



## Marine Littoral Diatoms from the Gordon's Bay, Region of False Bay Cape Province, South Africa

MALCOLM H. GIFFEN

*University College of Fort Hare, Cape Province and Council for Scientific and Industrial Research, Pretoria*

(Received: 5. 2. 1970)

The Gordon's Bay region occupies the north western corner of False Bay, a large rectangular bay, bounded on the west by the Cape Peninsula ending at Cape Point, on the east by the precipitous slopes of the Steenbras Mountains ending at Cape Hangklip, and in the north by the sandy beaches of the isthmus of the Cape Peninsula. Across the Bay in a south westerly direction from Gordon's Bay, lies Simons Bay, a former British Naval base.

The waters of False Bay are comparatively warm as they consist of a small branch of the Agulhas Current (Mocambique Current) which divides at Cape Point and washes onto the bay, the other branch, abutting the cold Benguella Current of the Atlantic Ocean, turns southwards to be eventually lost. On occasions, however, after strong south easterly gales, the Benguella Current is diverted into False Bay bringing cold water from the Atlantic and with it certain species of diatoms as yet only recorded from the Atlantic coasts (cf. Giffen 1969b: in press). The following are the species not previously recorded from the eastern Cape coasts by the author but reported from the Atlantic:

*Cocconeis pseudomarginata* GREGORY forma with very large blank bands across the striae of the epivalve, *Diploneis lineata* DONKIN, *Licmophora Juergensii* AGARDH, *Nitzschia composita* n. sp. (recently recorded from Saldanha Bay on the west coast), *Rhoicosphenia Adolphi* M. SCHMIDT, *Trachyneis speibonae* GIFFEN.

The most important recent collections of diatom material from False Bay are those of the „Gauss“, Dr. E. VON DRYGALSKI's Deutsche Südpolar Expedition 1901—1903,

worked by HEIDEN and KOLBE (1928) from large samples taken from Simon's Bay. They reported 365 species of which 7 were mesohalobic, 15 were oligohalobic and the remainder euhalobic.

More recently CHOLNOKY (1963) dealt mostly with the mesohalobic material from Cape Hangklip, Steenbras and Gordon's Bay, all within False Bay.

In 1945 summer a large quantity of *Dictyota dichotoma* AGARDH was collected for University classwork in algal morphology and later formed the material for this investigation. Much of the *Dictyota* proved sterile and was set aside to be finally prepared as a diatom sample and preserved in the GIFFEN collection as sample 594. The algae was collected from a large tidal pool to the south of Gordon's Bay village.

### Systematic Part

References to original descriptions have only been given where species are of recent origin or not reported in wellknown modern literature or not previously reported by the author. Certain wellknown cosmopolitan species are dealt without citation. These species are described and figured effectively by HUSTEDT 1930 (Bacillariophyta) and 1927—1966 (Kieselalgen). For convenience of reference genera and species are recorded in alphabetical order.

*Achnanthes* BORY 1822.

*A. brevipes* AGARDH (cf. HUSTEDT 1927—1966, Part 2: 424, fig. 877 a—c; HUSTEDT in A. SCHMIDT, Atlas: T. 417,

fig. 1—10 and T. 418, fig. 1—3, 8). — In the sample under review, this species was not very common, but a few of the examples showed a very strong development of large hyaline „eye-spots“, replacing the last two or three terminal rows of alveolae. Such a form is not common and was used by HENDEY (1957: 56, Pl. 6, fig. 8—10) to describe *A. kuwaitensis* HENDEY which is undoubtedly *A. brevipes* with this peculiarity. This feature is frequent in the upper valve (epitheca) of both *A. brevipes* and its var. *intermedia* (KÜTZING) CLEVE and cannot be regarded as a diagnostic character. — Fig. 1.

*A. brevipes* var. *intermedia* (KÜTZING) CLEVE. Not common in the sample.

*A. brevipes* var. *parvula* (KÜTZING) CLEVE (1895: 193; HUSTEDT 1927—1966, Part 2: 426, Fig. 877f—i; GIFFEN 1969a: in press, fig. 5, 6). — This variety was very abundant and remarkably constant in size and density of striae. Dimensions: 16—20  $\mu\text{m}$  long, 5—6  $\mu\text{m}$  broad, transapical striae 10 in 10  $\mu\text{m}$  on the epitheca and 12 in 10  $\mu\text{m}$  on the hypotheca.

*Actinocyclus* EHRENBERG 1838.

*A. subtilis* (GREGORY) RALFS (cf. HUSTEDT 1927—1966, Part 1: 534, fig. 304; GIFFEN 1969a: in press). — This was rare in the sample but the species is widely distributed and often abundant in South African brackish and estuarine waters.

*Actinopterychus* EHRENBERG 1839.

*A. adriaticus* GRUNOW var. *pumilus* GRUNOW (cf. HUSTEDT 1927—1966, Part 1: 481, fig. 269). — All the individuals observed were small with 6—10 segments, diameter from 20 to 25  $\mu\text{m}$ , areolae 17—18 in 10  $\mu\text{m}$ . The hyaline areas on the elevated segments were characteristically absent.

*A. splendens* (SHADBOLT) RALFS (cf. HUSTEDT 1927—1966, Part 1: 478, fig. 265).

*Amphiprora* EHRENBERG 1843.

*A. sulcata* O'MEARA (cf. CLEVE 1894: 18 as *A. gigantea* var. *sulcata*; PERAGALLO 1897—1908: Pl. 38, fig. 1—3; HUSTEDT 1955: 37). — In phase contrast it can be seen that, between the costae of the valve, there are two rows of very faint decussating puncta. The species was not frequent in the sample. — Fig. 2.

*Amphora* EHRENBERG 1840.

*A. acutiuscula* KÜTZING (cf. CLEVE 1895: 121).

*A. angusta* (GREGORY) CLEVE (1895: 135; A. SCHMIDT, Atlas: T. 25, fig. 15). Widespread and very variable in South Africa. It was numerous in the sample.

*A. bigibba* GRUNOW (cf. A. SCHMIDT, Atlas; T. 25, fig. 65—67, 70—77; HUSTEDT 1955: 40, Pl. 14, fig. 19—25). — In size this species seems to be very variable

in South Africa. In a previous paper (GIFFEN 1967: 251) the author reported individuals from the Eastern Cape Province from 7—20  $\mu\text{m}$  long. CHOLNOKY also (1963: 40) states that from the Steenbras area (close to Gordon's Bay) the specimens were exceptionally small often only 15  $\mu\text{m}$  in length. Those seen in the investigated material agree in averaging 20—22  $\mu\text{m}$  long.

*A. costata* W. SMITH (1853: 20, Pl. 30, fig. 253; A. SCHMIDT, Atlas: T. 25, fig. 29, 30 as *A. inflata* GRUNOW and PERAGALLO 1897—1908: Pl. 50, fig. 18—20 as *A. costata* var.). — Individuals which I have assigned to this species differ from the description in being somewhat shorter and possessing slightly closer striae along the ventral margin viz. 15 in 10  $\mu\text{m}$  as against 10 in 10  $\mu\text{m}$ . The puncta on the dorsal side are also closer. In general, however, the form and appearance are identical. The blank band across the upper portion as shown in the original figure and also seen in A. SCHMIDT, Atlas (l. c.) for *A. inflata* GRUNOW, included with *A. costata* by CLEVE, shows very clearly in the South African specimens. There is also a very fine line across the transapical striae of the dorsal side near the axial area. — Fig. 3.

*A. exigua* GREGORY (cf. CLEVE 1895: 123; GIFFEN 1963: 217, fig. 17, 18). — Moderately frequent and widespread in littoral and estuarine waters in South Africa.

*A. exilitata* n. sp. — Frustule in outline broadly elliptical to almost spherical with slightly truncate ends, 6—11  $\mu\text{m}$  long. Valve lunate with straight ventral margin and somewhat acute ends, 6—11  $\mu\text{m}$  long, 2,5  $\mu\text{m}$  broad. Axial area narrow on the dorsal side of the biarcuate raphe, wider on the ventral side with a unilateral central area almost reaching the margin. Transapical striae ca. 30 in 10  $\mu\text{m}$  on both dorsal and ventral sides. Intercalary bands on the pleural side obscure but apparently simple.

Type slide 594/1 in the GIFFEN Collection.

Iconotype: figures 5—7.

Frustula elliptica sive subsphaerica, apicibus leviter truncatis, 6—11  $\mu\text{m}$  longa 4,5—6,5  $\mu\text{m}$  lata. Valvae semiellipticae, margine ventrale directo, apicibus acutiuscule rotundatis, 6—11  $\mu\text{m}$  longae, circiter 2,5  $\mu\text{m}$  latae. Fissurae raphae biarcuate curvatae, area axialis in latere dorsale angusta, in ventrale latiora, area centralis unilateraliter in latere ventrale evoluta, marginem ventralem valvae paene attingens. Striae transapicales in lateribus utribus radiantes, circiter 30 in 10  $\mu\text{m}$ . Connectivae lateris pleuralis haud visibiles, sine structura visibile.

Habitat: in aquis marinis litoralibus Oceani Indici prope Gordon's Bay in provincia Capense Occidentale Africae Meridionalis.

Holotypus: praeparatum no. 594/1 in collectione GIFFEN, Fort Hare, C. P.

Iconotypus: figurae nostrae no. 5—7.

This species occurred somewhat infrequently in the sample. It is apparently related to *A. pusio* CLEVE (1895: 102, Pl. 3, fig. 40) from which it differs in its considerably smaller size with very much closer striae. PERAGALLO

(1897—1908: Pl. 44, fig. 9, 10) figures *A. pusio* var. *parvula* (FLÖGEL) PERAGALLO (also vide CLEVE, l. c. 103, *A. proteus* var. *parvula* FLÖGEL in a note on *A. pusio*) which is about 22  $\mu\text{m}$  long with 20 striae in 10  $\mu\text{m}$  and as such is still too large to include the individuals seen. I thus consider it necessary to describe these forms as a new species. — Fig. 5—7.

*A. granulata* GREGORY (cf. CLEVE 1895: 123; HUSTEDT 1955: 40, Pl. 14, fig. 8—12; GIFFEN 1967: 251, fig. 11; CHOLNOKY 1968a: 18, 19). There is considerable confusion over the identities of *A. cymbifera* GREGORY (cf. CLEVE 1895: 122, under the name *A. terroris* EHR.), and *A. granulata* GREGORY (cf. CLEVE, l. c.). Two recent accounts have appeared attempting to solve the problem: HUSTEDT (1955: 40, Pl. 14, fig. 8—12, 26, 27) describes amongst other characters, double rows of punta between the costae. This was reported and figured by the author (GIFFEN 1967: 251, fig. 11) although this South African material differed from HUSTEDT's in possessing 17—18 striae in 10  $\mu\text{m}$ . CHOLNOKY (l. c.) suggests that HUSTEDT's description and figures have no connection with *A. granulata* GREGORY, an opinion with which I now fully agree. CHOLNOKY also concludes that in all probability *A. cymbifera* and *A. granulata* are identical. — Individuals seen in the Gordon's Bay sample vary from 28—50  $\mu\text{m}$  long, 5—8  $\mu\text{m}$  broad with 12—13 striae in 10  $\mu\text{m}$ . The striae have closely spaced but readily distinguished puncta, 20 in 10  $\mu\text{m}$ , which fall very closely within the limits of the authoritative description (CLEVE, l. c.). CLEVE's description of the striae as „not distinctly punctate“ is in my opinion not quite correct and may be due to imperfect optical equipment of the time. Comparison of the South African forms of *A. granulata* with material recently obtained from the Clyde at Greenock, Scotland (the locus classicus) show that the Cape individuals are identical with those from Scotland. The strongly punctate intercalary bands seen from the pleural side gives a distinctly „granular“ appearance to this diatom. — Fig. 8, 9.

