ZOOLOGY.—*A new subgenus of* Diaptomus (*Copepoda: Calanoida*), *including an Asiatic species and a new species from Alaska.*

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This paper is part of a projected survey of the fresh-water Copepoda of Alaska. It includes the description of a new species of *Diaptomus* that has zoogeographical importance because of its close relationship to one from the Asiatic portion of the U. S. S. R. This latter species (*D. rylovi* Smirnov, 1930) has been assigned by Kiefer (1938a) to his genus *Neutrodiaptomus*. Since it and the new Alaskan species exhibit distinct differences from all the other members of this group, a new division is proposed to include them. This is given the status of subgenus, as I agree with Light that the structural range of variation among the species of *Diaptomus* (sensu lato) is not great enough to allow the full rank of genus to most of the subdivisions of the so-called Diaptominae proposed by Kiefer (1932, 1936a-d, 1937, 1938a-b) and himself (1938, 1939).

Family DIAPTOMIDAE

Genus **Diaptomus** Westwood

The broad definition of *Diaptomus* used here excludes only the species delegated by Kiefer to genera of the Paradiaptominae and to *Acanthodiaptomus*, which is characterized by features common to his two subfamilies. Such a definition must include *Hemidiaptomus* Sars, 1903, because it is naturally a part of the large series of subgenera into which it is possible to divide *Diaptomus*. Kiefer's studies have drawn attention to the highly significant, but hitherto largely neglected characters of the left exopod of the male fifth leg. The structure in *Hemidiaptomus* of this and of other appendages of systematic importance, do not depart from the basic patterns found in *Diaptomus*.

One of the remainder of Kiefer's groups, *Psychrodiaptomus* (1938b), is a synonym of *Leptodiaptomus* Light. These names were both proposed in 1938, but the publication date of *Leptodiaptomus*, March 9, precedes that of *Psychrodiaptomus*, April 20.

It is felt that detailed reexamination of many species, particularly of those of North America, is needed before an evaluation of Kiefer's system of classification is possible. Therefore, a rediagnosis of *Diaptomus* is deferred for the present.

Nordodiaptomus, n. subg.

Subgenotype.—*Diaptomus siberiensis*, new name for *Diaptomus rylovi* Smirnov, 1930.

Diagnosis.—Of moderate size, length of females between 1.6 and 2.4 mm; of males between 1.4 and 1.7 mm. Metasome without bizarre protrusions, the wings of last segment in female only moderately developed; last segment distinct in male. Urosome of female with 3 well-defined segments, the genital a little asymmetrical, the sensilla not grossly developed; urosome of male asymmetrical or not.

Antennules short in both sexes, only reaching to near the end of the metasome; that of the female with a stout, very elongate seta on the first segment, and with segments 11 and 13 to 19 usually with 2 setae. The left antennule of the male differing from that of the female in having the seta of segment 1 not so well developed and only a few of segments 13 to 19 with more than 1 seta. Right antennule of male with the spines of segments 8 and 12 not enlarged, those of 10, 11 and 13 much enlarged, with dissected ends, that of 13 not reaching beyond segment 14; segments 14–16 very tumid, 14 without a process or spine; segments 15–16 with short cuticular processes; the antepenultimate segment without armature of any kind.

Maxilliped not enlarged; the endopod about half the length of the basipod, its setae slender and nonprehensile.

Outer spines of the exopods of legs 1–4 normal, those of leg 1 not at all enlarged. Leg 2 of female lacking the dorsal cuticular lappet (Schmeil's organ) of the second endopod segment; absent or not in the male.

Fifth leg of female with exopod symmetrical, the third segment distinct, its setae and that of the second segment not elongate but very stout and subequal to one another. The endopod usually shorter than the first exopod segment, normally with a single, subapical, more or less well developed spiniform seta. The endopod and its armature symmetrical or not, the whole ramus sometimes subject to considerable variation within a single population.

Fifth leg of male without bizarre armature. The right leg having the apical claw very elongate, its length about equal to that of the rest of the ramus; the lateral spine of exopod 2 stout and near the terminus of the segment; posterior face of exopod 1 with very small but heavy lamellae. Exopod 2 with or without inner cuticular spine. Both pads of the distal segment of the left exopod well defined, about equal in length, the distal narrower than the other, posteromedial in position; the proximal bulging a little medially, and with a narrowed portion extended across the top of the segment on the anterior side; both pads armed conspicuously with slender to stout hairs. The processes closely set, both distally directed; the distal short, its length not more than one-half that of the outer margin of the segment, digitiform, continuous with but more or less demarcated from the segment, with or without spinules on its inner margin; the proximal process a subterminal, stout, curving spine, reaching to the end of the other process or beyond, armed laterally with spinules. Endopods not grossly developed.

Included species: *Diaptomus siberiensis*, n. name; *Diaptomus alaskaensis*, n. sp.

Diaptomus siberiensis, n. name

Diaptomus rylovi Smirnov, 1930, pp. 79–82, fig. 1; 1931, pp. 627–634, figs. 12–21; Kiefer, 1932, p. 478.
Neutrodiaptomus rylovi Kiefer, 1938a, p. 46.

The description given in German by Smirnov (1931) has been largely used in this study. The diagnostic characters of *D. siberiensis* are given herein in the section in which it is compared to the new Alaskan species.

Occurrence.—The type locality is a small lake at Bonmak, on the bank of the River Zeya, in the Amur region of southeastern Asiatic U. S. S. R. This is apparently in the area of the head waters of the River Zeya, which according to Berg (1938) lies in the Stanovoy mountain range. Smirnov does not give the altitude, but it appears to be in the secondary southern chain having peaks of relatively low elevation (1,400 meters). The species was also found in a collection from Kjusjur, toward Bulun, which is a little south of the delta of the Lena River on the Arctic coast. This is in tundra area where the subsoil is permanently frozen and superficially at least, represents a contrast to the mountain lake habitat of the Amur locality.

