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# FRESHWATER DIATOMS FROM GHANA

BY

NIELS FOGED



København 1966

Kommissionær: Ejnar Munksgaard



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### Synopsis

150 freshwater samples from 67 different localities in Ghana have been analyzed for contents of diatoms. The occurrence of 685 different forms of diatoms was demonstrated, belonging to 551 species and 43 genera. 135 species, 5 varieties, and 5 forms have not previously been described.

25 plates with 385 drawings of 336 different forms of diatoms have been made on the basis of the material investigated.



## PREFACE

The material which has been worked up in the present paper was collected in Ghana during the period 16/2–25/3 1961. I offer my respectful thanks to the Danish Ministry of Education for granting me leave from school work for the travels in the period 14/2–31/3 1961. Furthermore, I am greatly indebted to the Danish State Research Foundation for grants to cover the travelling expenses as well as the working up of the material brought home. The condition of success of the travels was the contacts established to the University of Ghana by the Veterinary Officer in Tamale at the time, KAY C. SCHRÖDER, and the Resident Tutor at the University of Ghana at the time, POUL BERTELSEN, M.A. Econ. The Director of the Department of Botany of the University, PROFESSOR F.W. SANSOME, Ph.D., not only placed laboratory and transport facilities at my disposal during my stay in Ghana, but entrusted it to his collaborator at the Department, Dr. G.W. LAWSON, Botanist, to plan a journey for me all over the country so that all more important vegetational areas would be visited. This journey was made in one of the cars of the Department with Dr. LAWSON as leader, with the permanent driver in charge of the car, and with a young Ghanese as boy and cook. Many other people contributed to securing that the journey was turned to advantage, first of all the other collaborators at the Department of Botany, but also many other university men, Africans as well as people “from abroad”. I am very much obliged to all of them as well as to the staff at the enterprises attached to the East Asiatic Company in Ghana, who in various ways lent assistance and extended hospitality to me out there, especially the Managers OLE ANDREASEN and BENT ANDERSEN, without whose assistance many practical problems would have been much more complicated and troublesome to a stranger.

Finally I offer my best thanks

To the Royal Danish Academy of Sciences and Letters

For inclusion of the paper in the *Biologiske Skrifter* of the Academy,

To the Rask-Ørsted Foundation

For defraying the expenses for translation into English and Latin,

To Lecturer GUNNAR ANDERSEN, M.A.,

For latinizing the diagnoses of new species, and

To the translator, NIELS HAISLUND, M.A.,

For translating the paper into English.

Odense, September 1964.

NIELS FOGED







## INTRODUCTION

The freshwater flora of diatoms in Ghana (The Gold Coast) has not previously been investigated, but there are a few, though not very comprehensive papers on the adjoining countries. On the countries in the west thus E. O'MEARA 1876, LEUDIGER-FORTMOREL 1898, V. ZANON 1941 a, P. GUERMEUR 1954, N. WOODHEAD & R.R. TWEED 1959, 1961, and K. MÖLDER 1962.

The flora of diatoms north of Ghana, in the Soudan and Sahara, is almost unknown. Papers by P. PETIT & H. COURTET 1906, M. AMOSSÉ 1935, R.F. BASTOW 1960, F.E. ROUND 1960, 1961, and P. MANGUIN 1962 deal with southern Sahara and Soudan and also deal with the deposits of kieselguhr found there.

The flora of diatoms in the countries immediately east of Ghana is no better known, as the only publications available are those by LEUDIGER-FORTMOREL 1898, F. HUSTEDT 1910, and F. MILLS 1932.

About the somewhat more distant areas in the eastern and southern parts of tropical Africa somewhat more is known, even though from there, too, it is mainly a question of minor papers, which often deal with the plankton flora only. The following may be mentioned: O. MÜLLER 1895, 1903, 1904, 1905, 1911, C.H. OSTENFELD 1908, 1909, F. HUSTEDT 1922, 1949 a, B.J. CHOLNOKY 1960, and K. MÖLDER 1961.

The part of Africa which at present is diatomologically best known is South Africa, as the flora of diatoms there since 1953 has been the object of intensive and fertile research headed by B.J. CHOLNOKY.

As to the African flora of diatoms north of Sahara few investigations have been published. The most important work from there is F. HUSTEDT 1953.

To sum up, it may be said that the flora of freshwater diatoms in Africa has been little investigated. The material for most investigations hitherto has been collected for other purposes. In many of the papers published so far the often very scanty material of illustrations is of rather a mediocre quality. This unfortunately not least applies to some recent works, which therefore can be of slight or no value for other investigators, as it is often impossible to use the drawings in question for an only fairly certain determination or comparison. For areas the flora of which is so little known as this, it is of the utmost importance that the drawings published are so precise as altogether possible if they are to be of value for further research.

