## STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 42.

# NOTOSTRACA FROM THE NETHERLANDS ANTILLES
## with notes on the Segmentation of the Group

by

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A collection of 79 specimens of Notostraca from the islands of Bonaire, Curaçao, and Aruba was kindly handed over to me for examination by Dr. P. WAGENAAR HUMMELINCK, Utrecht, to whom my thanks are due for giving me this opportunity of seeing some interesting material.

All the specimens concerned belong to *Triops longicaudatus* (LeConte) — usually known as *Apus longicaudatus* LeConte — which is the only species of its genus yet found in America.

The collection consists of the following samples, all from temporary pools.

| | | | | |
|---|---|---|---|---|
| Sta. 376 | BONAIRE, N of Kralendijk, pool (½ × ½ × 1 m) in very low limestone terrace, | 3.IX.1948 | (90 mg Cl/l) | 23 spec. |
| Sta. 376A | BONAIRE, pool (10 × 2 × 1/7 m) in connection with the former, | 3.IX.1948 | (90 mg Cl/l) | 21 spec. |
| Sta. 377 | BONAIRE, pool (15 × 3 × 1/8 m) separated from sta. 376 by a stretch of limestone of about 50 metres which may be inundated after rains, | 3.IX.1948 | (90 mg Cl/l) | 15 spec. |
| Sta. 396 | CURAÇAO, Tanki di Tera Corá, muddy pool (4 × 3 × ¼ m), | 20.VIII.1948 | (335 mg Cl/l) | 1 spec. |
| s.n. | CURAÇAO, Hato, shallow pool of rainwater | 15.VIII.1949 | | 8 spec. |
| Sta. 400 | ARUBA, near Hooiberg, pool (3 × 2½ × ½ m) in artificial depression of weathered diorite, | 31.XII.1948 | (60 mg Cl/l) | 6 spec. |
| Sta. 400d | ARUBA, same pool (soon dried up), | 10.II.1949 | (43 mg Cl/l) | 3 spec. |
| Sta. 400e | ARUBA, same pool (dried up), | 10.V.1955 | | 2 spec. |

The sample without station number was collected by A. D. RINGMA, no. 400d by J. VAN ZIJL, the others by Dr. HUMMELINCK, who has described the localities in another paper (1953).

The material (79 specimens, including 2 larvae) has been presented to the State Museum of Natural History at Leiden, with exception of the specimens from Sta. 400 which have been deposited at the Zoological Museum of the University at Lund.

The specimens are enumerated in table 2, where information is given about the origin, length of carapace — length of body cannot be measured with proper accuracy — and number of body-rings of each specimen. All of them are sexually mature, with well-developed egg capsules, often containing eggs (table 2). Sections show that they are hermaphroditic. LONGHURST (1954, 1955) has proved that hermaphroditism is common in the Notostraca, not parthogenesis, as was formerly assumed.

In this paper, I shall deal mainly with the segmentation of the specimens and with their armature of spines on the telson – features of established taxonomic interest.

Before going into the question of segmentation, I think it necessary to give an account of some basic principles of this feature. The first eleven body-rings form the thorax, after which follows the abdomen. In the latter, the rings are not ordinary segments (LINDER 1952); the abdomen consists of two segmental parts, the series of rings and the series of legs, the units of which have developed at different rates. The series of legs may end anywhere underneath a ring, and a ring furnished with legs to about half of its length ought to be counted as a 'half leg-bearing ring' as is done in the tables in this paper (cfr. LINDER 1952, p. 44, fig. 20). The number of legless rings, a feature which is greatly valued and is sometimes useful as a taxonomic character, is only the result of the varying interplay of the two above-mentioned series. Incomplete rings (LINDER 1947; 1952, p. 41, fig. 16) are sometimes found at the end of the series of rings, just before the telson. Thus, both the two series may end without regard to ordinary boundaries between rings.

The following short formula can be given for the segmentation. $11 + (16 — 19) + (6 — 8) = 35 — 37$ means that there are 11 thoracic, 16 — 19 abdominal leg-bearing, and 6 — 8 legless rings, and that the total number of rings is 35 — 37. The above formula characterizes the specimens in the present collection. For the whole species, the formula runs as follows: 11 + (16 — 21) + (4.5+i — 16+i) = 35 — 44. The abbreviation 'i' stands for an incomplete ring.