Variation.—Smirnov mentioned no variation in the specimens from the type locality, except for the division of the claw of the fifth leg in some males. In the Lena River specimens, the male was wholly typical, but the female was much smaller in size, 1.7 mm as opposed to the 2.4 mm of the Amur specimens, and had only one seta instead of two on the thirteenth segment of the antennule. The endopod of the fifth leg differed in being shorter, and in having its first segment longer than the second. No statement was made as to whether these variations characterized a single individual or several.

Nomenclature.—The specific name *rylovi* was used by Charin (1928) for a species of *Hemidiaptomus*. As pointed out above, this group exhibits no differences from other groups of *Diaptomus* sufficiently distinct enough to warrant other than subgeneric status; Charin's species should therefore be known as *Diaptomus* (*Hemidiaptomus*) *rylovi*. This necessitates the renaming of Smirnov's species; the name *siberiensis* is proposed as a geographic contrast to that of the related Alaskan species.

Diaptomus alaskaensis, n. sp.

Figs. 1–29

Specimens examined.—30 ♀ ♂, collected in a mountain top pool, Eagle Summit, on the Steese Highway between Fairbanks and Circle, Alaska; elevation 3,880 feet; July 4, 1947. Collector, Charles S. Wilson.

Types.—In the United States National Museum. Holotype male, no. 90711; allotype female, no. 90712.

Description.—Length of preserved specimens, middorsal line, female, about 1.65 mm; male, about 1.44 mm.

FEMALE

Metasome (Fig. 7).—Approximately twice the length of the urosome in middorsal line. In dorsal view, the greatest width occurring just behind the cephalic suture, tapering from there to the beginning of the second segment, beyond that of rather uniform width to the wings of the last segment which are a little expanded. The cephalic segment a little longer than segments 2–4 combined (proportions approximately 37:32); its suture distinct; the anterior portion roughly triangular in dorsal view. The last segment imperfectly separated by a short lateral suture, the wings well rounded at the sides, reaching posteriorly to about the middle of the

genital segment; the tips only slightly drawn out, the asymmetry not distinctly pronounced. Each side armed with two types of sensilla, that of the wing tip a small peglike seta; the other a shorter seta set on a small rounded tubercle and arising on the inner rounded portion of the wing (Fig. 10). The marginal hyaline area of the wing (demarcated in Fig. 11 by dotted lines) very narrow.

Urosome (Fig. 11).—All three segments distinct. Genital segment not markedly inflated, but noticeably asymmetrical; the left side with a gently rounding lobe above the middle; the anterior half of the right side produced into a large backwardly directed lobe, behind which laterally is another narrowly rounded area. Each side armed on the anterior lobe with a sensillum very like that of the inner lobe of the thoracic wing. The rest of the urosome symmetrical; the third segment longer than the second (proportions about 3:2); the caudal rami only a little longer than the third segment, their length about twice their greatest width; with hairs on the inner margins from near the proximal portion to the tip; caudal setae normal.

Most females of the sample were ovigerous; the eggs comparatively large and few in number (6 to 10).

Rostral filaments (Fig. 8) attenuated and very slender.

Antennule (Fig. 5).—Comparatively short, reaching to near the tips of the thoracic wings. The elongate seta of segment 1 (measured from its base) reaching to between the end of segment 11 and the middle of segment 12; very stout basally and throughout much of its length, arising from a well defined and large cuticular base. (In Fig. 5 for convenience in arrangement of drawings, this seta has been "pulled in" towards the body of the antennule; in all the preserved specimens, both before and after dissection, it is held out more or less perpendicular to the segment; the stoutness of the proximal portion suggests that this is the natural position in life.)

The number of setae on segments 1–10, 12 and 20–25 as usual: 3 on segment 2, 2 on 9 and 22–23, 5 on 25, 1 on the others. Segments 11 and 13–19 with 2 setae each. Aesthetes normal in distribution.

Maxilliped (Fig. 6).—First basal segment with all 4 lobes well developed, their setation normal; the distal seta of lobes 2–3 much longer than the others accompanying it, subequal to each other and to that of lobe 1; the four setae of the extended distal lobe all shorter than the longest seta of lobes 1–3, the proximal the shortest, the others subequal. Second basal segment a little shorter than segment 1, its distal seta the longer, about equal to the longest setae of lobes 1–3 of the second segment. The partially suppressed segment bearing two setae. The endopod about as long as basal segment 2, of five distinct segments, all of its setae slender and setiform, those of the inner side all shorter than the 3 terminal outer setae of the apical segment.

