCTION

For a long time there has been much confusion in the literature about the taxonomic status of *Trechus obtusus* Er. Many authors from the 19th century considered *T. obtusus* a distinct species (e.g., ERICHSON, 1837; THOMSON, 1859; SCHAUM, 1860; PANDELLÉ, 1867; PUTZEYS, 1870; SEIDLITZ, 1891; cited by JEANNEL, 1927). whereas others believed it to be merely a brachypterous form of *T. quadristriatus* Schrk. (e.g., REDTENBACHER, 1858; GANGLBAUER, 1892; EVERTS, 1898). During the first quarter of the 20th century many authors again considered *T. obtusus* to be a separate species (e.g., REITTER, 1903, 1908; KUHNT, 1913; MUNSTER, 1926; DAHL, 1928), but others (e.g., APFELBECK, 1904; EVERTS, 1922) still regarded *T. obtusus* as a form of *T. quadristriatus.*

After the discovery of the valuable characters of the male genitalia (JEANNEL, 1927) most authors agreed that *T. obtusus* should be considered a distinct species, e.g., JEANNEL (1927, 1941); LINDROTH (1943, 1945); CSIKI (1946), with the remarkable exception of HORION (1941): "Nach meiner Meinung besteht die alte Ansicht von GANGLBAUER auch heute noch (trotz der JEANNEL'schen Monographie) zu recht, dass *obtusus* n u r e i n e F o r m von *quadristriatus* ist; ..... H. WAGNER ist derselben Ansicht".

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In my opinion *T. obtusus* is a distinct species, the males of which can be separated from those of *T. quadristriatus* with the characters of the genitalia. I had the opportunity to study the genitalia of a great number of male specimens especially from the Netherlands, and also some from Western Germany and Iceland (fig. 1, 5).

Although I am sure that the structure of the male genitalia has solved the taxonomic status of *T. obtusus,* there is still much confusion about the external characters which enable us to separate *T. obtusus* from *T. quadristriatus.* This is illustrated by the following survey of the opinions of a number of authors. My view, to be presented here, is mainly based on the study of specimens from the Netherlands, Western Germany, Scandinavia, Iceland, Czechoslovakia and England.

TABLE 1. EXTERNAL CHARACTERS OF TRECHUS OBTUSUS ER. AND QUADRISTRIATUS SCHRK.

(1) *a. T. obtusus* is brachypterous and *quadristriatus* macropterous: REDTENBACHER, 1858; GANGLBAUER, 1892; EVERTS, 1898, 1922; DAHL, 1928; HORION, 1941; LINDROTH, 1943, 1945 (especially in West and North Europe); CSIKI, 1946.

— *b. T. obtusus* is dimorfic and *quadristriatus* macropterous (except specimens from Elbe, JEANNEL, 1927): JEANNEL, 1927, 1941; BRAKMAN, 1961; DEN BOER (p. 223).

(2) *a. T. obtusus* is smaller than *quadristriatus* : REITTER, 1908; KUHNT, 1913; the same, but only in the brachypterous form of *obtusus* and especially in the mountain form *renati* Jeann.: JEANNEL, 1941.

— *b. T. obtusus* is darker than *quadristriatus* : REITTER, 1908; KUHNT, 1913; DAHL, 1928; JEANNEL, 1927; CSIKI, 1946.

— *c.* No diagnostic differences in body length and in colour : GANGLBAUER, 1892; EVERTS, 1922; DEN BOER (p. 225 and Table 2; var. *renati* Jeann. is unknown to me).

(3) *a.* Hind angles of the pronotum are more rounded in *T. obtusus* than in *quadristriatus* : REDTENBACHER, 1858; GANGLBAUER, 1892; EVERTS, 1898; REITTER, 1908; DAHL, 1928; JEANNEL, 1927; CSIKI, 1946.
*quadristriatus* : REDTENBACHER, 1858; GANGLBAUER, 1892; EVERTS, 1898; REITTER, 1908; DAHL, 1928.

— *c.* Hind angles of the pronotum with a minute tooth in *T. quadristriatus* : GANGLBAUER, 1892.

— *d.* No diagnostic characters in the hind angles of the pronotum : GANGLBAUER, 1892; EVERTS, 1922; BRAKMAN, 1961; DEN BOER (they are highly variable).

(4) *a.* Elytra are more faintly striated in *T. obtusus* than in *quadristriatus* : GANGLBAUER, 1892; CSIKI, 1946.

— *b.* No diagnostic characters in the striae of the elytra : EVERTS, 1922; DEN BOER (highly variable).

(5) *a.* Elytra are shorter in *T. obtusus* than in *quadristriatus* : REDTENBACHER, 1858; the same especially in the brachypterous form of *obtusus* : JEANNEL, 1927, 1941; BRAKMAN, 1961.

— *b.* Elytra are broader and more rounded in *T. obtusus* than in *quadristriatus* : EVERTS, 1898; CSIKI, 1946; the same especially in the brachypterous form of *obtusus* : JEANNEL, 1927, 1941; BRAKMAN, 1961.

— *c.* No diagnostic characters in the dimensions of the elytra, neither for the separation of *T. obtusus* from *quadristriatus,* nor of brachypterous from macropterous specimens of *obtusus* : DEN BOER (Table 4; fig. 2, 6 and graph 1); unfortunately it was not possible to study material from France. As far as the material studied is concerned, in *T. obtusus* the elytra are somewhat more rounded laterally than in *quadristriatus* (fig. 2, 6), but this difference could hardly be used for the separation of the two species; moreover the dimensions of the elytra are highly variable and the values largely overlap : DEN BOER (p. 225).

(6) *a.* Eyes are smaller in *T. obtusus* than in *quadristriatus* : GANGLBAUER, 1892; REITTER, 1903; JEANNEL, 1927.

— *b.* Eyes larger in *T. obtusus* than in *quadristriatus* : CSIKI, 1946.

— *c.* No diagnostic difference in the diameter of the eye, although in the material studied the eyes were on the whole a little smaller in *T. obtusus* than in *quadristriatus* : DEN BOER (p. 230 and Table 7).

(7) Temple is shorter in *T. quadristriatus* than in *obtusus* : REITTER, 1903; DEN BOER (p. 230, Table 7, and fig. 3—4, 7—8).

(8) *a.* Posterior supra-orbital setigerous pore b e h i n d the level of the hind margin of the eye in *T. obtusus* and i n this level in *quadristriatus* : GANGLBAUER, 1892; MUNSTER, 1926.

— *b.* Posterior supra-orbital setigerous pore i n the level of the hind margin of the eye in *T. obtusus* and b e f o r e it in *quadristriatus* : REITTER, 1903.

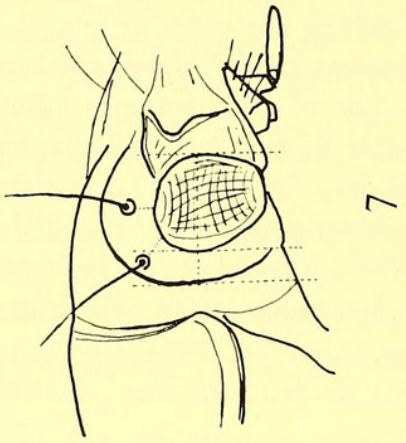
— *c.* No diagnostic character in the position of the posterior supra-orbital pore with respect to the hind margin of the eye, although in general this pore is situated more backward with respect to the hind margin of the eye in *T. obtusus* than in *quadristriatus* (fig. 3—4, 7—8); however, the situation is highly variable and difficult to express quantitatively : BRAKMAN, 1961; DEN BOER (p. 235).