*A. proteus* GREGORY (cf. CLEVE 1895: 103; GIFFEN 1969a: in press, fig. 19). As can be seen in the figures in A. SCHMIDT, Atlas: T. 27, fig. 2, 3, 5, 6 for *A. proteus* GREGORY, T. 27, fig. 7—9, T. 28, fig. 4? and also PERAGALLO 1897—1908: Pl. 44, fig. 21—30, this species is, as its name implies, exceedingly variable. In the material under review and also in material from South African waters already investigated, the varieties described in the literature as var. *contigua* CLEVE (1895: 103), var. *oculata* PERAGALLO (1897—1908: Pl. 44, fig. 21, 22 also “var.?” fig. 23), can scarcely be distinguished from each other and the so-called characteristic differences are so intergraded that it seems better to relinquish such varietal names. *A. proteus* GREGORY was not common in the sample.

*A. sublaevis* HUSTEDT (cf. HUSTEDT 1955: 41, Pl. 13, fig. 12—15; GIFFEN 1967: 254, fig. 18). — This species appeared to be rather scarce in the sample.

*A. submontana* HUSTEDT (1949: 112, T. 11, fig. 4; CHOLNOKY 1958: 103, fig. 1; 1966: 174, fig. 5). — A displaced fresh water species widespread in South African inland waters.

*A. tenellula* GIFFEN (1969a: in press, fig. 21 = *A. tenuissima* GIFFEN 1967: 254, fig. 19—21 non HUSTEDT). — Not common in the sample and apparently widespread in South Africa although probably overlooked owing to its small size and somewhat delicate structure.

*Anaulus* EHRENBERG 1844.

*A. birostratus* GRUNOW (cf. HUSTEDT 1927—1966, Part 1: 893, fig. 536; PERAGALLO 1897—1908: Pl. 90, fig. 13, 14; CHOLNOKY 1963: 41, fig. 5; HEIDEN and KOLBE 1928: 546, T. 13, fig. 185). — In shape the few specimens seen were somewhat broader at the apices than figured by HUSTEDT (l. c.) but were narrower than those of CHOLNOKY (l. c.). HEIDEN and KOLBE (1928: 546, T. 13, fig. 182—184) describe *A. excavatus* HEIDEN and KOLBE as a new species from Simon's Bay, South Africa, which in valve view agrees exactly with my specimens, characterised by more or less regularly tapering apices, sometimes slightly curved towards on side. CHOLNOKY who reported the species from Steenbras, also close to Gordon's Bay and Simon's Bay localities, shows an “atypical” form which, however, is closer to HEIDEN and KOLBE's species than to GRUNOW's species. HEIDEN and KOLBE separate *A. excavatus* from *A. birostratus* chiefly on the broadly tapering ends and the slightly concave margin of the valve in girdle view. They also record *A. birostratus* from the same locality. In view of the variability of these species, it is doubtful whether they should be separated. — Fig. 10.

*Asteromphalus* EHRENBERG 1844.

*A. flabellatus* (BRÉBISSE) GREVILLE (cf. HUSTEDT 1927—1966, Part 1: 498, fig. 279; PERAGALLO 1897—1908: Pl. 110, fig. 4, 5). — A single fragment of this species was noted but owing to its characteristic appearance there is no doubt as to its identity. HUSTEDT states that the species is probably a littoral form but FORTI holds it to be a tycholimnetic species. Its scarcity in the sample gives no clue to its usual habitat but it has been recorded in plankton in South Africa (Indian Ocean) by TAYLOR (1966) and by HEIDEN and KOLBE from Simon's Bay (1928: 504).

*Berkeleya* GREVILLE 1827.

*B. rutilans* (TRENTEPOHL) GRUNOW (cf. GIFFEN 1969b: in press = *Amphipleura rutilans* [TRENTEPOHL] CLEVE in HUSTEDT 1927—1966, Part 2: 720, fig. 1093). — Very scarce in the sample.

*Biddulphia* GRAY 1821.

*B. pulchella* GRAY (cf. HUSTEDT 1927—1966, Part 1: 832, fig. 490; GIFFEN 1963: 222). — Widespread in South

African marine littoral and commonly found attached to seaweeds of various kinds.

*B. reticulata* ROPER (cf. A. SCHMIDT, Atlas: T. 78, fig. 21—23, T. 84, fig. 15, 16, T. 121, fig. 11—15; GIFFEN 1963: 222; 1967: 255). — Widespread in South African waters, particularly in warm temperate regions e. g. shores of Indian Ocean. — Fig. 11, 12.

*Caloneis* CLEVE 1891.

*C. liber* (W. SMITH) CLEVE (1894: 54; GIFFEN 1969b: in press). — In a recent paper (in press) the author includes *C. liber* var. *linearis* (GRUNOW) CLEVE with the type as South African material shows there is no justification for retaining it as a species or a variety.

*Campylodiscus* EHRENBERG 1840.

*C. contiguus* A. SCHMIDT (Atlas: T. 18, F. 19, 20). — This species which occurred frequently in the sample is related to the common Mediterranean species *C. adriaticus* GRUNOW (cf. PERAGALLO 1897—1908: Pl. 53, fig. 4—7; A. SCHMIDT, Atlas: T. 16, fig. 13, 18) but differs in the strong canals which traverse the thirds of the valve surface between the margin and the central depression, the remaining third forming a strong short rib. The central depression is decorated with irregular reticulate markings (? wrinkles of fine folds). Between the main canals are 2—3 short canals. The spaces between the long canals are irregularly punctate, the puncta sometimes but not always forming radiate striae. Dimensions: from 60 to 76  $\mu\text{m}$  on one axis to 60 to 80  $\mu\text{m}$  at right angles, long canals 25 in 100  $\mu\text{m}$ , short canals 37 in 100  $\mu\text{m}$ . — Fig. 59.

*C. incertus* A. SCHMIDT (Atlas: T. 15, fig. 13—15, 19, 20, T. 207, fig. 14; *C. samoensis* GRUNOW in PERAGALLO 1897—1908: Pl. 54, fig. 6—8). — This species was very scarce in the material and has only been reported previously by HEIDEN and KOLBE from Simons Bay (1928).

*C. Lorenzianus* GRUNOW (cf. A. SCHMIDT, Atlas: T. 14, F. 24, T. 18, fig. 4, T. 208, fig. 5; PERAGALLO 1897—1908: Pl. 55, fig. 8; GIFFEN 1969a: in press). — Previously recorded from Africa by LEUDUGER-FORTMOREL (1898: 22) from the Congo and by GIFFEN (1969a) from the Eastern Cape coast. — Dimension: diameter 50  $\mu\text{m}$ , ribs 35 in 100  $\mu\text{m}$  at the margin, and over the central depression cs. 9 in 10  $\mu\text{m}$ .

*C. parvulus* W. SMITH (1853: 30, Pl. 6, fig. 56; PERAGALLO 1897—1908: Pl. 54, fig. 9, Pl. 55, fig. 5, 6). — This species has been recorded from many parts of the South African marine littoral and brackish waters.

*Campyloneis* GRUNOW 1862.

*C. Grevillei* (W. SMITH) GRUNOW (cf. CLEVE 1895: 167; HUSTEDT 1927—1966, Part 2: 321, fig. 781; GIFFEN 1967: 256). — This is an extremely variable species in

size, number of transapical striae in 10  $\mu\text{m}$  and arrangement of the puncta on the epivalve, and it is possible that some of the varieties are not fully justified. This species has been recorded from several localities along the South African coast.

*Campylosira* GRUNOW 1862.

*C. africana* n. sp. — Valve shortly and broadly lanceolate sublunate with strongly convex dorsal and moderately curved ventral margin, apices slightly produced, acute or capitate, 15—25  $\mu\text{m}$  long, 6—7  $\mu\text{m}$  broad. Transapical striae in more or less straight rows 12—15 in 10  $\mu\text{m}$ , longitudinal striae in rows following the curvature of the dorsal margin for several rows and becoming irregular or showing a more or less quincunx arrangement towards the ventral margin. Hyaline area absent. Type slide 294/1 in the GIFFEN collection. Iconotype: Figures No. 15—18.

Valvae late, asymmetric lanceolatae sive paene semi-lanceolatae, margine uno valde, altero leviter convexo, apicibus protractis, nonnumquam subcapitatis, 15—24  $\mu\text{m}$  longae, 6—7  $\mu\text{m}$  latae. Striae transapicales ex punctis isolatis in lineis transversalibus directis, sive leviter irregularibus ordinatis compositae. Costae longitudinales latae, valde evolutae, in vicinitate marginis margine parallelae, in partibus medianibus superficiei valvae irregulariter undulatae, itaque puncta striarum transapicalium solum prope margines in seriebus regularibus, ceterum in irregulariter undulatis longitudinalibus ordinatae.

Habitat: in aquis marinis litoralibus Oceani Indici prope Gordons Bay in provincia Capense Occidentale Africae Meridionalis.

Holotypus: praeparatum no. 594/1 in collectione GIFFEN, Fort Hare C. P.

Iconotypus: figure nostrae no. 15—18.

This new species differs from the only European species *C. cymbelliformis* (A. SCHMIDT) GRUNOW (cf. HUSTEDT 1927—1966, Part 2: 128, fig. 650; PERAGALLO 1897—1908: Pl. 82, fig. 26) in shape and size, being more lanceolate than lunate or cymbiform. In size, most of the measured specimens are shorter than *C. cymbelliformis* which varies in length from 20 to 55  $\mu\text{m}$ , and in breadth from 4—5  $\mu\text{m}$ . Girdle views of the frustule were not seen clearly but showed a slightly curved form as is given in the generic description. From one of the obliquely placed frustules it is just possible that the two valves, convex and concave differ slightly also in shape, the convex valve being capitate and the concave valve with simple acute apices. HUSTEDT mentions that two other described species, descriptions and figures of which I have not seen, viz. *C. japonica* TEMPÈRE & BRUN and its var. *leptostigma* CLEVE & GROVE and *C. Peragalloi* HÉRIBAUD require further study. — Fig. 15—18.

*Cerataulus* EHRENBERG 1844.

*C. Smithii* RALFS in PRITCHARD (cf. HUSTEDT 1927—1966, Part 1: 861, fig. 513; A. SCHMIDT, Atlas: T. 166, fig. 5, 6;

PERAGALLO 1897—1908: Pl. 112, fig. 4, 5). — Of this species only one or two individuals were seen but there is no doubt as to its identity.

*Climacosphenia* EHRENBERG 1843.

*C. moniligera* EHRENBERG (cf. HUSTEDT 1927—1966, Part 2: 89, fig. 625; HUSTEDT in A. SCHMIDT, Atlas: T. 307, fig. 1—9). — This species has been reported from many stations on both the Atlantic and Indian Ocean coasts of South Africa.

*Cocconeis* EHRENBERG 1838.