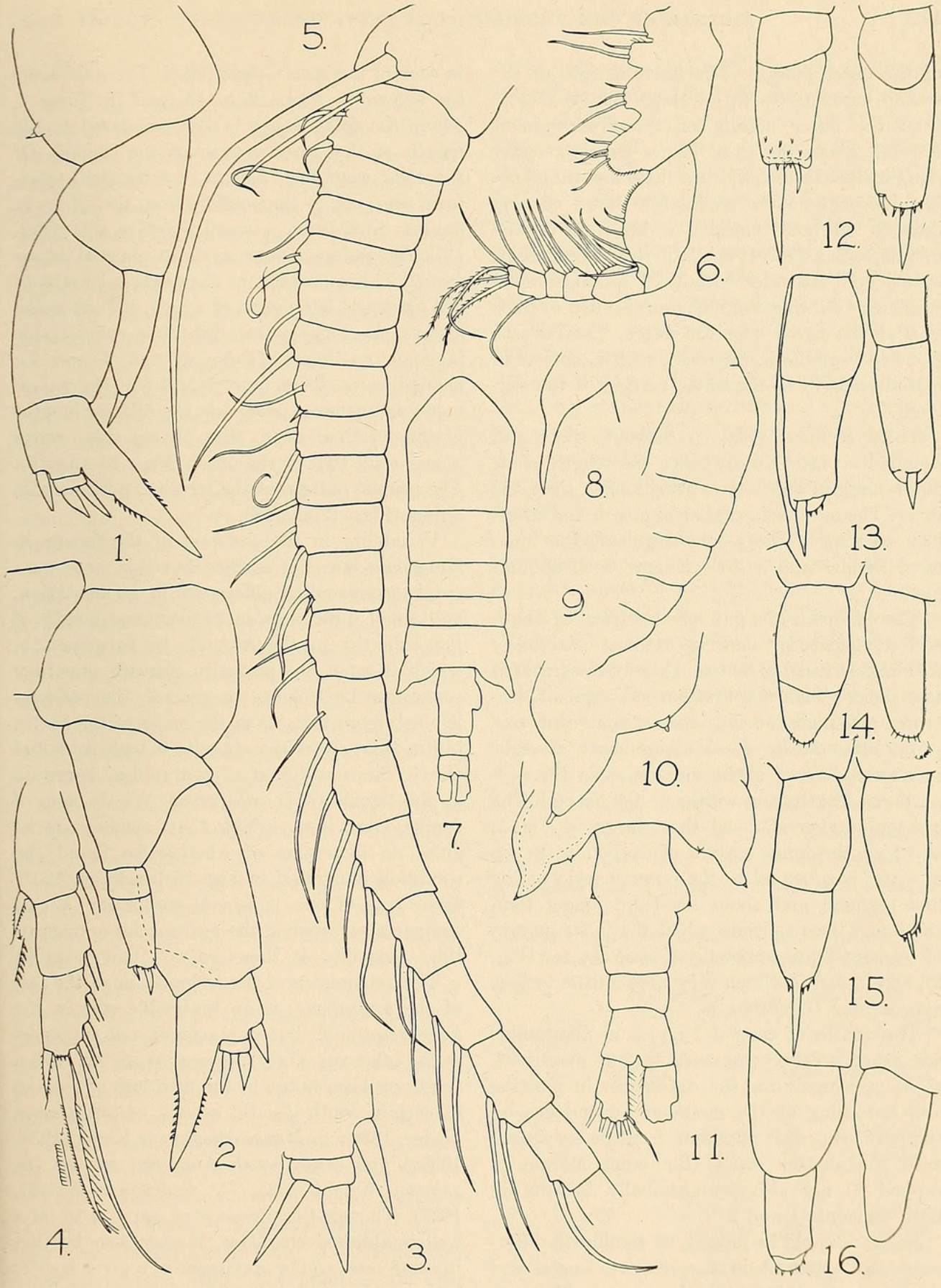
Leg 1 (Fig. 4).—The ventral surface of basipod 2 with a patch of long fine hairs on its outer portion just above the exopod, the remainder unarmed. Outer spines of exopod segments 1 and 3 only moderately stout; subequal to one another, that of segment 3 being only a little longer than that of 1 (approximate proportions 11:10); both tipped apically with a very slender sensory hair; their marginal spinules minute (see detail, Fig. 4), hardly distinguishable except at very high magnification. The spine of segment 1 reaching only to about the middle of the second segment, bent, with a resultant inner marginal notch proximally.

The elongate terminal spinelike seta of segment 3 stout, broader basally than the outer spine, its inner margin indented, bearing fine marginal hairs below the point of indentation; the outer margin, beginning at a corresponding point, armed with a very narrow, finely serrate flange (see detail, Fig. 4). The other setae of the segment all reaching considerably beyond the apex of this outer seta (proportional lengths, about 70:54). The outer margins of the exopod segments without hairs.

Leg 2.—The second segment of the endopod lacking a cuticular lobe on the dorsal face.

Leg 5 (Figs. 1 and 2).—The posterior side of the first basal segment tumid; the sensillum short and spinelike, mounted on a small tubercle. Second basal segment not tumid, considerably prolonged on the anteromedial side to the point of attachment of the endopod (Fig. 2); no sensory hair apparent, a cuticular depression observed in the place of its normal location on one specimen.

The exopod (to tip of claw) only a little longer along its inner margin than the basipod. The inner margin of the first segment roughly about two-thirds of the length of the outer (proportions 25:35); its width about three-fourths of the length of the inner and about one-half of that



FIGS. 1–16.—*Diaptomus alaskaensis*, n. sp., female

1–3, Leg 5: 1, Left side, posterior view, specimen no. 7; 2, left, anterior view, specimen no. 2; 3, exopod setae, specimen no. 5. 4, Leg 1, exopod. 5, Antennule, segments 1–20. 6, Maxilliped. 7, Dorsal outline of body. 8, Rostral filament. 9, Lateral outline of body. 10, Detail metasome wing and sensilla. 11, Last metasome segment and urosome. 12–16, Leg 5, endopods: 12, Specimen no. 2, anterior view; 13, specimen no. 6, posterior; 14, specimen no. 8, posterior; 15, specimen no. 7, posterior; 16, specimen no, 3, posterior.

of the outer margin. The inner margin of the second segment (to tip of claw) a little shorter than the outer margin of the first segment (32:35), about one-third longer than the inner margin; its greatest width a little less than one-half its length. Claw moderately stout, curving inwards on both margins a little above the middle, with a distinct notch on the outer margin; armed on both sides with 6–10 spinules; some specimens showing a faint crosswise line of division at the position of the notch. Lateral seta stout and spiniform, unarmed, a little more than half the length of the outer margin of the segment.

Third segment (Fig. 3) distinct, short and broad, its width almost twice the length of its outer margin which is a little longer than the inner. The outer seta similar in length and stoutness to that of the second segment, the inner more slender and a little longer; both unornamented.

The endopods of a pair asymmetrical in length and in armature; showing extreme variability within the available sample. Usually 2-segmented and shorter than the first exopod segment; unarmed terminally or with a short spiniform seta.