It must be pointed out that the exact number of legless rings can easily be deduced from the total number of rings and the number of leg-bearing rings in a single specimen, but that this is generally impossible when the varying figures for a population or species are given. I think it highly desirable that the numbers of abdominal leg-bearing rings should not be omitted when populations or species are described. These figures are sometimes significant.

We can now proceed to analyze the segmentation in this collection (table 2, 3).

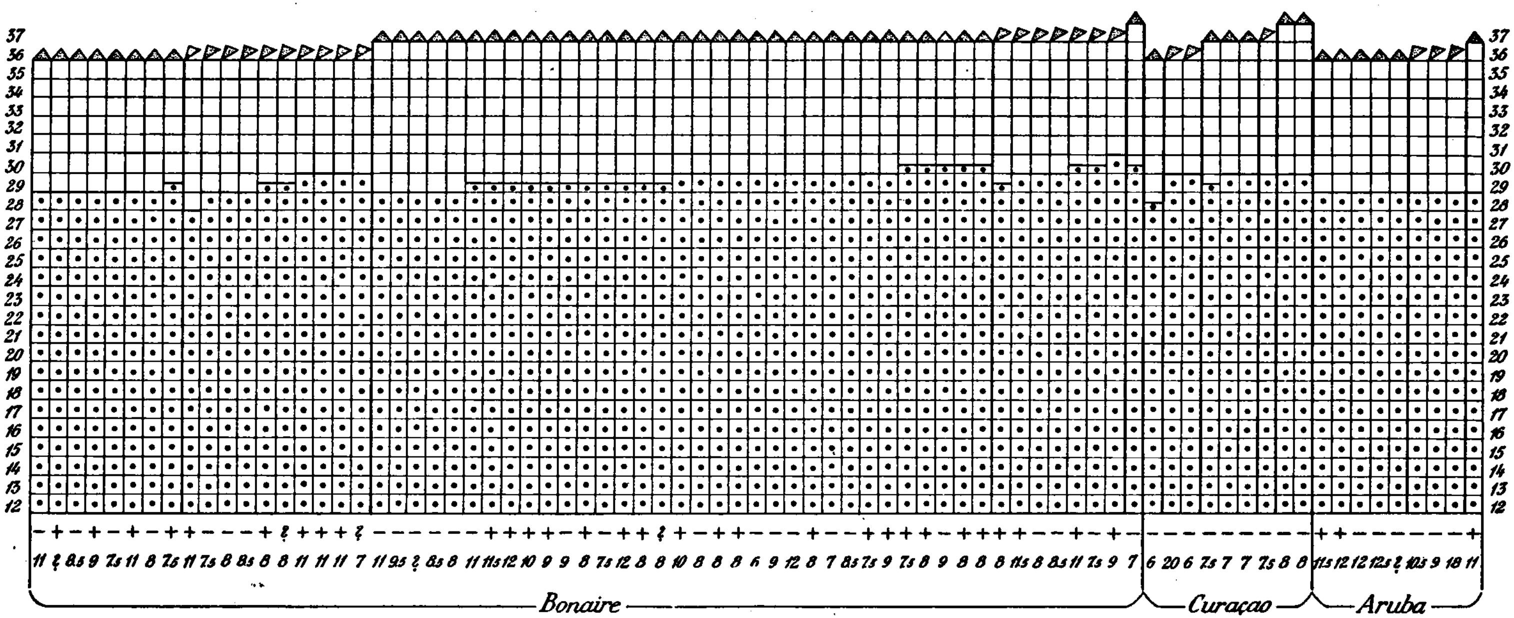
The total number of rings, viz., 35–37, shows remarkably small variation. In a bisexual population of the same species the variation may be as high as 39–44 (LINDER 1952, p. 63, fig. 31; table 5 here). This, however, is in close accordance with my earlier observations that hermaphroditic ('parthenogenetic') populations show less variation in this respect than bisexual ones. The relatively low figures are also typical of hermaphroditic populations (LINDER 1952, p. 16). There are, however, bisexual populations with just as low total numbers. LONGHURST (1955, p. 47), for example, mentions males with 35 body-rings. This is nothing out of the ordinary. Similar cases are known in *Triops* (= *Apus*) *cancriformis* (Bosc) and *Lepidurus arcticus* (Pallas). But in no instance do we know of hermaphroditic populations with the higher numbers of those to be found in the whole species.