(9) Both the anterior and the posterior supra-orbital setigerous pores closer to the inner margin of the eye in *T. quadristriatus* than in *obtusus :* DEN BOER (p. 232, Table 9 and fig. 3—4, 7—8).

## MATERIAL AND METHODS

To study more closely the external characters of *T. obtusus* and *T. quadristriatus* the following material was examined: 458 specimens from different parts of the Netherlands (31 from the collection P. VAN DER WIEL, 29 from the collection K. VEGTER (Emmen), 257 from Rijksmuseum van Natuurlijke Historie, Leiden (119 of which from the collection EVERTS), 88 from the Meijendel collection, Zoölogisch Laboratorium, Leiden *, and 53 from the collection of Biologisch Station, Wijster); 104 specimens from different parts of Western Germany (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, among which

*) A random sample of 88 specimens of the 1953 catches from Meijendel, Netherlands (DEN BOER, 1958a and b) appear to contain *T. obtusus* only. This means that the results mentioned in these papers on *quadristriatus* obviously concern *obtusus.*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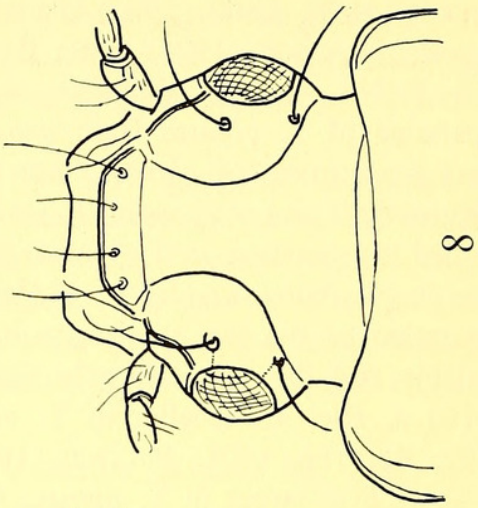
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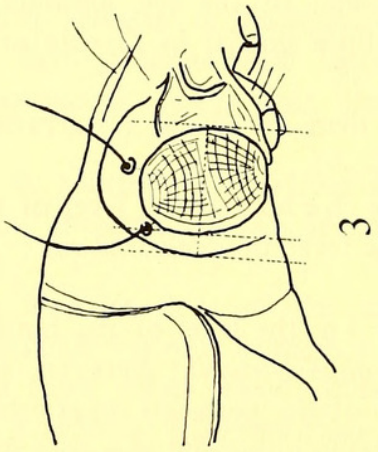
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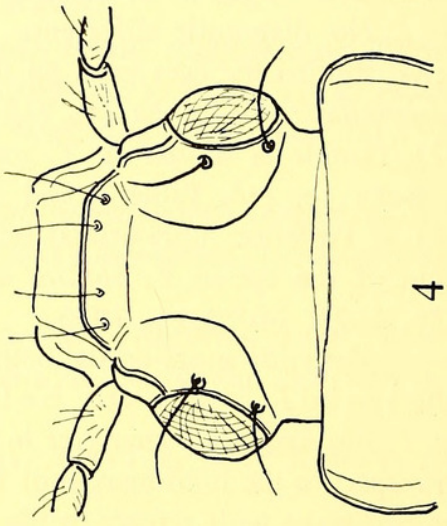
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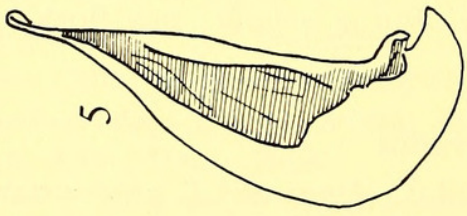
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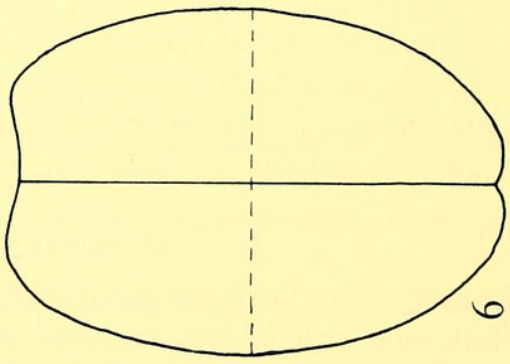
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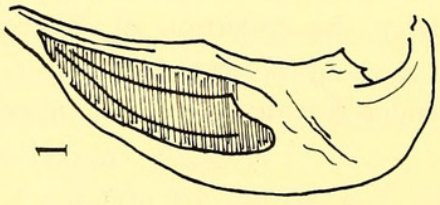
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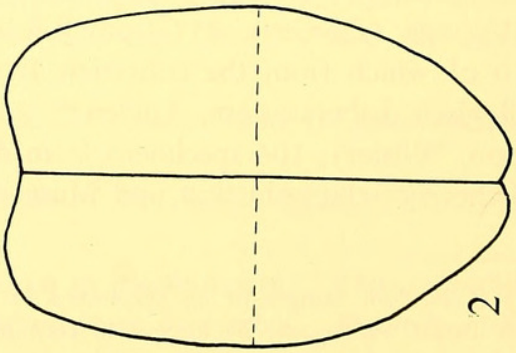
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specimens of HORION); 333 specimens from Drahanoviče (Olomouc, Czechoslovakia, B. NOVÁK); about 250 specimens from different parts of Sweden, 120 specimens from Iceland, five specimens from Finland, four specimens from the Caucasus, and one specimen from Esthonia, Norway, Denmark and Czechoslovakia each (these 383 specimens from Naturhistoriska Museet, Göteborg, for the greater part from the collection LINDROTH); 70 specimens from Wellesbourne (National Vegetable Research Station, Warwickshire, England, S. FINCH) and six specimens from Austria (Naturhistorisches Museum, Wien).

To test as objectively as possible the diagnostic value of the external characters recorded in the literature and given here in Table 1, the genitalia of a large number of male beetles collected in the Netherlands (especially from the collections K. VEGTER, P. VAN DER WIEL and Biologisch Station, Wijster) were dissected. Clear differences in the genitalia enabled me to separate these males easily and completely into two groups: *quadristriatus* (fig. 1) and *obtusus* (fig. 5). In the first place it appeared that these *quadristriatus* males were all macropterous while some of the *obtusus* males were macropterous but most specimens were brachypterous (also: Table 1, no. 1b). Next, the external characters of these two groups were studied and compared (Table 1). The only external characters which allowed separation into the same two groups as the male genitalia were: the width of the temple (Table 1, no. 7) and the distance between the supra-orbital setigerous pores and the inner margin of the eye (Table 1, no. 9). The division is especially distinct if in each specimen these dimensions are related to the diameter of the eye (p. 230 and 232).