Variation in leg 5.—Measurements of eight specimens showed slight differences in the proportional lengths and widths of the exopod. The greater number attained that shown in Fig. 1, in which the inner margin of exopod 2 (to tip of claw) is subequal to the outer margin of the first segment and about one-third longer than the inner. Two specimens had the inner margin of segment 2 proportionally a little shorter (Fig. 2), and in one specimen they were a little longer, approaching *D. siberiensis*.

The widths of exopod 1 and 2 in diaptomids are never precisely measurable, but even with allowances made for the differences in position and flattening of the mounted appendages by the cover slip, it is apparent that the specimens with the shorter claws (the inner margin of exopod 2) are also proportionally broader in both segments 1 and 2.

So far as could be judged, no significant difference was apparent in the relative length and width of the third exopod segment. There is some slight difference in the proportional strength of the setae from specimen to specimen, but the relation of the two to each other is rather constant.

The endopod is extremely variable, differing in each of the specimens studied. The differences are shown in Figs. 12 to 16, and in Table 1, where the total length is also compared to the length of the inner margin of the exopod. Of the eight examined, four have a terminal spiniform seta; one of these differs from the others in having in addition a small abortive seta (Fig. 12). The endopods also show an unusual asymmetry. This is evident in the relative lengths of the right and left ramus of a pair, the left being always the longer; this difference considerable in some specimens (Table 1, nos. 4 and 7); negligible in others (nos. 1 and 8). The asymmetry is further expressed in the relative lengths of the terminal setae, that of one side always longer than that of the other (Figs. 13 and 15). The spinule pattern of the terminal portions also differs (Figs. 12 and 16).

Variability in the endopod of the female in *Diaptomus* is not at all rare, but it is more commonly expressed in differences in segmentation, and small differences in proportional length of the endopod to the exopod. In subgenera in which 2 setae are normally present, one may sometimes be lacking. In general, the endopod is much more variable in the males of the genus, but in this species the opposite is true. As noted above, Smirnov found a geographical variation in the female of *D. siberiensis*. We do not, of course, know how variable that species is, as he gives no indication of whether he found the condition illustrated in Fig. 15 (Smirnov, 1931) to be true of one or several specimens. Actual comparisons between the two species as regards this variability is therefore not now possible.

The asymmetry of the endopod, as of the rest of the appendage, is an invariable rule in the male diaptomid, but it is usually not expressed in the other sex. Only in recent years has such a condition been noted in the fifth legs of females of certain south Asiatic groups (*Allodiaptomus* Kiefer, 1936a–b, *Mongolodiaptomus* Kiefer, 1937, 1938a) and some South American species (*D. azevedoi* Wright 1935, *D. paulistanus* Wright, 1937). Though this asymmetry appears to be a well established character, it may also be that in some cases so few specimens of a given species have been examined that what is actually anomalous has been described as normal. For my part, I should like to reserve judgment on the condition in *D. alaskaensis* until more individuals from both the type and other localities in which it may occur are available for study.

MALE

Metasome.—About one and a half times the length of the urosome. More slender than the female, the greatest width in dorsal view occurring at the middle of the cephalic segment, from there the whole body tapering gradually to the terminal part. The anterior portion of the cephalic segment somewhat narrowed, the rather broad triangular appearance of the female only indistinctly suggested. The last segment separated, its lateral tips not drawn out, but asymmetrical (Fig. 21), the left side straight, the right angular, its distal half directed inwards; each side armed at the lateral tip with a single sensillum, very small and spiniform, mounted on a tubercle having rather straight sides (Fig. 20), the tubercle of the right a little larger than that of the left side of the segment. The hyaline area as demarcated in Fig. 20.

Urosome (Fig. 21).—Not conspicuously asymmetrical. The genital segment with the right side a little inflated and irregular in outline; the left side with the lateral slit conspicuous, the backwardly produced proximal lobe not covering it; neither side with apparent sensillum. Segment 4 a little longer on the right than the left side, the other segments symmetrical. Caudal rami normal, with the inner margins hairy.

Rostral filaments.—Relatively as long as those of the female, but a little stouter throughout most of their length.

Antennule.—The right reaching to the end of the second urosomal segment, the left a little shorter; both relatively longer than those of the female. The left (Fig. 17) differing also from that of the female in having the seta of segment 1 not so enlarged or lengthened; stretched out it reaches from its base only to about the middle of the fourth segment. Setae of the second segment also unlike those of the female. The setal pattern differing in that only segments 11, 16 and 19 of the midportion of the antennule have 2 setae; the others with one each. In addition to that of segment 1, rather long setae found on segments 7, 9, and 14. Those of 7 and 9 subequal and a little longer than those of 1 and 14 which are also subequal to each other. The approximate proportions of these setae to one another are:

segment 1—41	segment 7—55
segment 14—40	segment 9—54

Aesthetes of normal distribution as in female.

The right antennule with segments 14–16 conspicuously swollen (Fig. 18). Spines of 8 and 12 not enlarged; those of segments 10–11 and 13 very stout; that of 10 not as long as the width of its segment; that of 11 longer, reaching to the middle of segment 13; that of 13 strongly bent distad, incompletely demarcated from the segment, a little stouter but scarcely longer than that of 11, reaching to the middle of segment 14; the tips of all 3 spines dissected as indicated in figure 19. Segments 15–16 each with short cuticular processes of similar size; modified setae, with subterminal lateral tongue-like processes (Fig. 18), accompanying them and the depressed process of segment 17, all subequal to one another. Antepenultimate segment without process or lamella. Setae of terminal segment all weakly developed.

Maxilliped and *leg 1* as in female. *Leg 2* also lacking a cuticular lobe on the dorsal face of the second segment of the endopod.