*C. convexa* GIFFEN (1967: 257, fig. 26—28). — *C. convexa* was first described from the Eastern Cape littoral where it was usually abundant. In the sample under investigation it occurred very rarely. The species is characterized by a highly convex rapheless valve with a series of narrow longitudinal blank bands across the transapical striae. The central area of the raphe valve shows the middle striae alternately long and short. — Fig. 19, 20.

*C. costata* GREGORY (cf. HUSTEDT 1927—1966, Part 2: 332, fig. 785; GIFFEN 1969a: in press; 1969b: in press). — Common in the material and fairly widespread in South African waters.

*C. dirupta* GREGORY (cf. CLEVE 1895: 175; HUSTEDT 1927—1966, Part 2: 354, fig. 809a—c). — The species was common in the sample and has been reported from many localities along South African coasts.

*C. dirupta* var. *flexella* (JANISCH & RABENHORST) GRUNOW (cf. HUSTEDT l. c.: fig. 809e—i). — The variety usually accompanies the type.

*C. diruptoides* HUSTEDT (cf. HUSTEDT 1927—1964, Part 2: 356, fig. 810). — This small and very slightly silicified species occurred frequently in the sample. — Fig. 21, 22.

*C. discrepans* A. SCHMIDT (Atlas: T. 193, fig. 26, 27; cf. GIFFEN 1967: 258, fig. 31, 32). — This species recently rediscovered and described by the author from the Eastern Cape Province where it occurred abundantly, was observed occasionally in the sample. — Fig. 23, 24.

*C. distans* GREGORY (cf. HUSTEDT 1927—1966, Part 2: 343, fig. 797). — Not uncommon.

*C. pseudomarginata* GREGORY (cf. HUSTEDT 1927—1966, Part 2: 359, fig. 813; GIFFEN 1969a: in press; 1969b: in press). — In a recent contribution (GIFFEN 1969a: in press) the author described and figured aberrant specimens of this species in which the so-called blank bands (furrows) across the transapical striae were much widened and the pseudoraphe became exceedingly wide. This form was also observed in the Gordon's Bay sample, as well as typical examples. EDSBAGGE (1966: 64, Pl. 1, fig. 5, Pl. 2, fig. 5) describes and figures *Cocconeis nidulus* EDSBAGGE which is identical in structure to that of the South African specimens, differing only in the density of the transapical striae viz. *C. pseudo-*

*marginata* 22 and 19 in 10  $\mu$ m (outer and inner respectively) on the rapheless valvae, 18 and 15 in 10  $\mu$ m for *C. nidulus*, and 24 and 18 in 10  $\mu$ m for the Cape variation. The figure for the South African form was an extreme form of *C. pseudomarginata* linked to the type by intermediates, and thus in my opinion *C. nidulus* EDSBAGGE should be included in *C. pseudomarginata* GREGORY.

*C. scutellum* EHRENBERG (cf. CLEVE 1895: 170; HUSTEDT 1927—1966, Part 2: 337, fig. 790). — Present in most of the investigated regions of South Africa and very variable in size and density of transapical striae.

*C. scutellum* var. *parva* GRUNOW (cf. HUSTEDT, l. c.: 338, fig. 791).

*C. scutellum* var. *stauroneiformis* (W. SMITH) RABENHORST (cf. HUSTEDT 1927—1966, Part 2: 339, fig. 792; GIFFEN 1967: 259). — HENDEY (1964: 180) names this variety *C. stauroneiformis* (VAN HEURCK) OKUNO, stating that from the study of electronmicrographs, OKUNO (1957: 217, fig. 2) considers that this taxon differs sufficiently from *C. scutellum* to be regarded as separate and distinct. The epithet "*stauroneiformis*" seems to have been given by RABENHORST (1864: 101) and not by W. SMITH (1853: 22, suppl. pl. 30, fig. 34b) who separated the variety from *C. scutellum* EHRENBERG as "*β. nodule dilated into a staurus*" without an epithet.

*C. testudo* GIFFEN (1963: 225, fig. 37—39). — A littoral marine form usually associated with seaweeds and frequent in the sample. Widespread in South African marine littoral, particularly on the eastern coasts (Indian Ocean).

*Coscinodiscus* EHRENBERG 1838.

*C. oculus-iridis* EHRENBERG (cf. HUSTEDT 1927—1966, Part 1: 454, fig. 252; A. SCHMIDT, Atlas: T. 63, fig. 6, 7, 9, T. 113, fig. 1, 3, 5, 20). — This planktonic diatom has been recorded from the East coast (TAYLOR 1966) and by HEIDEN and KOLBE (1928) from Simon's Bay. In the Gordon's Bay area it should probably be regarded as displaced. Only one specimen was seen.

*Cyclotella* KÜTZING 1834.

*C. striata* (KÜTZING) GRUNOW (cf. HUSTEDT 1927—1966, Part 1: 344, fig. 176a, b). — A typical brackish water species probably displaced from the mouth of the local stream, only a single example was observed.

*Denticula* KÜTZING 1844.

*D. subtilis* GRUNOW. Widely distributed in South Africa.

*Diploneis* EHRENBERG 1844.

*D. lineata* (DONKIN) CLEVE (cf. HUSTEDT 1927—1966, Part 2: 677, fig. 1069; PERAGALLO 1897—1908: Pl. 19, fig. 13—15; GIFFEN 1969b: in press, fig. 24).

*D. littoralis* (DONKIN) CLEVE (1894: 94; cf. A. SCHMIDT Atlas: T. 8, fig. 23—25; HUSTEDT 1927—1966, Part 2:

665, fig. 1062a). — *D. litoralis* occurred fairly frequently in the sample. HUSTEDT (l. c.) in his notes on the distribution of this diatom more or less restricted it to the North Atlantic and Arctic Oceans. A. SCHMIDT (l. c.) figured material from "Cap" (Cape of Good Hope) and CLEVE gives several tropical localities. Dimensions: 24  $\mu\text{m}$  long, 12–14  $\mu\text{m}$  broad, transapical striae 12, puncta 20 in 10  $\mu$ . — Fig. 25.

*D. papula* (A. SCHMIDT) CLEVE var. *constricta* HUSTEDT (1927–1966, Part 2: 680, fig. 1071d). — Not frequent in the sample.

*D. Smithii* (BRÉBISSEON) CLEVE. — A widespread and estuarine species.

*D. vacillans* (A. SCHMIDT) CLEVE var. *renitens* A. SCHMIDT (cf. HUSTEDT 1927–1966, Part 2: 662, fig. 1060a–d; GIFFEN 1963: 228, fig. 49; CHOLNOKY 1968: 32). — CHOLNOKY considers that the more or less constricted forms which occur in many of the *Diploneis* species are usually connected to the type with a complete line of forms and as such should not be provided with varietal names. In the case of *D. vacillans* var. *renitens* he considers it should be included in the type and the diagnosis emended. In the sample no typical unconstricted forms were seen.

*Gomphonema* AGARDH 1824.

*G. aestuarii* CLEVE (1894: 188; cf. GIFFEN 1967: 262, fig. 37).

*G. exiguum* KÜTZING (cf. CLEVE 1894: 188). — Widespread in South Africa.

*Grammatophora* EHRENBERG 1839.

*G. angulosa* EHRENBERG (cf. GRUNOW in VAN HEURCK 1880–1881: T. 53, fig. 5; PERAGALLO 1897–1908: 357, T. 88, fig. 11–13, 18).

*G. arcuata* EHRENBERG (cf. HUSTEDT 1927–1966, Part 2: 42, fig. 567). — Typical examples of this species were seen but were never frequent.

*G. marina* (Lyngbye) KÜTZING (cf. HUSTEDT 1927–1966, Part 2: 34, fig. 569).

*G. undulata* EHRENBERG (cf. HUSTEDT 1927–1966, Part 2: 48, fig. 576). — All these species of *Grammatophora* are widely distributed in South African littoral waters mostly attached to marine algae.

*Gyrosigma* HASSALL 1845.

*G. Spenceri* (W. SMITH) CLEVE (1894: 117; PERAGALLO 1897–1908: Pl. 34, fig. 22). — Cleve in his description states that the transverse striae are more distant than the longitudinal and measure 17:22, 21:24, in 10  $\mu\text{m}$  in the type and in the var. *exilis* GRUNOW, 28–29 in 10  $\mu\text{m}$ . In the reported individuals, which are otherwise identical, the transapical striae were 27 in 10  $\mu\text{m}$  and the

longitudinal striae could not be resolved, probably being more than 33 in 10  $\mu\text{m}$  and very faint.

*Hantzschia* GRUNOW 1880.

*H. amphioxys* (EHRENBERG) GRUNOW (cf. HUSTEDT 1930: 394, fig. 747). — A fresh water species indicative of contamination from seashore streams and springs.

*H. marina* (DONKIN) GRUNOW (cf. HUSTEDT in A. SCHMIDT, Atlas: T. 345, fig. 4–7; GIFFEN 1963: 233, fig. 58). — In South Africa usually found on beach sands and at river mouths.

*Isthmia* AGARDH 1832.

*I. enervis* EHRENBERG (cf. HUSTEDT 1927–1966, Part 1: 866, fig. 516; A. SCHMIDT, Atlas: T. 136, fig. 1, 3, 6, 7). — Not frequent in the material.

*Licmophora* AGARDH 1827.

*L. gracilis* (EHRENBERG) GRUNOW var. *anglica* (KÜTZING) PERAGALLO (1897–1908: Pl. 84, fig. 13; cf. HUSTEDT 1927–1966, Part 2: 60, fig. 583). — This was not frequent in the sample but the individuals that were seen very closely agreed with the description, the dimensions being 25–27  $\mu\text{m}$  long, 4  $\mu\text{m}$  broad, transapical striae 27 in 10  $\mu\text{m}$ .

*L. Ehrenbergii* (KÜTZING) GRUNOW f. *Grunowii* (MERESCHKOWSKY) HUSTEDT (cf. HUSTEDT 1927–1966, Part 2: 70, fig. 594). — Only two individuals were observed, one in valve view and one in girdle view, but there is no doubt as to their identity. The characteristic oblique striae on the side of the valve separate it from the recently described *L. opephoroides* GIFFEN (1969b: in press, fig. 35–37) which the valve view closely resembles, particularly as double rows of puncta can be seen between the transapical ribs (cf. HUSTEDT, l. c.: „wahrscheinlich Doppelpunkte“) in phase contrast. — Fig. 26, 27.

*L. Juergensii* AGARDH (cf. HUSTEDT 1927–1966, Part 2: 63, fig. 586; PERAGALLO 1897–1908: Pl. 84, fig. 4, 5; GIFFEN 1969b: in press). — The species has recently been reported (GIFFEN 1969b) from Sea Point near Cape Town and may prove widespread in South Africa, particularly in the colder coastal waters.

*Mastogloia* THWAITES 1856.

*M. ciskeiensis* GIFFEN (1967: 264, fig. 43–45; 1969b: in press, fig. 38, 39). — Apparently widespread in the littoral regions of South Africa but always scarce in the samples.

*Melosira* AGARDH 1824.

*M. nummuloides* (DILLWYN) AGARDH (cf. HUSTEDT 1927–1966, Part 1: 231, fig. 95).

*M. sulcata* (EHRENBERG) KÜTZING (cf. HUSTEDT 1927–1966, Part 1: 276, fig. 118, 119). — Widespread, abun-

dant and very variable in sculpture and diameter in South African littoral.