With the help of these external characters most specimens (including females) could be placed into one of the groups mentioned above; of males that could not easily be identified in this way (especially some macropterous specimens) the genitalia were examined. In random samples from different regions the width of the temple, the diameter of the eye and the distance between the supra-orbital setigerous pores and the inner margin of the eye were measured with an eyepiece micrometer (enlargement 25 × 4, i.e., one eyepiece micrometer unit = 24,3 $\mu$) in the manner as given in fig. 3—4, 7—8; the results are given in Tables 7 and 9. In other random samples from the same regions the length of the body, the length of the elytra and the greatest width of both elytra combined (enlargement 25 × 1,6, i.e., one eyepiece micrometer unit = 63,1 $\mu$) were measured (results in Tables 2 and 4).

## RESULTS

L e n g t h o f t h e b o d y. To test the diagnostic value of the length of the body (Table 1, no. 2) the frequency distributions over ten classes (class interval = 0,12 mm) of a number of random samples containing 30 specimens each were compared

Fig. 1—4. *Trechus quadristriatus* Schrk. 1—2, specimen from Emmen, Province of Drente (coll. K. VEGTER); 1. aedeagus, lateral aspect; 2. elytra; 3—4, the same, specimen from Schouwen, Province of Zeeland (coll. v. d. WIEL); 3, temple region of head, lateral aspect; 4, head, dorsal aspect. Fig. 5—8. *T. obtusus* Er. 5—6, macropterous specimen from Emmen (coll. K. VEGTER); 5, aedeagus, lateral aspect; 6, elytra; 7—8, the same, specimen from Lheebroek, Province of Drente (coll. Biol. Stat., Wijster); 7, temple region of head; 8, head, dorsal aspect

Table 2. Body length in different samples of Trechus obtusus and T. quadristriatus

| cf. Table 3 | | | length of the body (in mm) | | | | | | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimens from | sample of species | | 3.05-3.17 | 3.18-3.30 | 3.31-3.43 | 3.44-3.56 | 3.57-3.69 | 3.70-3.82 | 3.83-3.95 | 3.96-4.08 | 4.09-4.21 | 4.22-4.34 | |
| Netherlands | A | T. obtusus macropterous | | | 1 | | 4 | 4 | 6 | 3 | 8 | 4 | 30 |
| | B | T. obtusus brachypterous | 1 | 1 | | 2 | 5 | 5 | 6 | 8 | 2 | | 30 |
| | A+B | T. obtusus macr. + brach. | 1 | 1 | 1 | 2 | 9 | 9 | 12 | 11 | 10 | 4 | 60 |
| | C | T. quadristriatus | 1 | | 1 | 3 | 3 | 9 | 5 | 4 | 3 | 1 | 30 |
| Western Germany | E | T. quadristriatus | | | | 1 | 4 | 8 | 9 | 6 | 2 | | 30 |
| | F | T. obtusus macr. + brach. | | | | 5 | 2 | 13 | 5 | 4 | | 1 | 30 |
| Iceland | D | T. obtusus brachypterous | | | | 3 | 3 | 10 | 4 | 7 | 1 | 2 | 30 |
| Czechoslovakia | G | T. quadristriatus | | | | 2 | 4 | 7 | 8 | 7 | 2 | | 30 |

(Table 2). It is evident from Table 2 that the frequency distributions of most samples largely or wholly overlap, to such an extent that the body length cannot have any diagnostic value, neither for separation of *T. obtusus* and *quadristriatus,* nor for ready separation of the brachypterous and macropterous specimens of *T. obtusus,* nor of individuals of the same species from different regions. When tested with the two-sample test devised by WILCOXON (VAN DER VAART, 1950; WABEKE & VAN EEDEN, 1955; DE JONGE, 1963) the differences between various combinations of two samples are significant in only two out of ten cases tested (Table 3): macropterous *T. obtusus* specimens from the Netherlands (A) are significantly longer than brachypterous specimens (B) and even significantly longer than *T. quadristriatus* specimens from the Netherlands (C) (also: Table 1, no. 2a). Although in the greater body length the macropterous specimens of *T. obtusus* agree with JEANNEL's form *obtusioides* (JEANNEL, 1927, 1941), in my opinion there is no reason to consider these specimens as belonging to a separate form, since body length measured in the two Dutch samples (A and B) overlap to a great extent (about 85%); unfortunately among the *obtusus* specimens studied from other regions (183 in total) only a few macropterous specimens were found (eight from Western Germany and one from the Caucasus).

Table 3. Length of the body

p value of the difference between two samples

| samples cf. Table 2 | | p value of the difference between a and b |
|---|---|---|
| a | b | |
| A | B | 0.0324 |
| B | C | 0.8026 |
| A | C | 0.0348 |
| B | D | 0.5824 |
| B | F | 0.2584 |
| D | F | 0.2006 |
| E | F | 0.0548 |
| C | E | 0.3734 |
| C | G | 0.5486 |
| E | G | 0.7948 |

Dimensions of the elytra. From Table 4 it will be evident that no diagnostic characters can be found in the length (Table 1, no. 5a) or the width (Table 1, no. 5b) of the elytra. Nevertheless, the elytra of *T. obtusus* specimens generally make an impression of being somewhat shorter and broader than those of *T. quadristriatus* specimens. This is however, a form of optical illusion, caused by the laterally more rounded elytra in *obtusus* as compared with the elytra in

Table 4. Dimensions of the elytra in different samples of Trechus obtusus and T. quadristriatus