A similar situation is found as regards the number of abdominal leg-bearing rings. This is 16–19 here as against 16–21 for the whole species, a range which may be covered by a single bisexual population (table 4). In the latter case the number is highest in the females, viz., 17+i — 21, while the males have only 16 — 18+i. The numbers of legs are in close conformity with this.

Here it is tempting to examine the question of the respects in which the hermaphroditic specimens are built as males or as females in the bisexual populations. As yet, however, only such bisexual populations, where the specimens have a relatively high number of rings, have been sufficiently described. The low-numbered

TABLE 2

Diagram indicating the number of body-rings in the abdomen of 77 hermaphroditic specimens of *Triops* (= *Apus*) *longicaudatus*. — Each shaded triangle at the top of the diagram represents the telson of a specimen, below which are indicated the legless rings and the leg-bearing abdominal rings (dotted). Incomplete rings at the anterior boundary of the telson are denoted by oblique position of the triangle. Body-ring numbers are shown in the marginal columns at the left and right. Below, the presence (+) or absence (—) of eggs in the egg capsules, and the length of carapace in mm, are indicated.



ones should also be considered, especially as regards the condition of the series of legs — a point which has, unfortunately, been all too seldom properly described in the literature.

From the above it seems clear, however, that both the series of legs and the series of rings are less well-developed here than in some bisexual populations of the species — in fact most likely less well-developed than in the great majority of them.

TABLE 3.

Number of body-rings in 59 hermaphroditic specimens of *Triops longicaudatus* from Bonaire (sta. 376, 376A, 377).

| Total number of rings . . . . . | 35 | 35+i | 36 | 36+i | 37 | |
|---|---|---|---|---|---|---|
| Number of specimens . . . . . | 8 | 10 | 33 | 7 | 1 | = 59 |

| Number of leg-bearing abdom. rings . . . . . | 16 | 16.5 | 17 | 17.5 | 18 | 18.5 | 19 | |
|---|---|---|---|---|---|---|---|---|
| Number of specimens . . . . . | 1 | 0 | 15 | 15 | 19 | 8 | 1 | = 59 |

| Number of legless abdominal rings | 6 | 6+i | 6.5 | 6.5+i | 7 | 7+i | 7.5 | 7.5+i | 8 | 8+i | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of specimens . . . . . | 1 | 5 | 6 | 4 | 19 | 6 | 12 | 1 | 4 | 1 | =59 |

After having thus established the conditions of both the series, we may turn to the resulting number of legless rings. Since the total number of rings is much lower, and the number of leg-bearing rings only a little lower, than in some bisexual populations, there ought to be few legless rings here. They number 6 — 8+i, the whole species having 4.5+i — 16, and bisexual females, as far as is known, 9+i — 13 (LINDER op.cit., p. 12).

For purpose of comparison, I have studied two samples without males from the Galapagos Islands (table 4). Though I have made no sections from these, I think there is no room for doubting that the specimens are hermaphroditic. The small populations from Curaçao and Aruba are not considered in the table. The specimens from there do not show any significant differences from the Bonaire specimens (table 2). The samples from Bonaire probably represent a single population. The localities are separated from each other "by a stretch of limestone plateau of about 50 metres which may be inundated after rains". Specimens with incomplete rings are omitted from the table, because it is difficult to say how such rings ought to be counted as compared with ordinary ones.

The three populations are very similar to each other in several respects. The total number of rings is the same, though specimens with 37 rings are missing from one of the Galapagos populations. In the number of abdominal leg-bearing rings, the similarity is closer than would appear from the table, because the missing numbers in the populations from Bonaire and Duncan Island are represented by specimens with incomplete rings (see table 3 for Bonaire).