*Navicula* BORY 1824.

*N. abrupta* (GREGORY) DONKIN (1870—1873: 13, Pl. 2, fig. 6; cf. HUSTEDT 1927—1966, Part 3: 516, fig. 1558; GIFFEN 1963: 235, fig. 63). — Widely distributed in South African littoral but always more or less isolated and infrequent.

*N. abunda* HUSTEDT (1955: 27, Pl. 9, fig. 10—12; GIFFEN 1967: 265, fig. 53).

*N. cancellata* DONKIN var. *Gregorii* RALFS (cf. CLEVE 1895: 30; A. SCHMIDT, Atlas: T. 46, fig. 41, 42, 71, 72; GIFFEN 1967: 266, as *N. cancellata* var. *subcapitata*). — The author (GIFFEN 1967, l. c.) wrongly quoted "var. *subcapitata* GRUNOW" which does not exist, for var. *subapiculata* GRUNOW. This latter variety, together with var. *apiculata* have been included in *N. cancellata* by CHOLNOKY (1968a: 58) who also separates *N. Gregorii* RALFS as an independent species (1963: 58, fig. 51). Dimensions of the Gordon's Bay examples: length 40—50  $\mu\text{m}$ , breadth 8—10  $\mu\text{m}$ , transapical striae 9—10 in the middle, and to 12 in 10  $\mu\text{m}$  at the ends, lineolate, lineolae 18—20 in 10  $\mu\text{m}$ . — Fig. 28.

*N. cinctaeformis* HUSTEDT (cf. GIFFEN 1963: 236). — Not uncommon in brackish and estuarine waters of the Eastern Cape Province, but rare in the present locality.

*N. cingulatoides* CHOLNOKY (1963: 54, fig. 39; 1968a: 46, fig. 58). — This species was discovered at Rooiels, which is no great distance from Gordon's Bay but has recently been reported by CHOLNOKY (1968a: 46) from Santa Lucia Lagoon in Natal. It is probable that the species will prove widespread in the marine littoral of South Africa. — Fig. 29.

*N. comoides* (AGARDH?) PERAGALLO (1897—1908: Pl. 8, fig. 13; cf. HUSTEDT 1927—1966, Part 3: 304, fig. 1423; GIFFEN 1963: 238, fig. 69; CHOLNOKY 1968a: 47, fig. 97). — Frequent and widespread. The specimens seen were mostly 17—20  $\mu\text{m}$  long, 5  $\mu\text{m}$  broad with 17—20 transapical striae in 10  $\mu\text{m}$ . The central area was somewhat wider than usually figured, almost in some cases a fascia, often with a shorter isolated stria in the middle. — Fig. 30.

*N. dilucida* HUSTEDT (1939: 627, fig. 105—107; CHOLNOKY 1960: 57, fig. 180; GIFFEN 1963: 236, fig. 66). — Not common in the material but widespread in South African coastal waters and seashore lagoons.

*N. directa* W. SMITH (1853: 56, Pl. 18, fig. 172 under *Pinnularia*; cf. CLEVE 1895: 27; A. SCHMIDT, Atlas: T. 47, F. 4, 5).

*N. Grevillei* (AGARDH) HEIBERG (cf. PERAGALLO 1897—1908: 64, 65, Pl. 8, fig. 13, 14).

*N. guttata* GRUNOW (cf. CLEVE 1895: 34; A. SCHMIDT, Atlas: T. 46, fig. 10 without name). — Several examples

of this species were seen which differed from the figure in A. SCHMIDT (l. c.) in possessing rounded slightly obtuse ends, whereas the published figures show slightly protracted ends. In spite of these differences there is no doubt as to its identity. The species does not seem to have been previously recorded from South Africa. — Fig. 31.

*N. Johanrossii* GIFFEN (1967: 268, fig. 63, 64). — This recently described species which is characterized by a strongly convex and somewhat angular valve surface, leading to a crooked appearance of the striae, appeared to be scarce in the material. — Fig. 32.

*N. longa* (GREGORY) RALFS (cf. GREGORY 1856: 47, Pl. 5, fig. 18; A. SCHMIDT, Atlas: T. 47, fig. 6, 8—10; GIFFEN 1969a: in press). — CLEVE (1895 + 27) places this species under the name *N. directa* (W. SMITH) CLEVE var. *remota* GRUNOW. The author (GIFFEN, 1969a) considers that GREGORY's species should be upheld.

*N. mollis* (W. SMITH) CLEVE (1895: 26 = *Schizonema molle* W. SMITH 1856: 77, Pl. 58, fig. 365). Abundant in the sample and widely distributed in the South African littoral.

*N. mutica* KÜTZING (cf. HUSTEDT 1957: 300; CHOLNOKY 1968a: 54). — CHOLNOKY discusses the position of this species in the light of HUSTEDT's last contribution on its taxonomy (HUSTEDT 1927—1966, Part 3: 583—589). The species was rare in the sample.

*N. nautica* CHOLNOKY (1963: 62, fig. 64). — Fairly numerous and typical specimens occurred in the sample. The area under investigation is close to the "locus classicus" but it has been recorded from other localities in South Africa viz. Kidd's Beach, Eastern Cape (GIFFEN 1967) and Sea Point, near Cape Town, Southern Cape (GIFFEN, 1969a).

*N. peregrina* (EHRENBERG) KÜTZING (cf. CLEVE 1895: 18; HUSTEDT 1930: 300, fig. 516; HENDEY 1964: Pl. 30, fig. 12, 13).

*N. rhabboneis* (EHRENBERG) CLEVE (1895: 36, Pl. I, fig. 30). — Numerous specimens were observed which agree in shape, size and number of transapical striae with the description of this species. However, CLEVE's description is restricted in the sizes given, for the Gordon's Bay examples vary from 13—30  $\mu\text{m}$  in length (27  $\mu\text{m}$ ), 7.5 to 10  $\mu\text{m}$  (11  $\mu\text{m}$ ) in breadth, transapical striae 9—10 in 10  $\mu\text{m}$  (8 in 10  $\mu\text{m}$ ), with longitudinal striae 20—25 in 10  $\mu\text{m}$  (lineolae 20 in 10  $\mu\text{m}$ ). In most cases the shape appears somewhat more convex than in CLEVE's figure. — Fig. 33—35.

*N. salinicola* HUSTEDT (1939: 638, fig. 61—69; 1955: 27; GIFFEN 1967: 273; CHOLNOKY 1968: 60). — Widespread in the marine littoral and strongly brackish water of lagoons and river estuaries in South Africa. Common in the sample.

*N. scopulorum* BRÉBISSON (cf. HUSTEDT in A. SCHMIDT, Atlas: T. 394, fig. 1, 2; 1927—1966, Part 3: 25, fig.

1186a—c; CHOLNOKY 1968: 61). — CHOLNOKY (l. c.) considers that the characters separating the various forms and varieties into which the species is divided is unnecessary as it is not based on genetic fundamentals. The individuals seen were not frequent in the material, belonged to either f. *triundulata* MEISTER, or to f. *belgica* (VAN HEURCK) DE TONI. This latter form does not seem to have been previously recorded from South Africa. — Fig. 36.

*N. sponsalia* n. sp. — Frustule in girdle view arcuate, subrectangular with moderately broad connecting zone, intercalary band simple. Valves elliptical to linear elliptical with regularly rounded ends, 22—40  $\mu\text{m}$  long, 7—8  $\mu\text{m}$  broad. Raphe filiform, straight or very slightly flexuose, axial area narrow widening slightly towards the centre, central area moderately large, quadrate due to the shortening of the middle 3—4 striae. Transapical striae radiate throughout, 13—15 in 10  $\mu\text{m}$ , central 3 or 4 shortened and of uneven length, longitudinal striae not visible.

Type slide 594 in the GIFFEN Collection.

Iconotype: figures 37—39.

Frustula in visu connectivale arcuata, rectangularia. Pleura modice lata, zona connectiva simplex. Valvae ellipticae sive lineari-ellipticae apicibus regulariter rotundatis, 22—40  $\mu\text{m}$  longae, 7—8  $\mu\text{m}$  latae. Raphe filiformis, directa sive levissime flexuosa, area axialis anguste linearis, ad nodulum centralem versus lanceolate dilatata, area centralis mediocris, transverse oblonga, abbreviacione striarum medianarum 3—4 parata. Striae transapicales in tota longitudine valvae radiant, 13—15 in 10  $\mu\text{m}$ , medianes 3 sive 4 abbreviata, inaequaliter longae. Costae longitudinales invisibiles.

Habitat: in aquis marinis litoralibus Oceani Indici prope Gordon's Bay in provincia Capense Occidentale Africae Meridionalis.

Holotypus: praeparatum no. 594 in collectione GIFFEN, Fort Hare, C. P.

Iconotypus: figurae nostrae no. 37—39.

*Navicula sponsalia* n. sp. belongs to a group of *Naviculae* which possess arcuate frustules, hence the valves differ in curvature, one being convex, the other concave. GRUNOW (1863) devised the genus *RHOICONEIS* to include these bent diatoms. CLEVE (1895: 10) placed them in his *Naviculae lineolatae*, except for one species (*N. Garkeana* GRUNOW) which fell more naturally into his *Naviculae microstigmatica*. It is in CLEVE's introduction to this latter group that he states (1894: 143) "As to *Rhoiconeis*, this genus is also inadmissible, as it contains widely different forms and the degree of flexure in the frustule varies in the same species". VAN HEURCK in the "Treatise" (1899) accepts *Rhoiconeis* as a genus in his key to the genera (p. 152) and on p. 238 gives a brief description of the genus and a figure of *Rhoiconeis Garkeana* GRUNOW. Several species of *Navicula* with flexed frustules have been observed in South Africa (unpublished material) of which *N. sponsalia* n. sp. is

the first to be described. It is very similar to *N. Bolleana* GRUNOW (CLEVE 1895: 25; A. SCHMIDT, Atlas: T. 47, fig. 18) but differs in size, being considerably smaller and possessing 13—15 striae in 10  $\mu\text{m}$  as against 8—11 in 10  $\mu\text{m}$ . From *N. sibirica* GRUNOW (cf. CLEVE 1895: 29) it differs its radiate transapical striae. It was scarce in the sample. — Fig. 37—39.

*N. spuria* CLEVE (1895: 31, with no figure; cf. PERAGALLO 1897—1908: 92, Pl. 12, fig. 15; CHOLNOKY 1963: 66). — First recorded from South African waters by CHOLNOKY from Steenbras in the region under investigation. First African record by LEUDUGER-FORTMOREL (1898: 30) from St. Thome. Dimensions 88  $\mu$  long, 14  $\mu\text{m}$  broad, striae 6—7 in 10  $\mu\text{m}$ , lineolae 20—22 in 10  $\mu\text{m}$ . — Fig. 40.

*N. Stompsii* CHOLNOKY (1963: 66, fig. 77, 78; cf. GIFFEN 1967: 273). — This species, previously described from the Knysna region of the South Coast by CHOLNOKY has been recorded from the eastern coasts where the individuals differed slightly from the original description in having somewhat closer transapical striae. The material from Gordon's Bay is identical with the original.