Leg 5 (Figs. 22–23).—The left leg a little more slender than that of the right side; reaching almost to the end of its second exopod segment.

Right leg: The outer portion of the first basal segment very tumid, overhanging the second segment considerably on the postero-lateral side; the inner side also expanded with a large distally directed hyaline lamella on the anterior face (Fig. 22); the sensillum a seta without apparent tubercular base, in a distal medial position on the dorsal side. The outer margin of the second

TABLE 1.—COMPARISON OF THE ENDOPODS OF LEG 5 IN EIGHT PARATYPE FEMALES OF DIAPTOMUS ALASKAENSIS

Specimen No.	Exopod 1 Inner margain	Right endopod			Left endopod		
		Total length	Number of segments	Armature	Total length	Number of segments	Armature
1	78μ	39μ	2	Spinules	42μ	2	Spinules
2	75	45	2	2 setae + spinules	57	2	2 setae + spinules
3	81	45	1	None	57	2	Spinules
4	81	42	2	Spinules	60	2	Spinules
5	75	36	2	None	45	2	Spinules
6	75	54	2	1 seta + spinules	66	2	1 seta + spinules
7	69	42	2	1 seta + spinules	57	2	1 seta + spinules
8	60	42	1	Terminal hairs	45	1	Terminal hairs

basal segment rounded, the hair at the distal fourth; the inner margin a little longer than the outer, prolonged a little to the point of attachment of the endopod; the medial portion somewhat expanded and having attached to its posterior face a hyaline membranous lamella that bulges upward.

Exopod (exclusive of claw) subequal in length to the basipod. The first segment having the length of its outer margin greater than that of the inner (proportions about 27:17) and about equal to its greatest width; ending in a distally directed, rounded lobe; on the posterior face, near the extreme distal margin, two small, rather heavily chitinized lamellae (Fig. 24), that near the outer edge V-shaped, the other having a thick, pointed edge that is produced a little beyond the inner distal corner of the segment and extended more or less toward the other as a bar. The second segment with both margins nearly straight; the inner a little less than twice the greatest width (relative proportions 40:25); the outer curving inwardly at the point of attachment of the lateral spine; the inner distal edge membranous and somewhat crenulated. This segment bearing the characteristically rounded, small, heavy lamella on the proximal inner edge of the posterior side; somewhat distad to this and very near the margin, a minute and thin cuticular spine. Lateral spine near the terminus of the segment, stout and long, a little longer than the outer margin of the segment above its base, coarsely dentate on its inner edge. Claw very long, its length about equal to that of the ramus, strongly curved beyond its middle, enlarged at its base, with a small tubercle on the anterior side (Fig. 22), dentate below this bulbous enlargement to near the tip; in some specimens a fine division into two parts noticeable near the middle of the claw.

Endopod a little shorter than the inner margin of the first segment of the exopod; 2-segmented, the first broadened basally and only about half the length of the distal segment.

Left leg: The first basal segment not expanded on the outer margin, but extended inwardly to a well rounded lamelliform edge; sensillum a minute, curved spinule, mounted on a small tubercle. The second segment having its outer margin shorter than the inner, concave at its center; the sensory hair at the distal fifth; the inner distal margin considerably prolonged medially to the point of attachment of the endopod; a distinct jog in its margin just in front of the middle.

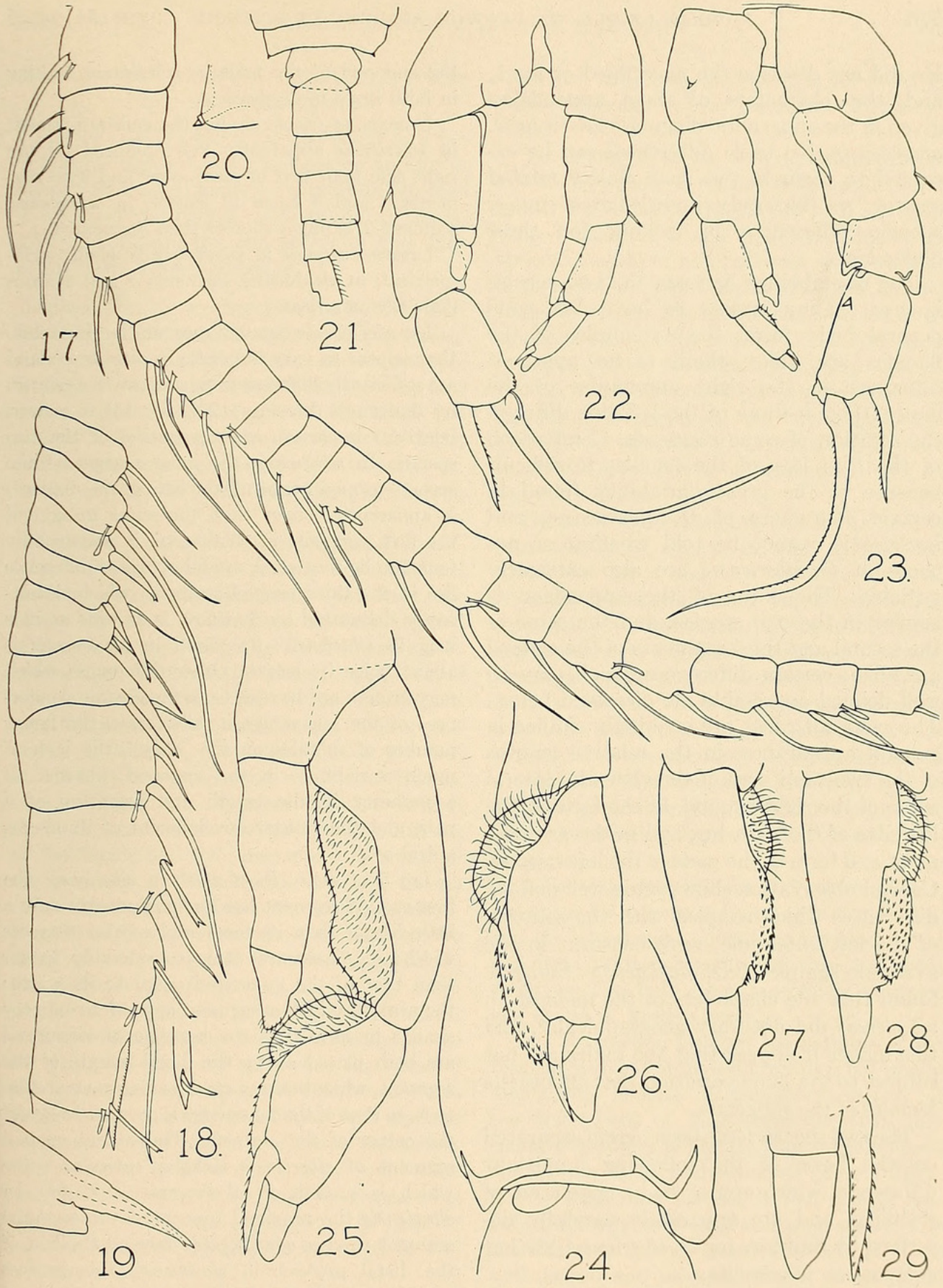
Exopod narrowed to about half the width of the basipod, its length along the outer margin somewhat less (about one-sixth). The first segment about two-thirds of the total length, provided on its anterior inner side (Fig. 25) with a narrow flattened pad armed with very short fine hairs. Both pads of the distal segment in a medial position, the proximal the more tumid, bulging a little on the anterior side with a narrowed portion carried across the proximal part of the segment so that it appears to fit tightly into the segmental suture (Fig. 26); on the posterior side only a small lengthwise portion of the pad visible (Figs. 27–28); armed with fine hairs that are longer than those of the pad of the first segment. The distal pad reduced in breadth, largely postero-medial in position, distally not reaching to the base of the terminal process; its apical portion sagging somewhat and forming a notch with the main body of the segment, as visible in posterior profile (Fig. 27); pad set with very short, stout hairs. On the margin of the segment between the apex of the pad and the inner base of the terminal process there may be 1–3 minute spinules, but these not always present.