Similarly low total numbers are met with in populations from California (34+i — 36, two populations, six specimens, LINDER op. cit., p. 62; ROSENBERG 1947, similar figures, more specimens); the Hawaiian Islands (37, one specimen, LINDER op. cit., p. 66; LONGHURST op. cit., p. 32); and the Argentine (38+i—39, six specimens, LINDER op. cit., p. 66). UÉNO (1926, p. 263) gives similar numbers (35–38, four populations with varying figures) for Japanese specimens which I have not seen. The numbers of abdominal leg-bearing rings in the above populations agree well with those in the present material, though UÉNO's paper gives only limited information about this. No males are reported from these localities, and I agree with LONGHURST when he says (op. cit., p. 32), "It may be that all populations of this species from the Pacific region are hermaphrodite". To this region is now added the Netherlands Antilles, and possibly also the Argentine, though the material from the latter country is admittedly very poor as yet.

We may now widen our outlook by taking into consideration even bisexual populations of this and other species of the genus (table 4). In all cases recorded here, whether concerning hermaphroditic or bisexual specimens, a clear tendency appears for the high numbers in the two series to be combined with each other — i.e., when the series of abdominal rings is well developed, the series of leg-bearing rings is also well developed. The averages show this remarkably clearly, though there are many exceptions.

On purely mathematical grounds it may be expected that high-numbered specimens have a high average number of legless rings. The table shows that this is the case.

TA-

Structure of the abdomen in populations belonging to various species, viz., *Triops* (LeConte) from Duncan Island, Galapagos (USNM 82031); Bonaire; S. Seymour *granarius* (Lucas) from South Africa (Swed. State Mus. Nat. Hist. 6900); Shansi, mens found with a certain number of leg-bearing abdominal rings (on

| | *Triops cancriformis* | | | *Triops longicaudatus* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Morocco ♀, ♂ | | | Duncan Isl. ⚥ | | Bonaire ⚥ | | | S. Seymour Isl. ⚥ | | |
| 21 | | | | | | | | | | | |
| 20.5 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| 19.5 | | | | | | | | | | | |
| 19 | | | | | | | | | | | 1 |
| 18.5 | | | | | 4 | | 5 | 1 | | | 1 |
| 18 | | | | 1 | 120 | | 12 | | | 11 | 1 |
| 17.5 | | | | 1 | 1 | 1 | 11 | | | 6 | |
| 17 | | | | 1 | | 7 | 5 | | 3 | 17 | |
| 16.5 | | | | | | | | | 3 | | |
| 16 | | | | | | | | | 2 | | |
| 15.5 | | ♀ | | | | | | | | | |
| 15 | | | *4* | | | | | | | | |
| 14.5 | | *13* | 1 | | | | | | | | |
| 14 | | *52* | 15 | | | | | | | | |
| 13.5 | | 9 | 1 | | | | | | | | |
| 13 | 1 | 3 | | | | | | | | | |
| 12.5 | 1 | | ♂ | | | | | | | | |
| Nr. abd. rings | 19 | 20 | 21 | 24 | 25 | 24 | 25 | 26 | 24 | 25 | 26 |
| Total nr. rings | 30 | 31 | 32 | 35 | 36 | 35 | 36 | 37 | 35 | 36 | 37 |
| Nr. specim. ♀ | — | 18 | 4 | 3 | 125 | 8 | 33 | 1 | 8 | 34 | 3 |
| ♂ | 2 | 14 | 17 | | | | | | | | |
| Av. nr. leg-bear. ♀ rings | — | 14.36 | 15 | 17.5 | 18.02 | 17.06 | 17.78 | 18.5 | 16.56 | 17.41 | 18.5 |
| ♂ | 12.75 | 13.46 | 14 | | | | | | | | |
| Av. nr. legless ♀ rings | — | 5.64 | 6 | 6.5 | 6.98 | 6.94 | 7.22 | 7.5 | 7.44 | 7.59 | 7.5 |
| ♂ | 6.25 | 6.54 | 7 | | | | | | | | |

Expression of the number of leg-bearing abdominal rings as a percentage of the number of abdominal rings gives varying figures in each of the populations described here, and thus the body proportions in this respect are not stabilized. The differences within a population may be as small as 2.5% (70–72.5%) — as is the case, for example with the females of *Triops cancriformis*, but this is a small sample. The greatest differences are found in males of *Triops longicaudatus*, where the figures are from 50 to 60%. I am, of course, BLE 4