*N. subforcipata* HUSTEDT (1927—1966, Part 3: 533, fig. 1569). I have no doubt as to the identity of this species because the few examples seen fell completely within the dimensional limits of HUSTEDT's description. Dimensions: 16  $\mu\text{m}$  long, 7  $\mu\text{m}$  broad, transapical striae 15 in 10  $\mu\text{m}$ , puncta ca. 30 in 10  $\mu\text{m}$ . — Fig. 41.

*Nitzschia* HASALL 1845.

*N. composita* n. sp. — Frustule in girdle view linear with rounded truncate ends. Valve lanceolate with capitate ends, 60—75  $\mu\text{m}$  long, 4—7  $\mu\text{m}$  broad. Keel moderately excentric, carinal puncta 9—11 in 10  $\mu\text{m}$ , strong, with carinal costae crossing from the keel to the margin. Transapical striae faint, ca. 20 in 10  $\mu\text{m}$ , with more or less 2 between each rib, very finely punctate.

Type: Slide 594 in the GIFFEN Collection.

Iconotype: Figures 42, 43.

Frustula in visu pleurale linearia, apicibus rotundatis, truncatis. Valvae lanceolatae, apicibus protractis, distincte capitatis, 60—75  $\mu\text{m}$  longae, 4—7  $\mu\text{m}$  latae. Carina modice excentrica, pori carinales distincti, 9—11 in 10  $\mu\text{m}$ , costis carinalibus margines valvae attingentibus connectae. Striae transapicales subtiles, circiter 20 in 10  $\mu\text{m}$ , plerumque duo inter costas duas carinales, subtiliter punctatae.

Habitat: in aquis marinis litoralibus prope Bay in Provincia Capense Occidentale Africae Meridionalis.

Holotypus: praeparatum no. in collectione GIFFEN, Fort Hare, C. P.

Iconotypus: figurae nostrae no. 42 et 43.

This new species is characterized by the transverse costae or ribs from the keel to the margin and the presence of either double rows of small punta or two finely punctate transapical striae between the costae. The diatom is



weekly silicified and complete and unbroken specimens were difficult to find although it was not infrequent in the sample. — Fig. 42, 43.

*N. constricta* GREGORY (cf. PERAGALLO 1897—1908: 270, Pl. 70, fig. 8—10; HUSTEDT in A. SCHMIDT, Atlas: T. 333, fig. 8). Widespread and often frequent in the South African marine littoral and river estuaries. In the sample, the observed individuals were mostly small being about 25  $\mu\text{m}$  long with 15 transapical striae in 10  $\mu\text{m}$  and the carinal pores 10 in 10  $\mu\text{m}$ .

*N. dissipata* (Kützing) GRUNOW (in CLEVE & GRUNOW 1880: 90; in VAN HEURCK 1880—1881: 178, Pl. 63, fig. 1—3).

*N. distans* GREGORY (cf. PERAGALLO 1897—1908: Pl. 73, fig. 3; GIFFEN 1963: 245, fig. 85).

*N. distantoides* HUSTEDT (1958: 711, fig. 161; CHOLNOKY 1963: 72, fig. 90, 91; GIFFEN 1967: 274, fig. 83, 84). — Since HUSTEDT's original description was published (l. c.) the diagnosis has been emended by CHOLNOKY and further information added by the author (GIFFEN, l. c.). The dimensions now accepted are: length 32—96  $\mu\text{m}$ , 3,5—5,0  $\mu\text{m}$  broad, carinal pores very irregular from 2,5 to 5 in 10  $\mu\text{m}$ . The species was infrequent in the material and fell well within the limits of the new dimensions viz. 45—50  $\mu\text{m}$  long, 5  $\mu\text{m}$  wide, carinal pores 4—6 in 10  $\mu\text{m}$ .

*N. dubia* W. SMITH (cf. HUSTEDT 1930: 403, fig. 770; PERAGALLO 1897—1908: Pl. 70, fig. 30). — A fresh to brackish water species probably displaced in the sample.

*N. frustulum* (KÜTZING) GRUNOW var. *subsalina* HUSTEDT (1930: 415, fig. 796; GIFFEN 1963: 245; 1967: 275).

*N. Hustedtiana* SALAH (1952: 166, Pl. 9, fig. 11 = *N. Hustedtiana* CHOLNOKY 1959: 50, fig. 313—315; HUSTEDT in A. SCHMIDT, Atlas: T. 330, fig. 12 as *N. punctata* (W. SMITH) GRUNOW f. *minores*; GIFFEN 1967: 275). — The author (GIFFEN, l. c.) discussed the authority for the specific epithet. The species is not uncommon in brackish waters of estuaries and salt marshes. It was rare in the material in hand. Dimensions: 17  $\mu\text{m}$  long, 7  $\mu\text{m}$  broad, transapical striae 15 in 10  $\mu\text{m}$ .

*N. hybrida* GRUNOW (cf. HUSTEDT 1930: 406, fig. 778; GIFFEN 1967: 275).

*N. incrustans* GRUNOW (1862: 579, T. 12, fig. 35; cf. CHOLNOKY 1968: 73, fig. 134—138). — According to CHOLNOKY (l. c.) this species is well represented in

African localities and apparently widespread in South African waters. Dimensions of local material: 12—16  $\mu\text{m}$  long, 3,5  $\mu\text{m}$  broad, carinal pores 5—7 in 10  $\mu\text{m}$ . — Fig. 44, 45

*N. Lorenziana* GRUNOW (cf. HUSTEDT 1930: 423, fig. 820; PERAGALLO 1897—1908: Pl. 74, fig. 21—26). — The distinction between the varieties described in HUSTEDT (l. c.) and PERAGALLO (l. c.) seem to be inconsequential and the differences so slight as to make their separation unnecessary. The following table shows the intergrading of species and varieties: (Table)

The South African specimens appear to belong to *N. Lorenziana* GRUNOW, as they are closest in number of striae although shorter in length and with very slightly closer carinal pores. The species was not frequent in the sample.

*N. marginulata* GRUNOW (cf. PERAGALLO 1897—1908: Pl. 70, fig. 14, 15 as *N. marginulata* var.). — Specimens occurred in the material which I have assigned to this species. In shape they are very similar to *N. plicatula* HUSTEDT (1953: 150, fig. 1, 2; cf. CHOLNOKY 1959: 58, fig. 295—296; 1960: 101, fig. 292—295) but differ in width, being 11—12  $\mu\text{m}$  wide (7,5—8  $\mu\text{m}$  at the constriction) which is almost double the width of *N. plicatula* and in the possession of 20—24 transapical striae in 10  $\mu\text{m}$ , considerably coarser than in *N. plicatula*; carinal pores in both species are more or less the same, 10—12 in 10  $\mu\text{m}$ . The South African specimens are somewhat shorter than shown in PERAGALLO. — Fig. 47.

*N. Martiana* AGARDH (cf. PERAGALLO 1897—1908: Pl. 72, fig. 20). — Individuals, not very numerous and mostly broken into short pieces were identified with *N. Martiana* AGARDH. They were identical with PERAGALLO's figures and measured 120—140  $\mu\text{m}$  long, 4  $\mu\text{m}$  broad, with carinal pores 5—6 in 10  $\mu\text{m}$ , rectangular in shape and irregular. The striae in the local material were not visible but are given by PERAGALLO as 30 in 10  $\mu\text{m}$ . — Fig. 48.

*N. media* HANTZSCH (cf. PERAGALLO: Pl. 72, fig. 12). — Specimens which I place with this species agree very closely with PERAGALLO's figure (l. c.) and dimensions except for the length which is considerably shorter. The South African examples were 45—52  $\mu\text{m}$  long, 5, 5—6  $\mu\text{m}$  broad, carinal pores 5—6 in 10  $\mu\text{m}$ , very slightly irregular, the pores somewhat thickwalled and rounded, striae not visible. *N. media* HANTZSCH has been recorded by HEIDEN and KOLBE (1928: 664) from Simon's Bay. They

Taxa:	Length	Breadth	carinal pores in 10 $\mu\text{m}$	Striae in 10 $\mu\text{m}$
<i>N. Lorenziana</i>	130—190	6—7	6—7	13,5—14 20 at end
var. <i>incurva</i>	50—60	5	6—7	14,5 18—20 at end
var. <i>subtilis</i>	65—160	3—5	6—8	17—19
var. <i>densestriata</i>	60—80	3—4	6—8	18—20 24 at end
Gordon's Bay specimens	70—72	4	7—8	12—13

give dimensions which agree very closely with mine, above. — Fig. 49, 50.

*N. ovalis* ARNOTT (cf. HUSTEDT 1930: 417, fig. 808; CHOLNOKY 1963: 75, fig. 97). — This species was not frequent in the sample.

*N. panduriformis* GREGORY (cf. VAN HEURCK 1899: 386, Pl. 15, fig. 500; PERAGALLO 1897—1908: Pl. 70, fig. 5; GIFFEN 1969b: in press). — The forms seen were smaller than described by VAN HEURCK but are identical with PERAGALLO's figure. The South African specimens seem to conform to this rather short form (vide GIFFEN 1969b: in press).

*N. panduriformis* var. *minor* GRUNOW (cf. PERAGALLO 1897—1908: Pl. 70, fig. 6).

*N. perpusilla* RABENHORST (cf. HUSTEDT 1930: 349 as *N. frustulum* var. *perpusilla*; CHOLNOKY 1966a: 56; 1966a: 202). — As CHOLNOKY notes this should be regarded as a separate species from *N. frustulum* (KÜTZING) GRUNOW. It was very rare in the material and must be regarded here as a displaced species.

*N. procera* HUSTEDT (1955: 47, Pl. 16, fig. 6, 7; cf. GIFFEN 1969a: in press, fig. 79). — Typical examples, but usually slightly shorter, were plentiful in the sample. Dimensions: 68—73  $\mu\text{m}$  long, 6  $\mu\text{m}$  broad, carinal pores 10 in 10  $\mu\text{m}$ , transapical striae ca. 30 in 10  $\mu\text{m}$ , longitudinal striae ca. 30 in 10  $\mu\text{m}$ . — Fig. 51.

*N. pseudohybrida* HUSTEDT (1955: 45, Pl. 15, fig. 3). — A few examples of this species were observed and were identical with HUSTEDT's species. Dimensions: 25  $\mu\text{m}$  long, 6  $\mu\text{m}$  broad, carinal pores 15 in 10  $\mu\text{m}$ , striae not visible.

*N. ruda* CHOLNOKY (1968: 79, fig. 144—146; cf. GIFFEN 1969a: in press, fig. 83). — This species, recently described from the Santa Lucia Lagoon, Natal, has been reported by the author from the Eastern Cape Province (GIFFEN, l. c.) is now recorded from the South Western coast. In these southern and eastern regions it seems rare but owing to its small size may be overlooked. Dimensions of the local material: 10—12  $\mu\text{m}$  long, 6  $\mu\text{m}$  broad, striae 25—27 in 10  $\mu\text{m}$ , oblique in two directions.

*N. sigma* (KÜTZING) W. SMITH (cf. HUSTEDT 1930: 420, fig. 813; GIFFEN 1963: 248). — Not infrequent in the sample and widespread in the South African marine littoral and brackish waters.

*N. sigma* var. *intercedens* GRUNOW (in VAN HEURCK 1880—1881: Pl. 66, fig. 1\*; cf. VAN HEURCK 1899: 396, Pl. 16, fig. 532; GIFFEN 1969a: in press).

*N. sigma* var. *rigida* (KÜTZING) W. SMITH (cf. HUSTEDT 1930: 420; VAN HEURCK 1899: Pl. 16, fig. 533).