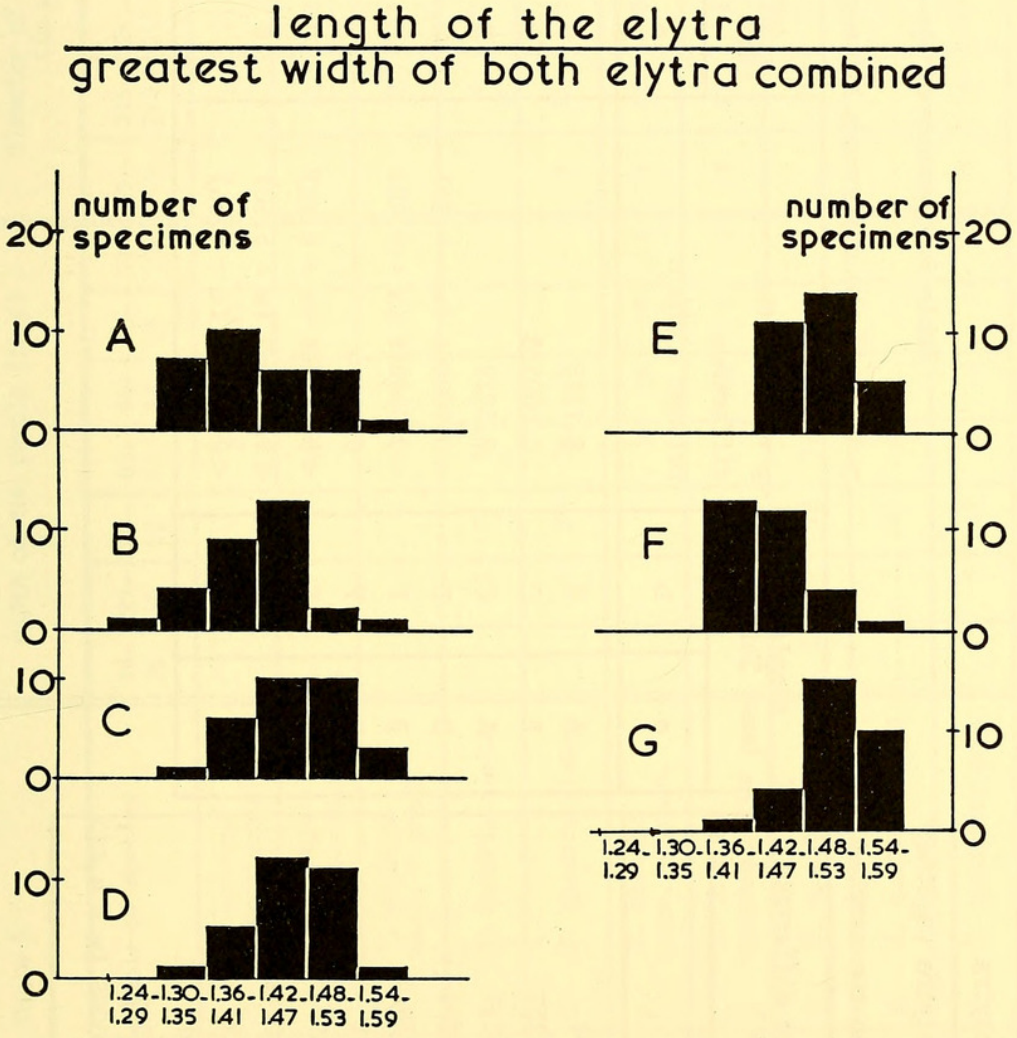
| Specimens from | sample of species | | length of the elytra (in mm) | | | | | | | greatest width of both elytra together (in mm) | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.79-1.91 | 1.92-2.04 | 2.05-2.17 | 2.18-2.30 | 2.31-2.43 | 2.44-2.56 | 2.57-2.69 | 1.27-1.39 | 1.40-1.52 | 1.53-1.65 | 1.66-1.78 | 1.79-1.91 | |
| Netherlands | A | T. obtusus macropterous | | | 3 | 3 | 12 | 8 | 4 | | 2 | 10 | 13 | 5 | 30 |
| | B | T. obtusus brachypterous | 1 | | 3 | 6 | 9 | 11 | | 1 | 3 | 10 | 14 | 2 | 30 |
| | A+B | T. obtusus macr. + brach. | 1 | | 6 | 9 | 21 | 19 | 4 | 1 | 5 | 20 | 27 | 7 | 60 |
| | C | T. quadristriatus | | 1 | 3 | 1 | 18 | 6 | 1 | 2 | 4 | 14 | 10 | | 30 |
| Western Germany | E | T. quadristriatus | | | | 3 | 16 | 10 | 1 | | 5 | 17 | 8 | | 30 |
| | F | T. obtusus macr. + brach. | | | 3 | 10 | 13 | 3 | 1 | | 5 | 16 | 9 | | 30 |
| Iceland | D | T. obtusus brachypterous | | | 4 | 8 | 14 | 2 | 2 | | 7 | 18 | 5 | | 30 |
| Czechoslovakia | G | T. quadristriatus | | | | 3 | 12 | 11 | 4 | | 5 | 19 | 6 | | 30 |

*quadristriatus* (Table 1, no. 5c). This optical illusion is nicely illustrated by two specimens from Emmen with exactly the same length and width of the elytra: one *quadristriatus* specimen (fig. 2) and one macropterous *obtusus* specimen (fig. 6).

Besides the small but unreliable (difficult to express quantitatively) difference in the lateral curve of the elytra, the form of the elytra, expressed as the quotient

$$\frac{\text{length of the elytra}}{\text{greatest width of both elytra combined}}$$

largely overlaps in the two species (graph 1) and consequently has no diagnostic value (Table 1, no. 5c). Nevertheless, the differences between various combinations of two samples are often significant (Table 5; Wilcoxon's two sample test). Generally the value of the




Graph 1. Shape of the elytra (length/greatest width) in 30 specimens of *Trechus*. *A. obtusus* (macropterous), Netherlands. B. *obtusus* (brachypterous), Netherlands. C. *quadristriatus*, Netherlands. D. *obtusus* (brachypterous), Iceland. E. *quadristriatus*, Western Germany. F. *obtusus* (brachypterous + macropterous), Western Germany. G. *quadristriatus*, Czechoslovakia (cf. Table 5)

quotient is significantly higher (form of the elytra more elongate) in the samples of *quadristriatus* than in those of *obtusus*. There are, however, important statistical differences in the form of the elytra between samples of the same species from different regions (geographic variation). For instance, the quotient mentioned

Table 5. $\frac{\text{length of the elytra}}{\text{greatest width of both elytra together}}$

p value of the difference between two samples

| samples | | p value of the difference between a and b |
|---|---|---|
| a | b | |
| A | B | 0.842 |
| B | C | 0.00252 |
| A | C | 0.00596 |
| B | D | 0.00222 |
| C | D | 0.8258 |
| C | E | 0.022 |
| E | G | 0.091 |
| C | G | 0.000176 |
| B | F | 0.418 |
| D | F | 0.1416 |
| D | E | 0.00652 |
| E | F | <0.000066 (x = 4.61) |

Table 6. Diameter of the eye

p value of the difference between two samples

| samples (see: Table 7) | | p value of the difference between a and b | samples (see: Table 7) | | p value of the difference between a and b |
|---|---|---|---|---|---|
| a | b | | a | b | |
| A | B | 0.1286 | E | G | 0.3844 |
| B | C | 0.000108 | C | H | 0.0548 |
| A | C | 0.5028 | E | H | 0.0156 |
| B | D | <0.000066 (x = 4.22) | G | H | 0.0628 |
| B | F | <0.000066 (x = 6.60) | H | J | 0.6242 |
| D | F | 0.00544 | E | J | 0.00988 |
| E | F | <0.000066 (x = 6.20) | C | J | 0.3788 |
| C | E | <0.000066 (x = 5.50) | G | J | 0.0414 |
| C | G | <0.000066 (x = 4.56) | | | |

Table 7. Width of the temple and diameter of the eye in different samples of Trechus obtusus and T. quadristriatus ')

| cf. Table 6 | | | width of the temple (in μ) | | | | | | | diameter of the eye (in μ) | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimens from | sample of species | | 14-26 | 27-39 | 40-52 | 53-65 | 66-78 | 79-91 | 92-104 | 191-215 | 216-240 | 241-265 | 266-290 | 291-315 | |
| Netherlands | A | T. obtusus macropterous | | | | 3 | 11 | 10 | 7 | 1 | 7 | 17 | 6 | | 31 |
| | B | T. obtusus brachypterous | | | 1 | 10 | 38 | 11 | 9 | 2 | 13 | 30 | 24 | | 69 |
| | A+B | T. obtusus macr. + brach. | | | 1 | 13 | 49 | 21 | 16 | 3 | 20 | 47 | 30 | | 100 |
| | C | T. quadristriatus | | 13 | 77 | 10 | | | | | 4 | 37 | 50 | 9 | 100 |
| Western Germany | E | T. quadristriatus | | 1 | 30 | 24 | 5 | | | 2 | 15 | 34 | 9 | | 60 |
| | F | T. obtusus macr. + brach. | | | | 3 | 14 | 19 | 8 | 18 | 18 | 8 | | | 44 |
| Iceland | D | T. obtusus brachypterous | | | | | 15 | 9 | 6 | 3 | 17 | 8 | 2 | | 30 |
| Czechoslovakia | G | T. quadristriatus | 2 | 27 | 29 | 10 | 2 | | | | 21 | 32 | 15 | 2 | 70 |
| Scandinavia | H | T. quadristriatus | | 3 | 21 | 6 | | | | | 2 | 17 | 9 | 2 | 30 |
| England | J | T. quadristriatus | | 9 | 12 | 6 | 3 | | | 1 | 5 | 11 | 10 | 3 | 30 |

') the measures are taken from the left side of the head as far as possible.

above is significantly higher in *obtusus* specimens from Iceland (D) than in those from the Netherlands (A), whereas *obtusus* specimens from Western Germany (F) are intermediate. In fact, the form of the elytra in *obtusus* specimens from Iceland (D) is the same as that in *quadristriatus* specimens from the Netherlands (C). The elytra of *quadristriatus* specimens from Czechoslovakia (G) are the most elongate among the samples studied.