The processes of the distal segment closely set (Fig. 29). The digitiform distal process demarcated from the segment, its length a little less than one-third that of the outer margin of the segment; very broad throughout most of its length, but its tip slightly drawn out; its inner margin without teeth. The proximal process spiniform, curving toward the terminal process and reaching to its apex or a very little beyond it; attached on the anterior side of the segment, distally directed; a little enlarged basally, the width at its middle about one-third that of the distal process; with coarse teeth on its inner margin, and a similar row on the posterior side near its outer edge.

Endopod reaching a little beyond the first exopod segment, 2-segmented, the distal segment about one-third the length of the other, with a few fine hairs on the apex.

COMPARISON OF D. SIBERIENSIS AND D. ALASKAENSIS

Smirnov's description of *D. siberiensis* is precise and detailed so that a fairly exact comparison of the two species can be made.



FIGS. 17–29.—*Diaptomus alaskaensis*, n. sp., male

17, Left antennule, segments 1–20. 18, Right antennule, segments 8–17, with detail of modified seta. 19, Right antennule, segment 13. 20, Detail, left metasome wing. 21, Last metasome segment and urosome. 22–29, Leg 5: 22, Anterior view; 23, posterior view; 24, detail lamellae, right exopod; 25, left exopod and endopod, anterior; 26, detail exopod 2, anteromedial view; 27, exopod 2, posterior; 28, exopod 2, posteromedial view; 29, exopod 2, detail of processes, posterior view.

He did not describe the maxilliped or leg 1, and the characters of these appendages given in the subgeneric diagnosis are from *D. alaskaensis*. No basic differences can be expected to occur in two such closely related species, so that only knowledge of minor specific differences is lacking for these appendages.

The resemblance between the two species is great. They appear to have the same general body form; the antennules of the females are alike; there is no apparent difference in the right antennules of the males, though those of the left side differ in the setation of some segments. Comparison of the fifth legs of the females is difficult because of the great variability found in certain characters of *D. alaskaensis*, and because it cannot be told whether or not those of *D. siberiensis* are also extremely variable. The form of the appendage is similar in the two species, and the setae of the second and third segments of the exopod are alike; certain differences which may be well defined and stable are discussed below. The male fifth legs are strikingly similar in general appearance, in the relative lengths of the two rami, and of the claw and lateral spine of the right exopod, in the form of the lamellae of the right leg, and in the arrangement and form of the pads of the left exopod. Careful observation shows some well-defined differences which coupled with the setation of the left antennule, were constant in the available sample of *D. alaskaensis*. Smirnov found that the characters of the male of *D. siberiensis* did not vary geographically, and this makes it appear that the males are not subject to the same variation that affects the females of the subgenus.

The two species have been herein separated on the basis of the following important differences which appear to be characters of stability, and are apparently carefully described by Smirnov for *D. siberiensis*, so that comparison is possible:

Rostral filaments short and stout in *siberiensis*; slender and attenuated in *alaskaensis*.

Left antennule of male with 2 setae on segments 11 and 18 in *siberiensis*; with 2 setae on segments 11, 16 and 19 in *alaskaensis*.

Leg 2 with a cuticular lappet on segment 2 of the endopod of the male in *siberiensis*; lacking in both sexes in *alaskaensis*.

Urosome of female having the genital segment in *siberiensis* apparently less produced on the right side than that of *alaskaensis* and with segments 2 and 3 equal in length; in *alaskaensis* segment 2 is much shorter than segment 3.

Urosome of male in *siberiensis* is wholly symmetrical; in *alaskaensis* segments 1 and 4 are a little asymmetrical.