*cancriformis* (Bosc) from Safi, French Morocco (USNM 174363); *Triops longicaudatus* Island, Galapagos (USNM 82033); Aurora, Wyoming, U.S.A. (USNM 58766); *Triops* China (Swed. State Mus. Nat. Hist. 5153). — The table shows the number of speci- the left and right of the table) and of abdominal rings in all (below).

| | | | | | *Triops granarius* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wyoming ♀, ♂ | | | | | South Africa ♀, ♂ | | | | | China ♀, ♂ | | | | | |
| | ♀ | *1* | | | | | | | | | ♀ | | | | 21 |
| | | | | | | | | | | | | | *2* | | 20.5 |
| | *3* | *5* | | | | | | | | | *3* | *3* | | | 20 |
| | *4* | *6* | | | | | | | | | *2* | | | | 19.5 |
| *1* | *18* | *5* | *1* | | | | ♀ | | | *1* | *8* | *1* | | **1** | 19 |
| *3* | *3* | *1* **1** | | **1** | | | | | | | | | | | 18.5 |
| | *2* | **1** | **3** | | | | *1* | *2* | *1* | *1* | *1* | **2** | **7** | | 18 |
| | | **1** | **1** | | | | *2* | | | | | **2** | | | 17.5 |
| | **2** | **3** | **3** | | | *2* | *2* | *6* | | | | **1** | **2** | | 17 |
| | | **2** | | | | *3* | *1* | | | | | | | | 16.5 |
| | **1** | | | | *1* | *2* | *2* | **1** | | | | | ♂ | | 16 |
| | | ♂ | | | *1* | | | | **1** | | | | | | 15.5 |
| | | | | | | | | **5** | **2** | | | | | | 15 |
| | | | | | | | **1** | **5** | | | | | | | 14.5 |
| | | | | | | | **5** | **1** | | | | | | | 14 |
| | | | | | | | | | | | | | | | 13.5 |
| | | | | | | | | ♂ | | | | | | | 13 |
| | | | | | | | | | | | | | | | 12.5 |
| 29 | 30 | 31 | 32 | 33 | 27 | 28 | 29 | 30 | 31 | 28 | 29 | 30 | 31 | 32 | |
| 40 | 41 | 42 | 43 | 44 | 38 | 39 | 40 | 41 | 42 | 39 | 40 | 41 | 42 | 43 | |
| 4 | 30 | 18 | 1 | — | 2 | 7 | 8 | 8 | 1 | 2 | 14 | 4 | 2 | — | |
| — | 3 | 8 | 7 | 1 | — | — | 6 | 12 | 3 | — | — | 5 | 9 | 1 | |
| 18.63 | 18.67 | 19.53 | 19 | — | 15.75 | 16.5 | 16.94 | 17.25 | 18 | 18.5 | 19.33 | 19.75 | 20.5 | — | |
| — | 16.67 | 17.25 | 17.5 | 18.5 | — | — | 14.08 | 14.79 | 15.17 | — | — | 17.6 | 17.78 | 19 | |
| 10.37 | 10.93 | 11.47 | 13 | — | 11.25 | 11.5 | 12.06 | 12.75 | 13 | 9.5 | 9.67 | 10.25 | 10.5 | — | |
| — | 13.33 | 13.75 | 14.5 | 14.5 | — | — | 14.92 | 15.21 | 15.83 | — | — | 12.4 | 13.22 | 13 | |

quite aware that these figures are not exact, but they may go to show the general tendency.

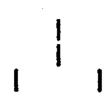
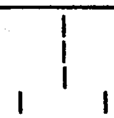
The relative proportions of the actual lengths in mm of the two series do not necessarily follow these figures. Sometimes the rings vary a little in size in a single specimen. The lengths cannot be measured with proper accuracy because of the varying contraction of the body, in both living and preserved specimens.

LONGHURST (op. cit., p. 47) says that in *Triops longicaudatus* the legless rings (which he calls 'apodous segments') have a varying number of supernumerary spines on their ventral surface. This is not the case in the specimens from the Netherlands Antilles. Here such spines are rare and often quite absent.