Diameter of the eye. Although in the *T. obtusus* samples the diameter of the eye is in general a little smaller than in the *quadristriatus* samples (Table 7), this difference has no diagnostic value (Table 1, no. 6), since there is an important overlap. About half of the differences between various combinations of two samples are significant (Table 6), but they do not show any clear tendency: the diameter of the eyes in brachypterous (B) and in macropterous (A) *obtusus* specimens from the Netherlands do not differ significantly, whereas the diameter of the eye in Dutch *quadristriatus* specimens (C) is significantly greater than that in brachypterous *obtusus* specimens (B) but it does not differ from that in macropterous *obtusus* specimens (A); the diameters of the eyes differ significantly in *obtusus* samples from different regions (geographic variation; Table 6 : B and D, B and F, D and F), but not in all samples of *T. quadristriatus*.

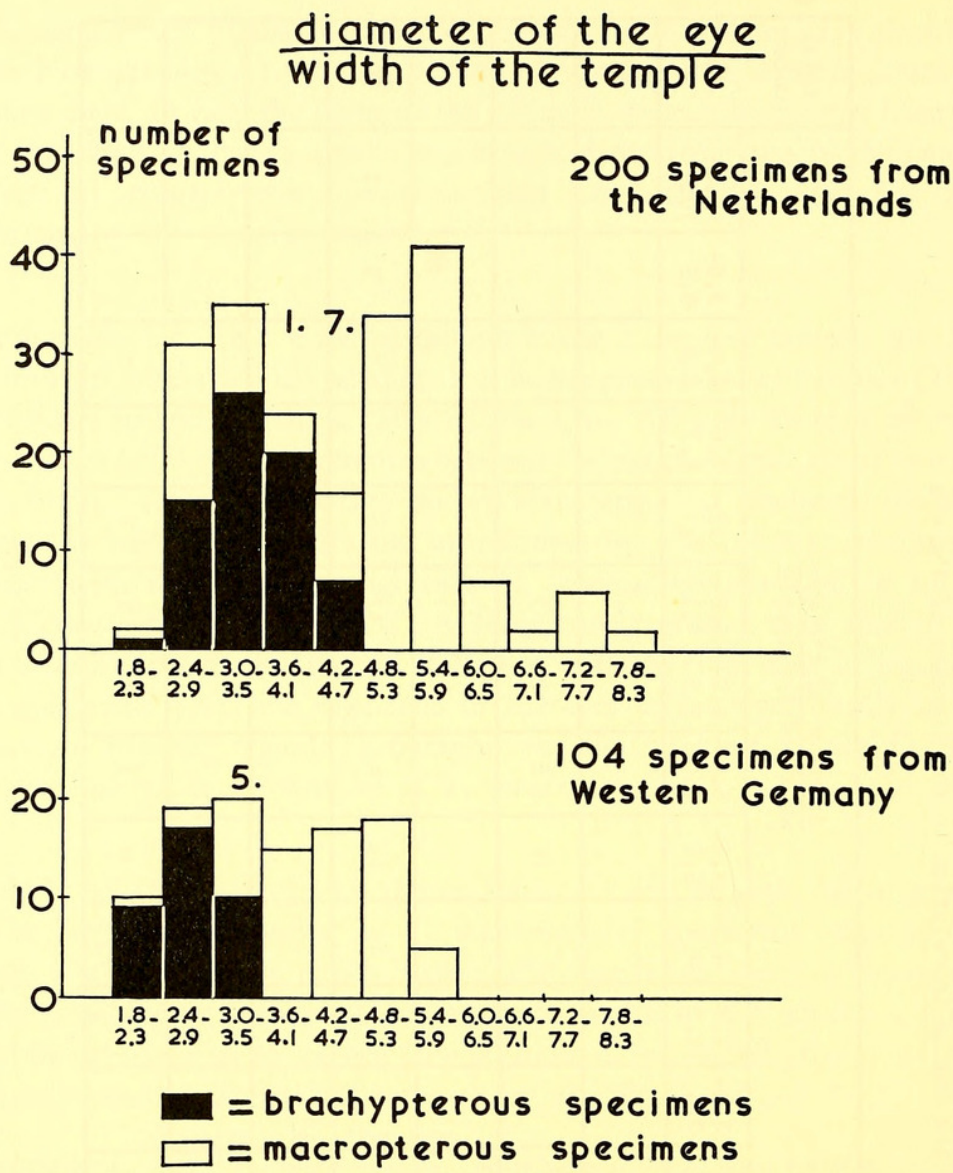
Width of the temple. From Table 7 it will be seen that in general the temple is diagnostically wider in *T. quadristriatus* specimens than in *obtusus* specimens (Table 1, no. 7), which is especially clear if specimens of the two species from the same region are compared. Since the width of the temple is highly influenced by the diameter of the eye (the position of the frontal groove is apparently more fixed than the diameter of the eye; see also fig. 3—4 and 7—8), the value of the quotient $\frac{\text{diameter of the eye}}{\text{width of the temple}}$ separates *obtusus* and *quadristriatus* specimens more sharply.

To show the diagnostic value of this character, the frequency distributions over eleven classes of the quotient, are given for all measured specimens combined from the Netherlands and Western Germany (graph 2). The histogram of the Dutch specimens is evidently bimodal: apparently one population consists of macropterous specimens only, the other mainly of brachypterous individuals. Thus, the Dutch material must contain two separate forms, one macropterous (*T. quadristriatus*) and one dimorfic (*T. obtusus*). The histogram of the specimens from Western Germany is less clear in this respect, although the distribution of macropterous and brachypterous specimens shows the same division into two separate groups. In the *Trechus* material from Western Germany this character apparently discriminates less distinctly between *T. quadristriatus* and *obtusus* than in the material from the Netherlands.

The data for the specimens from other regions are given in Table 8. From this table (and from graph 2) it is obvious that this character is more variable in *T. quadristriatus* than in *obtusus*; this is especially clear for the specimens from Czechoslovakia (Drahanoviče) and from England (Wellesbourne).