*N. sigma* var. *rigidula* GRUNOW (cf. HUSTEDT 1930: 420; VAN HEURCK 1899: Pl. 16, fig. 534). — These last two

varieties should be included with the type as they are linked by numerous intermediates (GIFFEN 1969a: in press).

*N. socialis* GREGORY (cf. PERAGALLO 1897—1908: Pl. 72, fig. 7, 8). — Widespread in South African waters.

*N. stauroptera* GIFFEN (1967: 278, fig. 96). — This remarkable *Nitzschia*, characterized by an elongated central nodule or stauros and irregular, lengthened carinal pores, occurred in the material but only a few damaged individuals were seen.

*N. Stompsii* CHOLNOKY (1963: 75, fig. 100—102; cf. GIFFEN 1967: 279, fig. 97).

*N. ventricosa* KITTON (cf. HUSTEDT 1955: 48; HUSTEDT in A. SCHMIDT, Atlas: T. 335, fig. 4 as *N. longissima* f. *costata* HUSTEDT; GIFFEN 1969a: in press, fig. 84).

*N. Vidovichii* (GRUNOW) PERAGALLO (GRUNOW in VAN HEURCK 1880—1881: Pl. 67, fig. 7 as *Homoeocladia Vidovichii* GRUNOW; CHOLNOKY 1963: 76, fig. 103—105 and also P. 73, fig. 92 as *N. knysnensis* CHOLNOKY; GIFFEN 1967: 279). — Rare.

*Opephora* PETIT 1888.

*O. gemmata* (GRUNOW) HUSTEDT (1927—1966, Part 2: 136, fig. 657; cf. GIFFEN 1967: 280, fig. 102). — The specimens seen in the Gordon's Bay sample were very like those figured by the author (GIFFEN, l. c.) from the Eastern Cape Province viz. 192  $\mu\text{m}$  long, 8—9  $\mu\text{m}$  broad, with 8—9 strong transapical striae in 10  $\mu\text{m}$  with a somewhat narrow pseudoraphe. Frequent in the material.

*O. Martyi* HÉRIBAUD (cf. HUSTEDT 1927—1966, Part 2: 135, fig. 654; GIFFEN 1967: 281, fig. 102).

*O. pacifica* (GRUNOW) PETIT (cf. HUSTEDT 1927—1966: 135, fig. 665; GIFFEN 1967: 281, fig. 104). — Widespread and often abundant in South African marine littoral.

*Plagiogramma* GREVILLE 1859.

*P. Vanbeurckii* GRUNOW (cf. HUSTEDT 1927—1966, Part 2: 112, fig. 638; PERAGALLO 1897—1908: Pl. 82, fig. 6). — Small specimens were seen not infrequently in the material, most of which possessed a slightly oblique transapical pseudoseptum and somewhat broader ends than figured in either HUSTEDT (l. c.) or PERAGALLO (l. c.). Dimensions: 13—15  $\mu\text{m}$  long, 5  $\mu\text{m}$  broad, transapical striae ca. 12 in 10  $\mu\text{m}$ . The species has been previously recorded from plankton in both Atlantic and Indian Oceans off South African shores. — Fig. 52, 53.

*Pleurosigma* W. SMITH 1825

*P. delicatulum* W. SMITH (1853: 64, Pl. 21, fig. 202; cf. CLEVE 1894: 37; PERAGALLO 1897—1908: Pl. 32, fig. 16, 17; GIFFEN 1963: 250). — Not frequent.

*P. formosum* W. SMITH (1853: 63, Pl. 20, fig. 195; cf. CLEVE 1894: 45; PERAGALLO 1897—1908: Pl. 30, fig. 1—3; GIFFEN 1969a: in press). — This was one of the largest diatoms seen in the sample. Length 274  $\mu\text{m}$ , breadth 30  $\mu\text{m}$ , striae, transverse 12 in 10  $\mu\text{m}$ , oblique 10 in 10  $\mu\text{m}$ , which is slightly coarser than given in CLEVE (l. c.) or PERAGALLO (l. c.) i. e. 14 in 10  $\mu\text{m}$ . The species was not common.

*P. rigidum* W. SMITH (1853: 64, Pl. 20, fig. 198; cf. CLEVE 1894: 39; PERAGALLO 1897—1908: Pl. 33, fig. 13—15; GIFFEN 1969a: in press). — Dimensions: 240—256  $\mu\text{m}$  long, 38  $\mu\text{m}$  wide, striae transverse: oblique as 18:19, 15:17, 15:15 in 10  $\mu\text{m}$  which is somewhat coarser than described. It was not infrequent in the sample.

*Podocystis* BAILEY 1854.

*P. spathulata* (SHADBOLT) VAN HEURCK (cf. HUSTEDT 1927—1966, Part 2: 133, fig. 653). — Typical specimens were seen in the material but were not abundant. This species does not seem to have been recorded from South African waters.

*Pyxidicula* EHRENBERG 1833.

*P. minuta* GRUNOW (cf. HUSTEDT 1927—1966, Part 1: 301, fig. 139; GIFFEN 1969b: in press). — Apparently widespread in South Africa.

*Rhaphoneis* EHRENBERG 1844.

*R. capensis* A. SCHMIDT (Atlas: T. 193, fig. 18; cf. GIFFEN 1967: 284, fig. 114, 115). — This recently rediscovered species, figured by A. SCHMIDT (l. c.) in 1894, was described and figured by the author and has been shown to be fairly widespread in South African marine littoral.

*R. mirabunda* GIFFEN (1963: 251, fig. 100—102; 1967: 284, fig. 116, 117). — Widely distributed and very variable in length but smaller specimens can be confused with somewhat elongated individuals of *R. surirella* (EHRENBERG) GRUNOW. Frequent and widespread in South Africa.

*R. superba* (JANISCH) GRUNOW (JANISCH 1862: Pl. 2, fig. 8 as *Cocconeis superba*; HUSTEDT 1951: 305, fig. 1, 2; A. SCHMIDT, Atlas: T. 193, fig. 9—11 as *Cocconeis superba* JANISCH and probably also, A. SCHMIDT, Atlas: T. 58, fig. 24—28 as *Coscinodiscus cocconeiformis* A. SCHMIDT; GIFFEN 1967: 284, fig. 118). — Widespread in the South African littoral, frequently on beach sands and often abundant.

*R. surirella* (EHRENBERG) GRUNOW (cf. HUSTEDT 1927—1966, Part 2: 173, fig. 679a—c; 1955: 14).

*Rhoicosphenia* GRUNOW 1860.

*R. Adolphi* M. SCHMIDT (in A. SCHMIDT, Atlas: T. 213, fig. 20—23; cf. GIFFEN 1969b: in press, fig. 51—54). — Recently reported from the Atlantic coast near Cape

Town, where it occurred in great numbers, it was represented here by a very few individuals.

*Striatella* AGARDH 1832.

*S. delicatula* (KÜTZING) GRUNOW (cf. HUSTEDT 1927—1966, Part 2: 33, fig. 561; CHOLNOKY 1968: 89, fig. 163). — Very rare. Dimensions: length 12  $\mu\text{m}$ , transapical striae 20—24 in 10  $\mu\text{m}$ .

*Surirella* TURPIN 1828.

*S. atomus* HUSTEDT (1955: 48, Pl. 16, fig. 23; cf. CHOLNOKY 1963: 79, fig. 112, 113; GIFFEN 1967: 268). — Dimensions: length 11  $\mu\text{m}$ , breadth 9  $\mu\text{m}$ , canals 9 in 10  $\mu\text{m}$ , closer than in the original description, but otherwise identical.

*S. fastuosa* EHRENBERG var. *cuneata* WITTROCK (cf. A. SCHMIDT, Atlas: T. 4, fig. 1, 2 as *S. cuneata* A. SCHMIDT; GIFFEN 1963: 253, fig. 109). — Rare in the material but widespread in South African waters.

*S. gemma* (EHRENBERG) KÜTZING (cf. GIFFEN 1967: 286; 1969a: in press; CHOLNOKY 1960: 118, fig. 341). — This is one of the commonest species of *Surirella* in the littoral of the Eastern Cape coasts and also the South Western regions.

*S. ovalis* BRÉBISSEON. — A displaced fresh or brackish water species.

*S. scalaris* GIFFEN (1967: 286, fig. 121—123). — Not infrequent in the sample. — Fig. 54.

*Synedra* EHRENBERG 1830.

*S. Gaillonii* (BORY) EHRENBERG (cf. HUSTEDT 1927—1966, Part 2: 195, fig. 690; HUSTEDT in A. SCHMIDT, Atlas: T. 306, fig. 9—13; PERAGALLO 1897—1908: Pl. 80, fig. 7; GRUNOW in VAN HEURCK 1880—1881: T. 42, fig. 1 as *S. capensis*). — The forms which I have assigned to this species differ from the authoritative descriptions (HUSTEDT, l. c., VAN HEURCK, l. c.) in one characteristic, that of the number of transapical striae in 10  $\mu\text{m}$ . The dimensions of the South African specimens are: 45—140  $\mu\text{m}$  long, 6—8  $\mu\text{m}$  broad with 20 transapical striae in 10  $\mu\text{m}$ , parallel but sometimes slightly radiate at the very ends, prominent mucilage pores are visible at the apices. The very fine striae compared with the 9—10 in 10  $\mu\text{m}$  given in the description is somewhat difficult to accept but for the fact that Hustedt himself, a very accurate draughtsman, drew 13—16 striae in 10  $\mu\text{m}$  in his figures in A. SCHMIDT, Atlas: 306, figs. 9, 10, which is intermediate between the South African specimens and the type. I have not seen GRUNOW's description of *S. capensis* GRUNOW in VAN HEURCK (l. c.) which may be the same as those of my material. *S. Gaillonii* has been recorded by HEIDEN & KOLBE (1928: 560) from Simon's Bay who give the striae as 9—11 in 10  $\mu\text{m}$ . — Fig. 55, 56.