The armature of spines on the telson may now be considered. On its dorsal side, there are some conspicuous large spines, the number of which PACKARD (1883) used as a taxonomic character. I found (op. cit., p. 53 ff) that this is not a reliable character, and united all American forms in *Triops* (= *Apus*) *longicaudatus* (LeConte). In distinguishing this species I mentioned "perhaps one outstanding feature — that the dorsal central spines on the telson are relatively large and are arranged in distinct patterns" (op. cit., p. 65). Some schematic figures of these patterns were given (op. cit., p. 59, fig. 29; p. 61, fig. 30), showing that they are variable to a moderate degree but still identifiable. Even some asymmetric patterns were figured.

TABLE 5.

Distribution of the patterns of spines on the dorsal side of the telson in *Triops longicaudatus*. — m. = medians, p.m. = posterior marginals.

| m.<br>p.m. |  |  |  | Various irregular patterns |
|---|---|---|---|---|
| Bonaire | 2 | 17 | 14 | 26 |
| Curaçao | — | 2 | 3 | 4 |
| Aruba | — | 2 | 4 | 3 |

LONGHURST (op. cit.) accepted my conception of the species and was able to show, after a useful analysis of these structures during the larval development, that the two most posterior spines pointed out in the original description are really characteristic of the American forms. He calls them 'posterior marginals'. The spines anterior to them are called 'median spines' or 'medians', and those round the dorsal sensory setae 'setal spines'. He attaches no importance to the latter and says that the medians are "large, 1–4 in number, in a row" (op. cit., p. 41) or "large, 1–3, in a single row in the midline" (op. cit., p. 47).

The specimens from the Netherlands Antilles vary a great deal in this respect (figs. 3–5, table 5). In the majority of them the medians

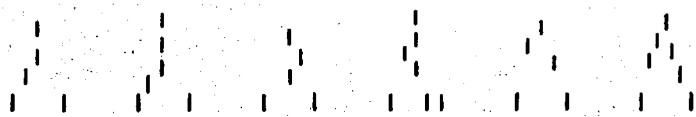


Fig. 3. Some irregular patterns of spines on the dorsal side of the telson in *Triops longicaudatus*.

are placed in a straight row, but in 33 of the 77 specimens the row is broken in different ways. The term 'medians' is perhaps not so good when the spines in question are scattered with only one or two in the midline, but I think it can be used as long as they are placed in the middle part of the area.

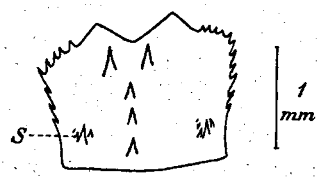



Fig. 4. The telson of a specimen of *Triops longicaudatus* from Bonaire. — *S* = setal spines.

In spite of the irregularity of the patterns there is no doubt that the specimens belong to the common American species. I have found no important differences in other respects as compared with the large material of the species which I examined earlier, and even

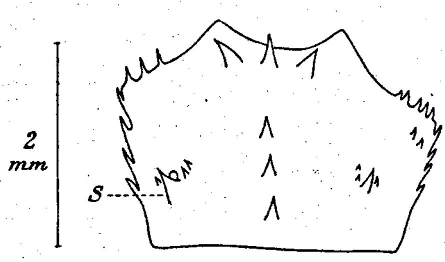



Fig. 5. The telson of a specimen of *Triops longicaudatus* from Curaçao (sta. 396), by far the largest in the collection. — *S* = setal spines. (Figs. 4 and 5 are drawn upside down as compared with the patterns in table 5 and fig. 3.)

there irregular patterns are found, though they are rather rare in bisexual populations.

In the hermaphroditic populations from California and the Galapagos Islands, however, I have found irregular patterns again, though a little less developed than and not quite so common as, in the populations from the Netherlands Antilles. One specimen from Hawaii (LINDER op. cit., p. 66) is slightly irregular, but a small collection from the Argentine (six specimens) shows only regular patterns. UÉNO (op. cit.) mentions no irregularities of this kind in Japanese material.

Though the majority of the forms of the species supports LONGHURST's claim that the medians ought to be placed in a row in the midline, the above-mentioned exceptions are noteworthy. The irregularities seem to be characteristic of some hermaphroditic populations.