Table 8. Width of the temple in relation to the diameter of the eye

| Specimens from | sample of species | diameter of the eye / width of the temple | | | | | | | | | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.8-2.3 | 2.4-2.9 | 3.0-3.5 | 3.6-4.1 | 4.2-4.7 | 4.8-5.3 | 5.4-5.9 | 6.0-6.5 | 6.6-7.1 | 7.2-7.7 | 7.8-8.3 | 8.4-8.9 | 9.0-9.5 | 9.6-10.1 | |
| Iceland | D T. obtusus | 1 | 15 | 14 | | | | | | | | | | | | 30 |
| Scandinavia | H T. quadristriatus | | | | | 5 | 16 | 5 | 2 | 2 | | | | | | 30 |
| Scandinavia | T. obtusus | | 4 | 4 | | | | | | | | | | | | 8 |
| Czechoslovakia | G T. quadristriatus | | | 1 | 8 | 14 | 13 | 4 | 7. | 12 | 6 | | 1 | 3 | 1 | 70 |
| Central Europe (Austria) | T. obtusus | 1 | 4 | 2 | | | | | | | | | | | | 7 |
| Caucasus | T. obtusus | | 3 | 1 | | | | | | | | | | | | 4 |
| England | J T. quadristriatus | | 1 | 2 | 3 | 6 | 4 | 3 | 2 | 1 | 7 | | 1 | | | 30 |




Graph 2. Width of the temple in relation to the diameter of the eye in all measured *Trechus* specimens from the Netherlands and Western Germany combined (cf. Table 8). Figures above columns indicate number of *T. quadristriatus* specimens falling in the relevant class (only given for classes where both species are represented)

Distance between the inner margin of the eye and the supra-orbital pores. Table 9 shows that in *T. quadristriatus* specimens the distance between the inner margin of the eye and the supra-orbital pores is diagnostically smaller than in *obtusus* specimens (Table 1, no. 9), which is clearer for the posterior supra-orbital pore than for the anterior. Since the distance between the inner margin of the eye and these pores is highly influenced by the diameter of the eye (the position of the supra-orbital pores is apparently more fixed than the diameter of the eye; see also fig. 3—4, 7—8), specimens of *obtusus* and of *quadristriatus* can be separated even more sharply by the value of the quotient

$$\frac{\text{diameter of the eye}}{\text{distance: anterior supra-orbital pore — eye}} \left(\frac{\text{d. eye}}{\text{a.p. — eye}}\right),$$ or by the value

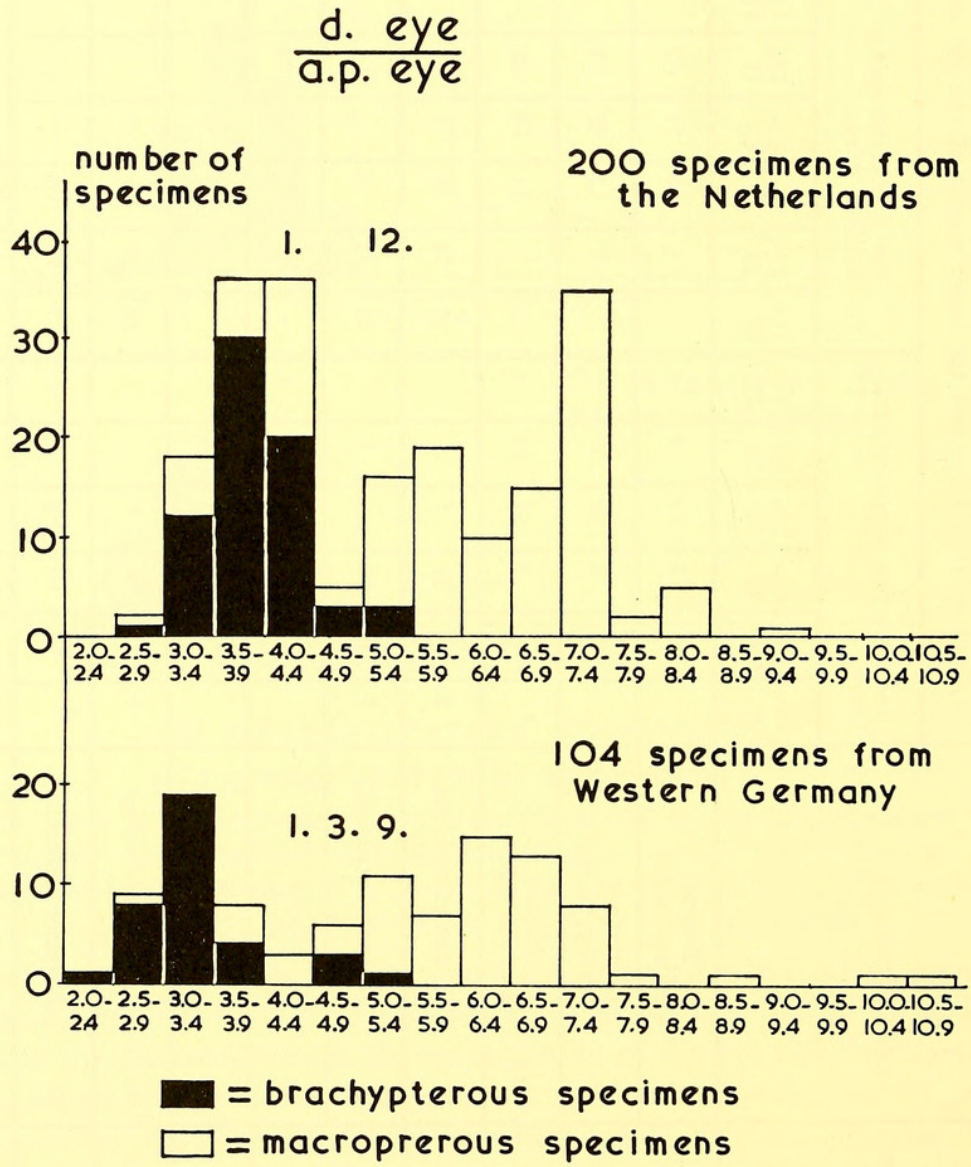
$$\frac{\text{diameter of the eye}}{\text{distance: posterior supra-orbital pore — eye}} \left(\frac{\text{d. eye}}{\text{p.p. — eye}}\right).$$

Table 9. Position of the supra-orbital pores in different samples of Trechus obtusus and T. quadristriatus [1])

| Specimens from | sample of species | | distance (in μ) between the inner margin of the eye and | | | | | | | | | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | the anterior supra-orbital pore | | | | | | the posterior supra-orbital pore | | | | | | | |
| | | | 14-26 | 27-39 | 40-52 | 53-65 | 66-78 | 79-91 | 14-26 | 27-39 | 40-52 | 53-65 | 66-78 | 79-91 | 92-104 | |
| Netherlands | A | T. obtusus macropterous | | | 3 | 19 | 8 | 1 | | | 1 | 17 | 13 | | | 31 |
| | B | T. obtusus brachypterous | | | 5 | 32 | 32 | | | | 12 | 36 | 17 | 4 | | 69 |
| | A+B | T. obtusus macr.+brach. | | | 8 | 51 | 40 | 1 | | | 13 | 53 | 30 | 4 | | 100 |
| | C | T. quadristriatus | 3 | 59 | 37 | 1 | | | 12 | 78 | 9 | 1 | | | | 100 |
| Western Germany | E | T. quadristriatus | 2 | 39 | 19 | | | | 10 | 43 | 7 | | | | | 60 |
| | F | T. obtusus macr.+brach. | | | 6 | 18 | 16 | 4 | | | 6 | 13 | 22 | 3 | | 44 |
| Iceland | D | T. obtusus brachypterous | | | 4 | 11 | 15 | | | | | 6 | 17 | 6 | 1 | 30 |
| Czechoslovakia | G | T. quadristriatus | 7 | 47 | 15 | 1 | | | 30 | 31 | 7 | 2 | | | | 70 |
| Scandinavia | H | T. quadristriatus | | 11 | 17 | 2 | | | 1 | 19 | 10 | | | | | 30 |
| England | J | T. quadristriatus | | 11 | 18 | 1 | | | 4 | 20 | 6 | | | | | 30 |