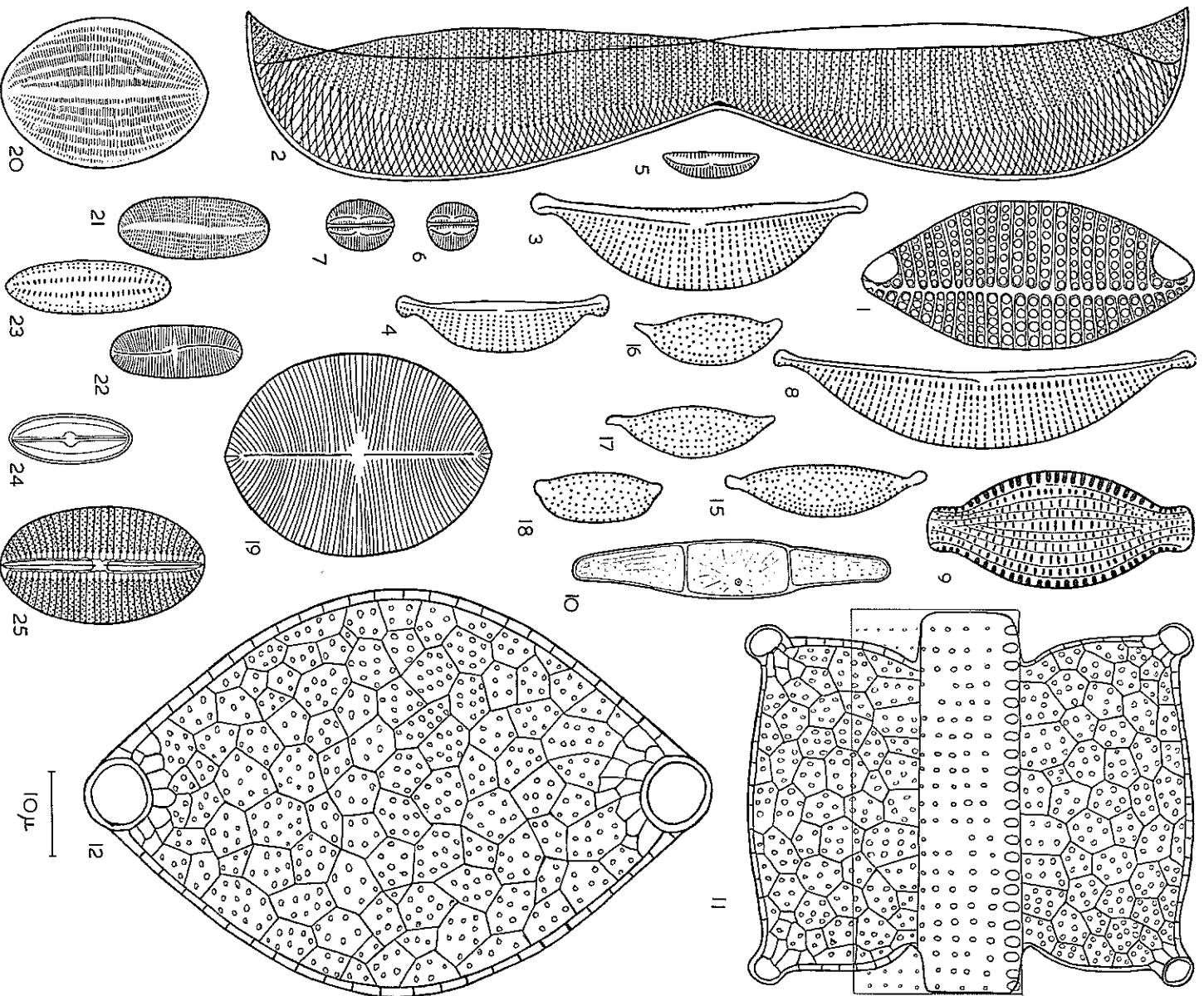


Plate 1

1. *Achnanthes brevipes* AGARDH. — 2. *Amphiprora sulcata* O'MEARA. — 3. *Amphora costata* W. SMITH. — 4. *A. exigua* GREGORY. — 5—7. *A. exilistata* n. sp. — 8, 9. *A. granulata* GREGORY. — 10. *Arcaulus birostratus* GRUNOW. — 11, 12. *Biddulphia reticulata* ROPER. — 15—18. *Campylostris africana* n. sp. — 19, 20. *Cocconeis convexa* GIFFEN. — 21, 22. *C. dirupitoides* HUSTEDT. — 23, 24. *C. discrepans* A. SCHMIDT. — 25. *Diploneis litoralis* (DONKIN) CLEVE

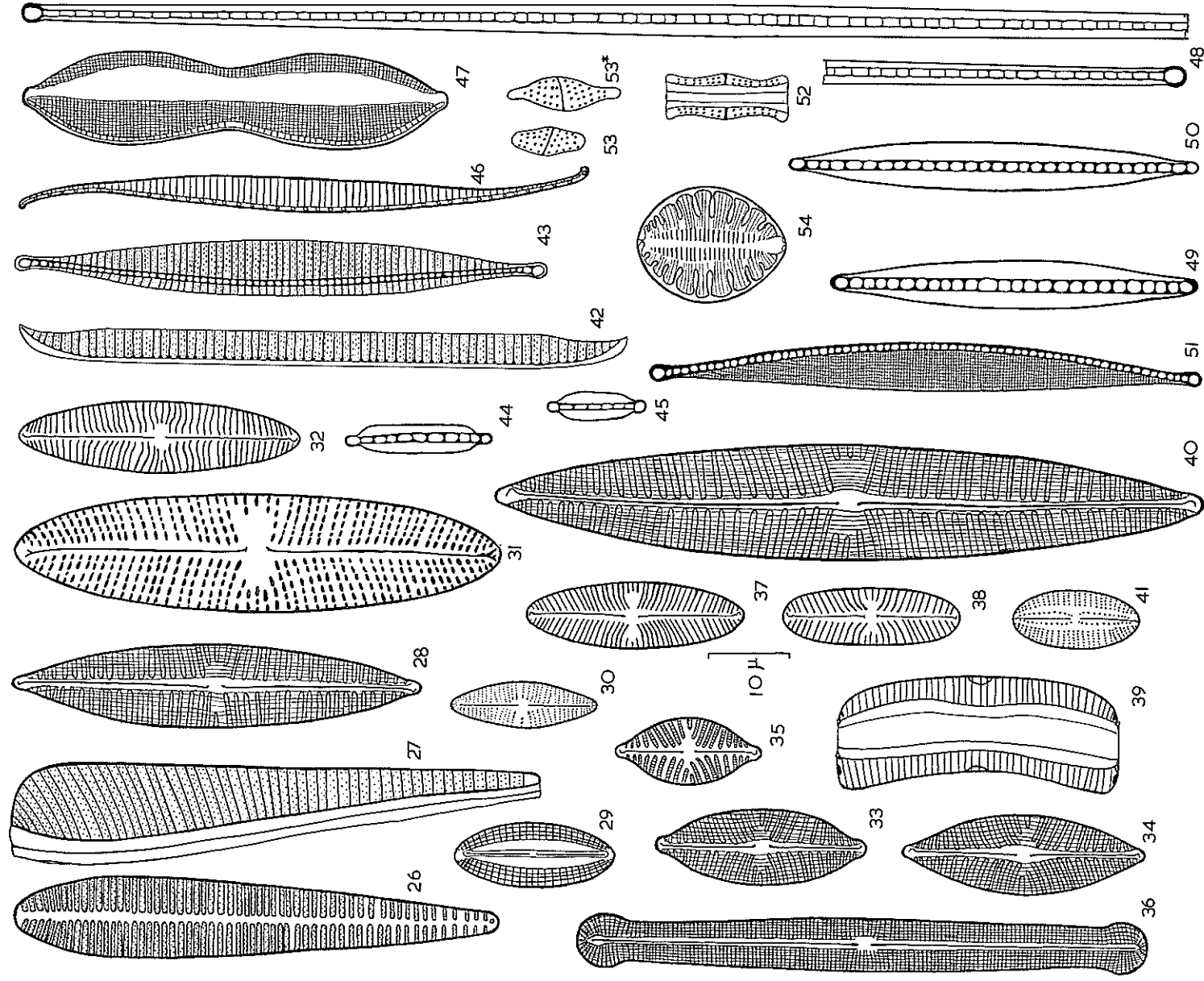


Plate 2

26, 27. *Licmophora Ehrenbergii* (KÜTZING) CLEVE f. *grunowii* (MERESCHKOWSKY) HUSTEDT. — 28. *Navicula cancellata* var. *gregorii* RALFS. — 29. *N. cingulatooides* CHOLNOKY. — 30. *N. comoides* (AGARDH ?) PERAGALLO. — 31. *N. guttata* GRUNOW. — 32. *N. johannrossii* GIFFEN. — 33—35. *N. rhaphoneis* CLEVE. — 36. *N. scopulorum* var. *belgica* (VAN HEURCK) DE TONI. — 37—39. *N. sponsaita* n. sp. — 40. *N. spurta* CLEVE. — 41. *N. subforcipata* HUSTEDT. — 42, 43. *Nitzschia composita* n. sp. — 44, 45. *N. incurvans* GRUNOW. — 46. *N. Lorenziana* GRUNOW. — 47. *N. marginulata* GRUNOW. — 48. *N. Martiana* AGARDH. — 49, 50. *N. media* HANTZSCH. — 51. *N. procer* HUSTEDT. — 52, 53, 53\*. *Plagiogramma Vanheurnkii* GRUNOW. — 54. *Surtirella scalaris* GIFFEN.

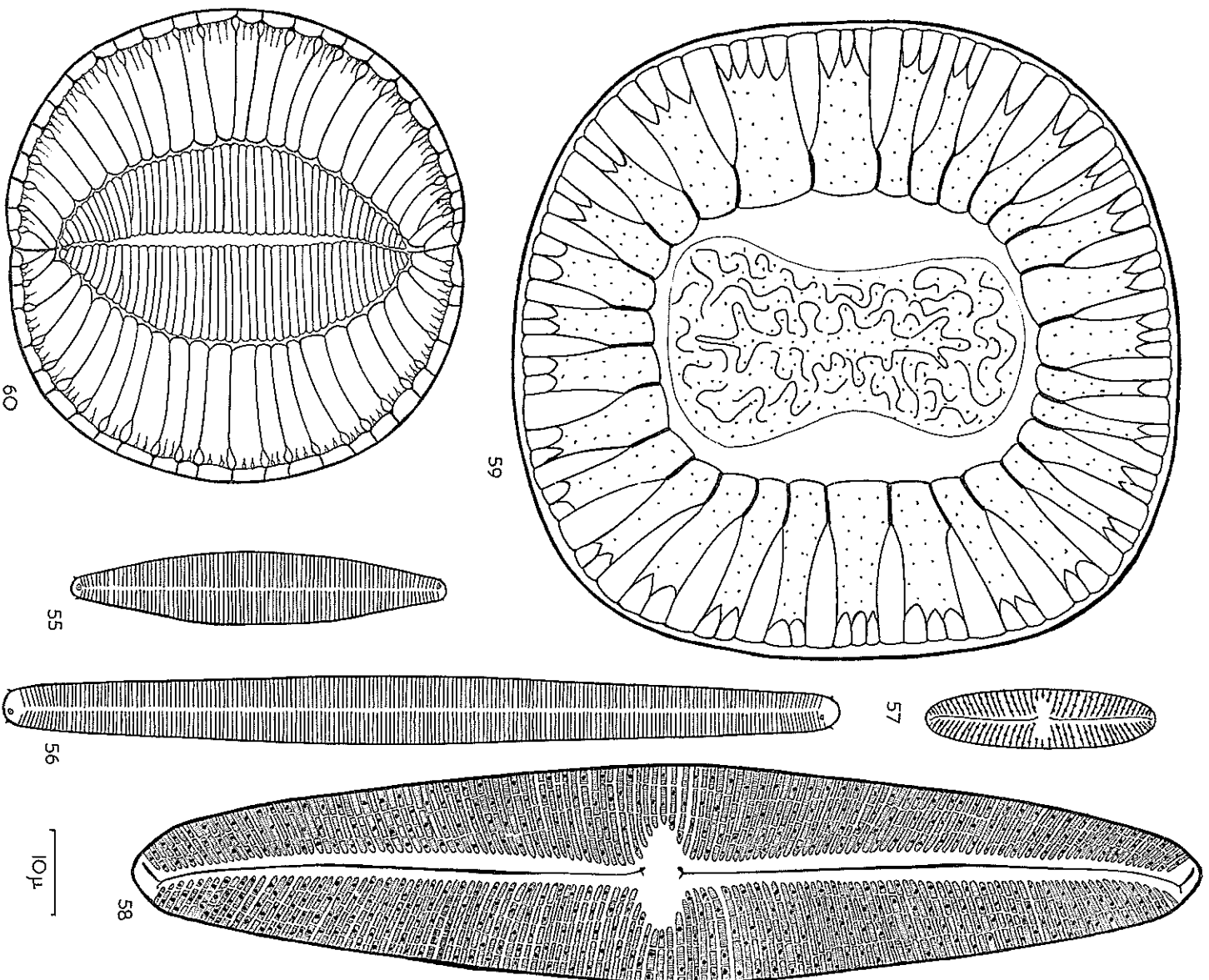


Plate 3

55, 56. *Synedra Gallionii* (BORY) EHRENBERG. — 57. *Trachyneis spethonae* GIFFEN. — 58. *T. velata* A. SCHMIDT. — 59. *Campylodiscus contiguus* A. SCHMIDT. — 60. *C. insertus* A. SCHMIDT

*S. tabulata* (AGARDH) KÜTZING var. *fasciculata* (KÜTZING) GRUNOW (cf. HUSTEDT 1927—1966, Part 2: 218, fig. 710a—n; CHOLNOKY 1968: 90). CHOLNOKY considers that the division of the species into so-called varieties is unnecessary and places the above variety with the type.