I have seen a good many Notostraca from Asia and Africa with large central spines, sometimes placed mostly in a median row but most often scattered in a way more or less similar to that in the present material. Further studies in this field may, of course, reveal interesting facts about the distribution of various features. For the present, however, great caution is needed in the use of this factor of variation in taxonomic connections; and the principal character of *Triops longicaudatus* (LeConte) seems to be the large posterior marginals.

As for the setal spines, the variations in which LONGHURST (op. cit.) considers to be without any taxonomic significance, all specimens from the Netherlands Antilles are uniform in so far that one spine on each side is larger than the others (figs. 4, 5). Even when all setal spines are unusually large in a specimen, the same relative proportions are to be found. In the forms of the species which PACKARD (op. cit.) called *Apus lucasanus*, the same feature is quite conspicuous, but I have found it even in other populations from North America, though I have not checked to see whether it is really characteristic of all forms of the species or is merely more common there than in other species of the genus.

In the present material, the carapace is rather long and narrow (fig. 6), though not as much as in the Argentine specimen which I figured earlier (op. cit., pl. 5 figs. 2, 3). The specimens from the Galapagos Islands are similar to those described here. LONGHURST (op. cit., p. 12) found that short-bodied Notostraca (with few body-rings) generally have such a carapace — an interesting observation, probably broadly correct.

A few words may be said here about the structure of the appendages.

The antennae, mandibulae, and maxillae are normal for the

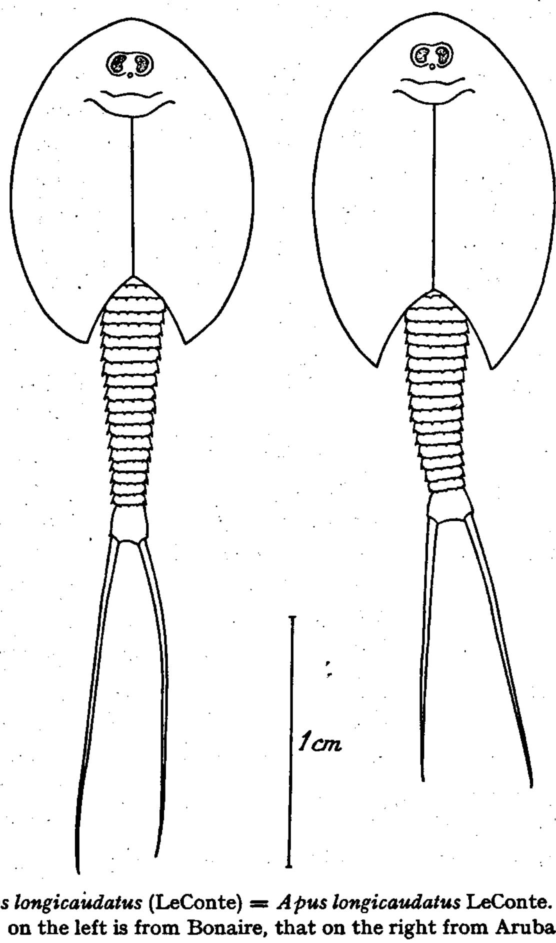



**Fig. 6. *Triops longicaudatus* (LeConte) = *Apus longicaudatus* LeConte. The specimen on the left is from Bonaire, that on the right from Aruba.**

species. LONGHURST (op. cit., p. 27) ascribes to me the opinion that the presence or absence of second antennae in full-grown animals is of taxonomic importance; but in actual fact I do not think it is. The second maxillae are totally absent in all specimens. The animals from the Galapagos Islands agree in the above respects.

The legs have been counted in ten specimens. There are 52–57 pairs, a low number compared with those in bisexual populations, viz., 56–66 (LINDER op. cit., p. 63, fig. 31). The Galapagos material gives similar figures. The low number tallies well with the fact that hermaphroditic specimens have relatively few leg-bearing abdominal rings.