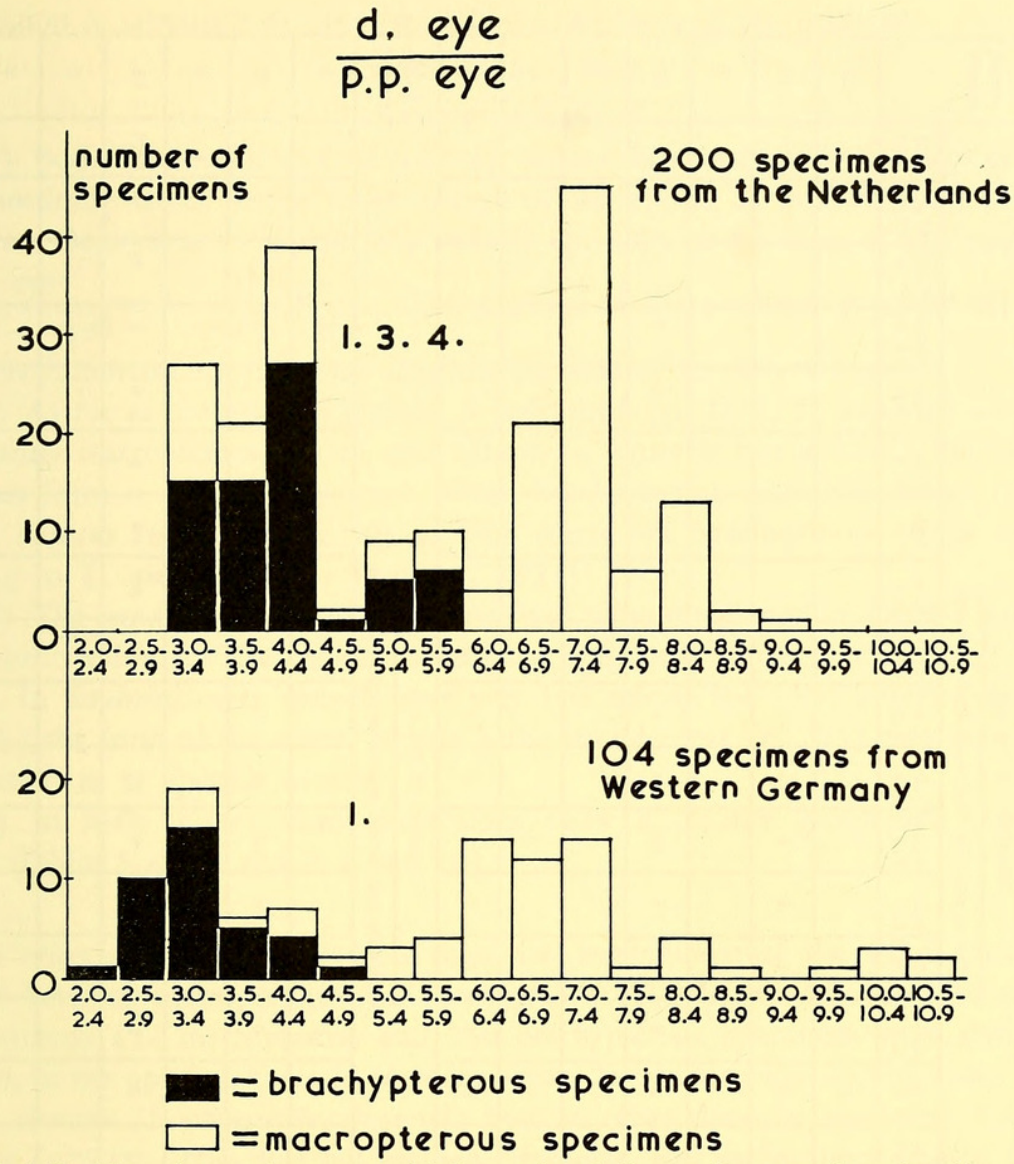
[1]) The measures are taken from the left side of the head as far as possible.

To show the diagnostic value of these characters the frequency distributions of these two quotients are given for all the measured *Trechus* specimens combined from the Netherlands and Western Germany (graph 3—4). Both histograms of graph 3 and those of graph 4 are bimodal, so that it is evident that the material from the Netherlands as well as that from Western Germany contains two separate forms: one macropterous (*T. quadristriatus*) and one dimorfic (*T. obtusus*). A comparison of the graphs 3 and 4 shows that $\frac{\text{d. eye}}{\text{p.p.} - \text{eye}}$ (graph 4) dis-




Graph 3. Position of anterior supra-orbital pore in relation to diameter of eye in all measured *Trechus* specimens from the Netherlands and Western Germany combined (cf. Table 10). Figures above columns indicate number of *T. quadristriatus* specimens falling in the relevant class (only given for classes where both species are represented)

criminates more sharply between *T. quadristriatus* and *obtusus* than does $\frac{\text{d. eye}}{\text{a.p.} - \text{eye}}$ (graph 3). The same conclusion can be drawn from Table 10 in which the data for specimens from other regions are given. From this table it becomes




Graph 4. Position of posterior supra-orbital pore in relation to diameter of eye in all measured *Trechus* specimens from the Netherlands and Western Germany combined (cf. Table 10). Figures above columns indicate number of *T. quadristriatus* specimens falling in the relevant class (only given for classes where both species are represented)

clear that these characters are more variable in *T. quadristriatus* than in *obtusus,* which is especially evident for the specimens from Czechoslovakia (Drahanoviče).

Since in both specimens not only the diameter of the eye but also the form of the eye is highly variable (e.g., fig. 3, 7), the position of the posterior supra-orbital pore in comparison with the hind margin of the eye (i n or b e h i n d this level) is also variable and has no or only little diagnostic value (Table 1, no. 8).