Leg 5 of female has two measurable characters that appear to vary but little in *alaskaensis* and are sufficiently different from *siberiensis*, as shown by Smirnov's drawing (1931, fig. 15) to permit relative comparison and separation of the two species. In *siberiensis* the inner margin of the second exopod segment (including the "claw") is apparently longer than the outer margin of the first segment; in *alaskaensis* it was usually found to be shorter. A more important difference lies in the third exopod segment, which, if correctly delineated by Smirnov, is as wide as it is long in *siberiensis*; its width in *alaskaensis* is about twice its length. Other differences which may or may not be real, lie in the greater slenderness of the appendage in *siberiensis*, the larger number of spinules on the "claw", the lack of much variability in the endopod, absence of asymmetry in the length and armature of a pair, and the stouter development of its single, apical seta.

Leg 5 of male. Right side: In *siberiensis* the first exopod segment has its outer margin only a little longer than its inner and greater than its width; in *alaskaensis* it is considerably longer than that of the inner and equal to its width; the armature of this segment appears to be very similar in form, but the lamellae of *siberiensis* are both placed above the distal margin of the segment, while those of *alaskaensis* are very close to it, so that of the inner edge is produced beyond the corner of the segment. The second exopod segment of *siberiensis* lacks a cuticular spine which is present in *alaskaensis*. *Left side:* In *siberiensis* the proximal process of the terminal segment reaches considerably beyond the end of the distal process; in *alaskaensis* this process reaches to the end of the distal process, or at most a very little beyond it; the distal process of *siberiensis* is armed on the inner margin with a few spinules; that of *alaskaensis* is unarmed. The distal pad of *siberiensis* appears to be a little more developed than that of *alaskaensis*, and is armed with slender instead of thick, short hairs.

DISTINCTIONS BETWEEN NORDODIAPTOMUS AND NEUTRODIAPTOMUS

Kiefer (1932) placed *D. siberiensis* in a list of species that he could not assign to any of his newly erected genera; in 1938 he referred it to *Neutrodiaptomus*. It is therefore necessary to compare the characters of this subgenus with *Nordodiaptomus*.

In establishing *Neutrodiaptomus* in 1937, Kiefer included the species *tumidus* Kiefer, *pachypoditus* Rylov, *amurensis* Rylov, and *mariadvigae* Brehm. To these he added (1938a) *incongruens* Poppe, *siberiensis* (as *D. rylovi* Smirnov), and *lobatus* Lilljeborg, the synonymy of the latter with *incongruens* appearing to him to be an uncertain matter. Hu (1943) described a new species *alatus*.

Of these species, *D. siberiensis* and *D. mariadvigae* appear to differ sharply from the consistently developed characters that hold the others together. *D. siberiensis* has been referred above to the new subgenus *Nordodiaptomus*. *D. mariadvigae* is apparently closely related to, if not conspecific with, the species *hsichowensis* recently described by Hsaio (1950). This species occurs in Yunnan, the same Chinese province in which Brehm's collection was made (Brehm, 1921, 1930). Hsaio considers that the lack of terminal setae on the endopod of the fifth leg of the female and the "pincerlike" structure of the processes of the left male fifth leg, though reduced in length, indicate relationship to *Arctodiaptomus*. He therefore made his new species the type of a subgenus *Pararctodiaptomus*. In the definition of *Diaptomus* used here, *Arctodiaptomus* is considered as a subgenus; the status of the various subgroups that have been proposed for it can be evaluated only when the whole of this subgenus is reinvestigated. It is possible that *Pararctodiaptomus* may be found to be of separate subgeneric status within the genus *Diaptomus*. This is particularly so if the distal pad of the male left fifth exopod is as well developed as is suggested by Hsaio's illustration; its loss or extreme reduction is highly characteristic of *Arctodiaptomus*.

So far as it is possible to ascertain from published descriptions, the remaining species of *Neutrodiaptomus* agree with one another very closely in several significant characters. From these, the species of *Nordodiaptomus* depart rather noticeably. Though agreeing in certain patterns, these two subgenera are naturally set apart by these differences. A brief comparison makes this clear.

The female fifth leg of *Neutrodiaptomus* has two short, equally developed setae on the terminus of the endopod; the pattern of the setae of exopod segments 2 and 3, identical in all the species, consists of a minute seta on 2, while on 3 there are a similar small outer and a much longer inner seta. *Nordodiaptomus* with the single spinelike seta of the endopod, and the stout, subequal setae of the exopod, is in sharp contrast. Indeed, these differences are among the most significant in separating the two groups, particularly the structure of the exopod setae which in *Nordodiaptomus* are of uncommon form for the whole genus.

The male right antennule has the pattern of segments 13–15 similar in both groups, but the spines of 10 and 11 are very short in *Neutrodiaptomus*, while they are of considerable stoutness in *Nordodiaptomus*; all species of *Neutrodiaptomus* have a hyaline lamella on the antepenultimate segment, in *Nordodiaptomus* this segment is unarmed. While these are characters that may vary within a group of related species, apparently their nonvariability may also distinguish a subgenus. This last seems especially true in *Neutrodiaptomus*; in our present knowledge there are no intermediate forms between it and *Nordodiaptomus*.

In the male right fifth leg of *Neutrodiaptomus*, the apical claw is never longer than the exopod, and the lateral spine, located at the proximal to the distal third, is usually less than the width of its segment. Both are of exceptional stoutness and length in *Nordodiaptomus*.

Any comparison between the patterns of the terminal segment of the left exopods is not wholly satisfactory because of the incompleteness of the descriptions of *Neutrodiaptomus*. The only enlarged drawings in literature are those of *tumidus* (Kiefer, 1938a) and *amurensis* (Rylov, 1930), and of these only *tumidus* is well enough described verbally to permit real comparison. The similarities of the two groups are: both pads are well defined and subequal to one another; the terminal process is short and digitiform; the proximal process is subterminal in position and about equal to or reaching a little beyond the distal. The differences between the two groups are more difficult to define; where it is possible to compare, the following are suggested.