The legs show nothing remarkable, with the exception of the last pair. They are similar in all respects to those of bisexual populations, and, as I have said before (op. cit., p. 29), the legs even of different species are known to be very similar to each other. Like many other writers, I use the term 'legs' to describe the appendages of the thorax and abdomen, excluding the furca. These appendages are well known from the works of ZADDACH (1841), PACKARD (1883), LANKESTER (1881), G. O. SARS (several papers), and others; so, unlike LONGHURST (op. cit., p. 26), I think that there is not much need for a comparative study of the legs, but only of the other appendages.

The legs of the last pair, however, are of special interest, as they may show how the series ends. The only leg of this pair which has been illustrated with proper regard to the armature of spines, viz., that of *Lepidurus lynchi* Linder (LINDER op. cit., p. 46, fig. 23), has a clearly larval appearance, with very few and short spines on its endites. Such a 'larval' leg is interesting from a phylogenetic point of view (cf., for example, the larval leg of *Branchinecta paludosa* O.F.M. in LINDER 1941, p. 154, fig. 12b). I have pointed out previously (1941 p. 164, 1945 p. 22) that more studies of larval legs are needed in phylogenetic connections. However, I shall not go into these questions here, but shall reserve them for another paper.

In the present material I have found last legs which are more or less unlike the one mentioned above. Their endites may be just as densely covered with short, thick spines as are the endites of the more anterior legs, and they seem capable of performing a function similar to the latter. Sometimes there is a less well-developed armature of spines on these endites, though it is not as simple as in the last leg of *Lepidurus lynchi* mentioned above.

I have observed varying development of the last legs in this respect even in other Notostraca.

This variation ought to be viewed in the light of the observation made by me (op. cit., p. 11) and later confirmed by LONGHURST (op. cit., p. 9) to the effect that in some cases the legs increase in number in late stages. The simplest last legs are found in specimens where this seems to be the case.

I am not yet prepared to say with certainty whether these variations are connected with varying location of the last legs underneath a ring, or with specific differences, or with both, or perhaps even with other circumstances.

Anyway, it is noteworthy that the series of legs ends with different types of legs in different cases within Notostraca. Conditions in this respect are not stabilized in the group.

## REFERENCES

LANKESTER, E. RAY, 1881. Observations and Reflections on the Appendages and on the Nervous System of Apus cancriformis. *Quart. Journ. Micr. Sci.* (*n.s.*) *21*, p. 343.

LINDER, FOLKE, 1941. Contributions to the Morphology and the Taxonomy of the Branchiopoda Anostraca. *Zool. Bidr. Uppsala 20*.

LINDER, FOLKE, 1945. Affinities within the Branchiopoda, with notes on some dubious fossils. *Ark. Zool.* Stockholm *37A*, No. 4.

LINDER, FOLKE, 1947. Abnormal Body-Rings in Branchiopoda Notostraca. *Zool. Bidr. Uppsala 25*, p. 378.

LINDER, FOLKE, 1952. Contributions to the Morphology and Taxonomy of the Branchiopoda Notostraca, with special reference to the North American species. *Proc. U. S. Nat. Mus. 102*, No. 3291.

LONGHURST, A. R., 1954. Reproduction in Notostraca (Crustacea). *Nature* London *173*, p. 781.

LONGHURST, A. R., 1955. A Review of the Notostraca. *Bull. Brit. Mus.* (*Nat. Hist.*) *Zool. 3*, No. 1.

PACKARD, A. S., 1883. A Monograph of the Phyllopod Crustacea of N. America. *U. S. Geol. Geogr. Surv. Terr. Rep. 12*, p. 295.

ROSENBERG, L. E., 1947. New species of Apus from California. *Trans. Amer. Micr. Soc.* *66*, No. 1, p. 70.

SARS, G. O., 1899. Additional notes on South African Phyllopoda. *Arch. math. nat. Christiania 21*.

SARS, G. O., 1901. On the Crustacean Fauna of Central Asia. *Ann. Mus. St. Petersburg 6*, p. 130.

UÉNO, MASUZO, 1926. The Freshwater Branchiopoda of Japan. 1. *Mem. Coll. Sci. Kyoto* (*B*) *2*, No. 5, Art. 12.

WAGENAAR HUMMELINCK, P., 1953. Description of New Localities. *Studies on the Fauna of Curaçao and other Caribbean Islands 4*, No. 17.

ZADDACH, E. G., 1841. *De Apodis cancriformis*. Bonn.