## Conclusions

We may conclude that *Trechus obtusus* and *T. quadristriatus* should be considered distinct species which can be distinguished not only by the shape of the male genitalia but also by the following characters:

(a) In *T. obtusus* the temple is diagnostically wider than in *quadristriatus*; the

Table 10. Position of the supra-orbital pores in relation to the diameter of the eye

| Specimens from | sample of species | diameter of the eye / distance: anterior supra-orbital pore-eye | | | | | | | | | | | | | | | | | | | | | total number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2.0-2.4 | 2.5-2.9 | 3.0-3.4 | 3.5-3.9 | 4.0-4.4 | 4.5-4.9 | 5.0-5.4 | 5.5-5.9 | 6.0-6.4 | 6.5-6.9 | 7.0-7.4 | 7.5-7.9 | 8.0-8.4 | 8.5-8.9 | 9.0-9.4 | 9.5-9.9 | 10.0-10.4 | 10.5-10.9 | 11.0-11.4 | 11.5-11.9 | 12.0-12.4 | |
| Iceland | D T. obtusus | | 1 | 13 | 11 | 2 | 2 | 1 | | | | | | | | | | | | | | | 30 |
| Scandinavia | H T. quadristriatus | | | | | 1 | 2 | 8 | 6 | 3 | 5 | 5 | | | | | | | | | | | 30 |
| Scandinavia | T. obtusus | 1 | 1 | 5 | | 1 | | | | | | | | | | | | | | | | | 8 |
| Czechoslovakia | G T. quadristriatus | | | | | 1 | 5 | 9 | 2 | 13 | 13 | 14 | 4 | 1 | 1 | 1 | | 2 | 3 | | | 1 | 70 |
| Central Europe (Austria) | T. obtusus | | 1 | 3 | 2 | | 1 | | | | | | | | | | | | | | | | 7 |
| Caucasus | T. obtusus | | | 1 | | 2 | 1 | | | | | | | | | | | | | | | | 4 |
| England | J T. quadristriatus | | | | | | 5 | 9 | 5 | 1 | 2 | 4 | 2 | 2 | | | | | | | | | 30 |
| specimens from | sample of species | diameter of the eye / distance: posterior supra-orbital pore-eye | | | | | | | | | | | | | | | | | | | | | total number |
| Iceland | D T. obtusus | 1 | 8 | 14 | 5 | 2 | | | | | | | | | | | | | | | | | 30 |
| Scandinavia | H T. quadristriatus | | | | | | | 4 | 4 | 4 | 10 | 6 | 1 | | | | | | 1 | | | | 30 |
| Scandinavia | T. obtusus | | 3 | 3 | 1 | 1 | | | | | | | | | | | | | | | | | 8 |
| Szechoslovakia | G T. quadristriatus | | | | | 2 | 2 | 3 | 2 | 8 | 9 | 10 | | 3 | 1 | 4 | 6 | 6 | 5 | 5 | 3 | 1 | 70 |
| Central Europe (Austria) | T. obtusus | 2 | 1 | 2 | 1 | 1 | | | | | | | | | | | | | | | | | 7 |
| Caucasus | T. obtusus | | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | 4 |
| England | J T. quadristriatus | | | | | | | 3 | 3 | 4 | 4 | 6 | 5 | | 1 | | 2 | | 1 | | | 1 | 30 |

separation is especially distinct (p. 230) in the form of the quotient

$$\frac{\text{width of the temple}}{\text{diameter of the eye}}.$$

(b) Both the anterior and the posterior supra-orbital setigerous pores are situated diagnostically closer to the inner margin of the eye in *T. quadristriatus* than in *obtusus;* the separation is especially distinct (p. 232) in the form of the quotients $\frac{\text{d. eye}}{\text{a.p. — eye}}$ and $\frac{\text{d. eye}}{\text{p.p. — eye}}$. The position of the posterior supra-orbital pore is more important for diagnosis than the position of the anterior pore.

(c) As far as the material studied is concerned (p. 221), *T. quadristriatus* is a constantly macropterous species, and *obtusus,* a dimorfic one in which the brachypterous form is the more common. Thus, brachypterous specimens always belong to *T. obtusus* (except in the Isle of Elbe where the brachypterous form would belong to *T. quadristriatus* : JEANNEL, 1927).

(d) The remaining external characters from those mentioned in Table 1 have no diagnostic value for the regions where the specimens under consideration came from. In doubtful cases (which were very few among the 1354 *Trechus* studied, p. 223) the form of the elytra, especially the lateral curve (p. 225) may give some indication as to specific identity.

(e) In both species many dimensions show a distinct geographic variation (e.g., Tables 5 and 6 and 7, 8 and 10).

No other diagnostic differences than the development of the wings could be found between macropterous and brachypterous *T. obtusus* specimens from the Netherlands (52 macropterous and 230 brachypterous specimens were studied). Hence, in my opinion, there is no more reason for naming the macropterous form in *T. obtusus* (f. *obtusioides* Jeannel) than in other dimorfic species of Carabid beetles (p. 225). This doet not exclude, of course, that in Southern France, Spain and North Africa, the range of *abtusioides* according to JEANNEL (1927), the full-winged form could be much more distinct morphologically than in the Netherlands. I had no opportunity to study specimens from Southern Europe and North Africa, but the remark by JEANNEL (1927): "Pas plus *obtusioides* que *renati* ne présentent d'ailleurs une constance absolue dans leurs caractères extérieurs; ce sont des variétés plus fréquentes dans certaines conditions de climat et d'altitude, mais non des sous-espèces nettement tranchées", suggests that for these geographical areas too, the situation is obscure.

## DISTRIBUTION

According to JEANNEL (1927, 1941) the macropterous form *obtusioides* of *Trechus obtusus* is restricted to Southern France (1927: Bordeaux, Gironde; Castres, Tarn), Spain (1927: Cadiz; Cercedilla) and North Africa (1927: Tétouan, Morocco; Yakouren, Kabylie, Algeria; Aïn-Draham, Souk-el-Arba, Tunisia). In England, Germany, Austria, the Faroe Islands, Iceland, Italy, Roumania, Yugoslavia and the greater part of France the brachypterous form (the typical form or the

form *renati* Jeannel) would be the only one. LINDROTH (1945: 659), apparently, has the same opinion: "Bei uns, wie überhaupt in W.- und N.-Europa, ist der Käfer konstant brachypter...". The results of my investigations are not in agreement with these views: macropterous specimens were frequently found in Dutch material (52 among 282 specimens = 18%), in material from Western Germany (8 among 44 specimens = 18%), and in material from the Caucasus (1 among 4 specimens). The *obtusus* specimens that I saw from other regions were all brachypterous: 8 from Scandinavia, 7 from Central Europe (6 from Austria), and 120 from Iceland. Within the Netherlands macropterous specimens were found in most *obtusus*-populations (these data will be published separately). In this connection it would be worth while to study large samples of *T. obtusus* from all parts of its range.

*Trechus quadristriatus* is distributed throughout Europe (except the Faroe Islands) and Western Asia (JEANNEL, 1927, 1941). I saw material from the Netherlands (176 specimens), from Western Germany (60), from Scandinavia (about 250), from Wellesbourne, England (70) and from Drahanoviče, Czechoslovakia (333).

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## ZUSAMMENFASSUNG

Der taxonomische Status von *Trechus obtusus* Er. hat viel Verwirrung gegeben in der Literatur. Tabelle 1 gibt eine Übersicht von dieser Verwirrung. Um die Bedeutung für die Diagnostik der aüsserlichen Merkmale, welche in der Literatur benutzt werden zur Trennung von *T. obtusus* und *T. quadristriatus* Schrk., objectiv beurteilen zu können, wurden diese Merkmale quantifiziert und an vielen Exemplaren aus den Niederlanden, West-Deutschland, Skandinavien, der Tsechoslowakei, England und Island gemessen. Die einzige aüsserliche Merkmale, welche sich als verwendbar für die Trennung der beiden Arten herausstellten, sind: die Breite der Schläfe, und der Abstand zwischen den Supraorbitalsetae und dem Innerrande des Auges. Die Frequenzverteilungen dieser quantitativen Merkmale werden verglichen und besprochen. Die Verbreitung der macropteren und brachypteren Form von *T. obtusus* wird besprochen.

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