*Thalassiothrix* CLEVE & GRUNOW 1880.

*T. Frauenfeldii* GRUNOW (in CLEVE & GRUNOW 1880: 109; cf. HUSTEDT 1927—1966, Part 2: 247, fig. 727). — Widespread in South Africa.

*Trachynois* CLEVE 1894.

*T. aspera* (EHRENBERG) CLEVE (1894: 191; cf. GIFFEN 1963: 255, fig. 106, 107). — An extremely variable species, most of whose many varieties should be not separated from the type.

*T. speibonae* GIFFEN (1969b: in press, fig. 62, 63). — This recently described species is apparently the smallest and least silicified of the genus. It was not frequent in the sample. — Fig. 57.

*T. velata* A. SCHMIDT (Atlas: T. 48, fig. 33, 34 and 35—37 without name; CLEVE 1894: 194). — This species differs from *T. aspera* in the shape and size of the central area which, here, is fairly small and circular or transapically slightly elongated. The number of striae is given by CLEVE as 15—16 in 10  $\mu$ m for the named figures in A. S. Atlas i. e. fig. 33, 34 which is quite correct. Measurement of the remaining quoted figures viz. fig. 35—37, give 10—13 striae in 10  $\mu$ m, which is consistent with the observed South African specimens, which have a very constant number of 10 transapical striae in 10  $\mu$ m. Schmidt quotes his figures 35—37 as originating from the Cape of Good Hope. The description

of *T. velata* A. SCHMIDT should be emended to include all specimens with transapical striae from 10—16 in 10  $\mu$ m. The species was frequent in the sample. — Fig. 58.

*Triceratium* EHRENBERG 1841.

*T. antediluvianum* (EHRENBERG) GRUNOW (cf. HUSTEDT 1927—1966, Part 1: 810, fig. 472; A. SCHMIDT, Atlas: T. 99, fig. 1—4, 6—9, 20; PERAGALLO 1897—1908: Pl. 102, fig. 1—7 in both the last as Amphitetras; CHOLNOKY 1963: 80). — Only one individual was seen which is consistent with the few reports of its presence and its scarcity in the samples. HEIDEN & KOLBE, 1928, report it from Simon's Bay.

*T. pentacrinus* (EHRENBERG) WALLICH var. *quadrata* PERAGALLO (1897—1908: Pl. 103, fig. 2, 3; cf. HUSTEDT 1927—1966, Part 1: 814, fig. 475; GIFFEN 1969a: in press). — Apparently widely distributed along the South African coasts but also very scarce.

#### Acknowledgements

I wish to acknowledge my thanks and indebtedness to Professor J. M. DE WET, Rector of the University College of Fort Hare, Cape Province, at which institution this work was carried out, and to Dr. B. J. CHOLNOKY of the National Institute for Water Research, Council for Scientific and Industrial Research, Pretoria, for his encouragement and assistance.

Sets of slides used in the preparation of this work have been presented to the British Museum, London, The Riksmuseet in Stockholm, the Senckenberg Museum in Frankfurt a. M., and the collection of the C.S.I.R. in Pretoria.

#### References

- BODEN, B. P. 1950, Some marine diatoms from the West coast of South Africa. Contribution from Scripps's Institution of Oceanography. New Series. No. 451. Transactions Royal Soc. South Africa, Vol. 32: 321—434. — CHOLNOKY, B. J. 1959, Neue und seltene Diatomeen aus Afrika IV. Diatomeen aus der Kaap Provinz. Österr. Bot. Zeitschrift, Bd. 106: 1—69. — CHOLNOKY, B. J. 1960, Beiträge zur Kenntnis der Diatomeenflora von Natal. Nova Hedwigia, Bd. 2: 1—128. — CHOLNOKY, B. J. 1961, Beiträge zur Kenntnis der südafrikanischen Diatomeenflora. III. Diatomeen aus der Kaap-Provinz. Revista de Biología, Vol. 3: 1—80. — CHOLNOKY, B. J. 1963, Beiträge zur Kenntnis des marinen Litorals von Südafrika. Botanica Marina, Bd. 5: 38—83. — CHOLNOKY, B. J. 1966a, Die Diatomeen im Unterlaufe des Okavango-Flusses. Nova Hedwigia, Beiheft 21: 1—102. — CHOLNOKY, B. J. 1966b, Diatomeenassoziationen aus einigen Quellen in Südwest-Afrika und Bechuanaland. Nova Hedwigia, Beiheft 21: 163—244. — CHOLNOKY, B. J. 1968, Die Diatomeenassoziationen der Santa-Lucia-Lagune in Natal (Südafrika). Botanica Marina, Vol. XI. Suppl.: 1—121. — CLEVE, P. T. 1894, Synopsis of the Naviculoid Diatoms, Pt. 1. Kongl. Svenska Vet.-Akad. Handlingar, Vol. 26, No. 2: 1—194. — CLEVE, P. T. 1895, Synopsis of the Naviculoid Diatoms. Part 2. Ibidem. Vol. 27, No. 3: 1—219. — DONKIN, A. S. 1871, The Natural History of the British Diatomaceae. Part I—III, pp. 1—74. — GIFFEN, M. H. 1963, Contributions to the Diatom Flora of South Africa. I. Diatoms of the estuaries of the Eastern Cape Province. Hydrobiologia, Vol. 21: 201—265. — GIFFEN, M. H. 1967, Contributions to the Diatom Flora of South Africa. III. Diatoms of the marine littoral regions at Kidd's Beach, near East London, Cape Province, South Africa. Nova Hedwigia, Bd. XIII: 245—292. — GIFFEN, M. H. 1969a, Marine littoral diatoms of the estuary of the Kowie River, Port Alfred, Cape Province. Nova Hedwigia, Hustedt Memorial Volume: in press. — GIFFEN, M. H. 1969b, New and interesting marine littoral diatoms from Sea Point, near Cape Town, South Africa. Botanica Marina: in press. — HAGELSTEIN, R. 1938, The Diatomaceae of Puerto Rico and the Virgin Islands. New York Academy of Sciences. Survey of Porto Rico and the Virgin Islands, Vol. 8, no. 3: 313—450. — HEIDEN, H. and R. W. KOLBE 1928, Die marinen Diatomeen der deutschen Südpolar-Expedition, 1901—1903. Deutsche Südpolar-Expedition 1901—1903, herausgegeben von Erich von DRYGALSKI, Bd. 8 (Botanik), Heft 5: 447—715. — HENDEY, N. I. 1951, Littoral Diatoms of Chichester Harbour with special reference to fouling. Journal of the Royal Microscopical Society. Series III. Vol. 71: 1—86. — HENDEY, N. I. 1964, An

- introductory account to the smaller algae of British coastal waters. Part. V. Bacillariophyta (Diatoms). Fishery Investigations. Ser. IV: 1—317. London. — HUSTEDT, F. 1930, Bacillariophyta (Diatomaceae). Die Süßwasserflora Mitteleuropas. Hrsg. v. Prof. Dr. A. PASCHER, Heft 10, Zweite Auflage: 1—466. Jena. — HUSTEDT, F. 1927—1966, Die Kieselalgen Deutschlands, Österreichs und der Schweiz, usw. Dr. L. RABENHORST's Kryptogamen-Flora, Bd. VII, Teil 1: I—XII + 1—920; Teil 2: I—XII + 1—845; Teil 3: 1—816. Jena. — HUSTEDT, F. 1939, Systematische und ökologische Untersuchungen über die Diatomeen-Flora von Java, Bali und Sumatra. Archiv f. Hydrobiol., Suppl. Bd. 15: 131—177 + 187—295 + 393—506 + 639—790, Suppl. Bd. 16: 1—155 + 274—394. — HUSTEDT, F. 1952, Neue und wenig bekannte Diatomeen II. Berichte d. Deutsch. Bot. Ges., Bd. 64: 305—315. — HUSTEDT, F. 1955, Marine Littoral Diatoms from Beaufort, North Carolina. Duke University Marine Station, Bulletin 406: 1—67, Durham, North Carolina. — HUSTEDT, F. 1957, Die Diatomeenflora des Flußsystems der Weser im Gebiet der Hansestadt Bremen. Abh. Natw. Ver. Bremen, Bd. 34: 181—440. — JANISCH, C. 1862, Zur Charakteristik des Guano's von verschiedenen Fundorten. Abh. d. Schlesischen Ges., naturw.-med. Abth., Heft 2: 1—29. — LEUDUGER-FORTMOREL, G. 1898, Diatomées marines de la côte occidentale d'Afrique: 1—41. Saint-Brieuc. — PERAGALLO, H. & M. 1897—1908, Diatomées marines de France et des districts maritimes voisines. Texte: I—III + 1—393 + I—XII + 1—48, Atlas: pl. 1—137. Grez-sur-Loing. — RABENHORST, L. 1864, Flora Europaea Algarum aquae dulcis et submarinae. Sectio I. Algae Diatomaceae complectens, usw.: 1—359. Lipsiae. — SALAH, M. M. 1952, Diatoms from Blakeney Point, Norfolk, new species and new records for Great Britain. Journ. Royal Microsc. Soc., Ser. III, Vol. 72: 155—169. — SCHMIDT, A. 1872—1959, Atlas der Diatomaceen-Kunde. Fortgesetzt durch MARTIN SCHMIDT, F. FRICKE, H. HEIDEN, O. MÜLLER und F. HUSTEDT. Aschersleben und Leipzig. — SMITH, W. 1853, A synopsis of the British Diatomaceae, etc. Vol. I: I—XXXIV + 1—92, London. — SMITH, W. 1856, A synopsis of the British Diatomaceae. Vol. II: I—XIX + 1—107. London. — TAYLOR, F. J. R. 1966, Phytoplankton of the South Western Indian Ocean. Nova Hedwigia, Bd. XII: 433—476. — VAN HEURCK, H. 1880—1881, Synopsis des Diatomées de Belgique. Texte 1—235; Atlas: 1—120 pl., 1—132 pages. Anvers. — VAN HEURCK, H. 1899, Traité des Diatomées. Anvers. (Reprint 1963, Brussels).