The proximal pad in *Nordodiaptomus* is not merely a medially bulging structure, but is carried well across the anterior side of the segment and its shape is thus distinctly asymmetrical; it appears as a simple, medially placed pad in *Neutrodiaptomus*. The distal pad is conspicuously armed with slender to short, stout hairs in *Nordodiaptomus*; in *Neutrodiaptomus* there may be little or no armature of this pad. Kiefer (1938a) has described that of *tumidus* as a "lobus" and shows no ornamentation, as is also true of Rylov's (1930) figure of *amurensis*.

The proximal process of *Nordodiaptomus* is stout and spiniform; Smirnov describes that of *siberiensis* as a "spine" and my observations in *alaskaensis* confirm this. Kiefer speaks of those of *tumidus* and *pachypoditus* as "setae" and his illustrations picture this process as exceedingly slender. The difference between seta and spine is undoubtedly one of degree and is not always easy to determine. In this case it may merely be one of interpretation. The degree of stoutness and the form of this process, however, distinguishes other subgenera of *Diaptomus*, and it is necessary in the absence of any other evidence, to consider that these two groups are separable by the spiniform character of this process in *Nordodiaptomus* as opposed to its setiform development in *Neutrodiaptomus*.

It is unfortunate that for the species of *Neutrodiaptomus* no information is available concerning the highly important details of the maxilliped, the first leg, the cuticular process of the endopod of the second leg, the setation of the female antennule and its comparison to the male left antennule. Until taxonomists also include information about these points in their descriptions of diaptomid copepods, we will not be able to arrive at any satisfactory comparison of species or of subgenera. My study of North American species suggests that the development of the maxilliped, particularly of the setae of the endopod, the characters of the first leg, the presence or absence of Schmeil's organ on the endopod of the second leg, and the setation of the female antennule, are often as characteristic of subgenera as the modifications of the left exopod of the male fifth leg or the terminal setae of the endopod of the female fifth leg. They are in any case a part of the whole picture, and must be considered before any comprehensive evaluation of subgeneric or generic characters can be made.

In addition to its distinctions from *Neutrodiaptomus*, *Nordodiaptomus* departs in some characters from the usual condition found in *Diaptomus*. One such instance is that Schmeil's organ may be either present or absent, and interestingly is exhibited as a case of sexual dimorphism in one species. The numerical difference in setation of the antennules of the female and that of the left side of the male is the only one known to me in literature or in fact; investigation may show it to be more common than suspected. The contrast in the size of the setae of the first and second segments is not confined to *Nordodiaptomus*; Smirnov (1928) has noted the same sexual dimorphism in *D.* (*Arctodiaptomus*) *dentifer* which has a similarly elongate seta on segment 1 of the female. The structure of the exopod setae of the female fifth leg in *Neutrodiaptomus* is common throughout the genus; that of *Nordodiaptomus*, as suggested, is rather unusual. The asymmetry of the endopod of *Nordodiaptomus alaskaensis* is likewise a rare condition, impossible now to evaluate.

It thus appears that there occur in the two species of *Nordodiaptomus*, characters that differ naturally from consistently developed structures in *Neutrodiaptomus*, and in addition, that they have certain distinctive features which set them apart from other subgenera of *Diaptomus*. The inclusion of the two species in *Neutrodiaptomus* could be only provisional and would make the definition of that subgenus ambiguous in many parts. It seems best in my judgment to delimit the two groups as has been done herein.

It is probable that these two subgenera may be safely assumed to be closely related. This cannot now be proved, however, due to our lack of complete knowledge of some structures of *Neutrodiaptomus*, and our present inability to evaluate characters as subgeneric or otherwise.

The species of *Neutrodiaptomus* extend from subarctic into southeastern Asia. *Nordodiaptomus* is in our present knowledge limited to Arctic and subarctic regions of Asia and North America. The discovery of an Alaskan species closely related to one from the Asiatic U. S. S. R. adds to the growing list of examples that disprove the old concept that North American diaptomids are distinct from those of Eurasia. It is to be expected that further study of Alaskan collections will increase the number.

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HELMINTHOLOGY.—*A new roundworm,* Nematodirus rufaevastitatis *(Nematoda: Trichostrongylidae) from domestic sheep,* Ovis aries, *in Wyoming.*

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The nematodes described in this paper were collected by one of the writers (R. F. H.) from domestic sheep in the area of the Red Desert, Wyo., and western Wyoming during 1948 and 1949. The specimens were forwarded for identification to the Zoological Division, Bureau of Animal Industry. A study of them by the senior writer shows that they belong to the genus *Nematodirus.* They differ, however, from the known species of the genus in certain characters and they are, therefore, described as new.

Nematodirus rufaevastitatis, n. sp.

Description.—MALE: 11.5 to 15.3 mm long and about 0.1 mm wide just anterior to the bursa. Esophagus 0.430 to 0.500 mm long and about 0.030 to 0.040 mm wide at its base. Head 0.025 to 0.030 mm wide, as measured with the cuticle slightly inflated (Fig. 1, *A*). Spicules 1.0 to 1.15 mm long and united for about the posterior two-thirds of their total length; the tips have a slight membranous inflation (Fig. 1, *B*). The bursa consists of two large lateral lobes and a dorsal lobe which is indicated only by a slight indentation of the margin of the bursa lateral to the dorsal ray. The length of the bursa from its base to tip is 0.25 to 0.34 mm. Each lateral lobe of bursa is supported by six rays, two ventral, three lateral, and one externodorsal (Fig. 1, *C, D*). The two ventral rays arise from a common trunk and are long and slender. The three lateral rays likewise arise from a common trunk and are also long and slender. The mediolateral and postero-