## CLIMATE, VEGETATION, AND SOIL

The area of Ghana is 238,000 square km. The country stretches from  $4^{\circ}44'$  lat. N. (Cape Three Points on the Gulf of Guinea) to  $11^{\circ}11'$  lat. N., and from  $3^{\circ}$  long. W. to  $1^{\circ}12'$  long. E.

The climate is tropical, the country being situated in the intertropical convergence zone. The strongest meteorological elements are the maritime air masses (monsoons), which during the rainy seasons pour into the country, and the wind (harmattan) which during the dry seasons blows from the zone of high pressure over Sahara and the Soudan down over the country towards the Gulf of Guinea. Climate and weather are mainly determined by these two oppositely directed air currents. Because of the course of the coast line in the direction WSW. to ENE. from Cape Three Points to the eastern frontier of the country, we find not only the normal tropical sequence of zones as regards climate and vegetation from south to north throughout the country, but in the southern part there is also a very considerable difference between west and east. The climatic differences are most pronounced as regards precipitation and air humidity, whereas the average temperatures there as elsewhere in the country are less variable.

It is the distribution of the precipitation on the seasons and the amount of it which are especially determinative of the distribution of the vegetational types (WILLS 1962, Tables 12 and 26).

Along the coast and in the areas near the coast from Takoradi in the west to the frontier towards Togoland in the east the vegetation is very variable. In the following section about localities and samples it is denoted as Coastal Scrub and Coastal Zone (A). Along the coast itself, in the lagoon region proper, there is a beach and lagoon vegetation where the edaphic conditions are of particular importance for the local development of the vegetation. Within this narrow—and in some cases severed—zone there is between Takoradi and Accra a vegetational type which is denoted as Coastal Thicket. East of Accra this is replaced by a more drought-stricken type: Coastal Grassland, which towards the east continues to the region around the delta of the river Volta. The precipitation in this area (A) is about 90–80 cm. a year.

West of Takoradi a forest zone reaches right down to the coast. From there it continues about 250–275 km. northwards into the country to the region immediately south of the town Wenchi. The forested area from there narrows towards the south-east along a line to the region N.–NE. of Accra. Between the localities Tafo and Ajena



the dominant vegetational type is Guinea savannah, but northeast of Ajena—in the mountainous regions in the east towards Togoland—the greater precipitation again conditions a forested region.

There are two main types of forest in Ghana: Rain Forest (B) and Semideciduous Forest (C and E). The Rain Forest is limited to a minor part of the country, the southwesternmost part, where the annual precipitation on an average amounts to 300–175 cm. 50–75 km. from the coast it is replaced by a Semideciduous Forest, which can hold its own in regions with an average annual precipitation of 175 to 125 cm.

In areas with less than 125 cm. annual precipitation—this applies to most of the country, the whole of the central and northern part—spreads the Guinea savannah, mostly very rich in trees (D). Farthest northeast, where the annual precipitation can drop to 50–100 cm., there are smaller areas with a type of savannah poorer in trees, the Soudan savannah.

Along the rivers, especially the perennial ones, forested areas of very different extent and kind are often found.

There is a certain coincidence between vegetational areas and geological conditions. The Guinea savannah area in the central and northern regions of the country thus roughly coincides with the distribution of the Early Palaeozoic Voltaian formation, the sandstone, shale, mudstone, conglomerates, and tillite of which form a large plateau with an average height of about 200–300 m. above sea level. The deposits of this formation are not or only slightly folded.

In the forested regions in the southwest and east there are mainly Pre-Cambrian rocks, which are often highly transformed. Most widely distributed are quartzites, phyllites, schist, as well as arkose and sandstone. They are greatly folded, which conditions the much more undulating and mountainous forms of terrain there.

In the triangle Ajena-Accra-Keta in the southeast, where the Guinea savannah approaches the coast, there is an area with Tertiary deposits, mainly limonite sandstone, sandy clay, and gravel, which in the regions near the coast, at Ada-Keta, are overlain by quite young, recent deposits: clay, sand, and gravel.

The regions farthest north, thus a fairly large area in the northwest and the Soudan savannah area in the northeast, are mainly based on Pre-Cambrian granite.

Everywhere where there has been no deposition of gravel, sand, and clay from rivers or stagnant water in recent times, the surface consists of some laterite type. These types form a weathering crust, the mostly reddish or brownish colours are very prominent, especially in the dry season when the vegetational cover is smallest. This crust can be of a very changing thickness, and in many places it is stated to reach a depth of 20–30 m.

At the formation of laterite the soluble original components of the rocks, first of all the alkalis, but also some  $\text{SiO}_2$ , have disappeared, and what is left is a more or less firm crust with a considerable content of hydroxides.

We have available some measurements of pH at the surface of the ground and from this down to depths of 2–3 m. from forested regions as well as a surface richer

in humus, and from savannah regions with soils poor in humus (WILLS 1962, Tables 4 and 5). It appears from these that pH at the surface of the ground in forest as well as savannah usually varies between 5.5 and 7.0. Mostly pH seems to have values between 6.0 and 6.5.

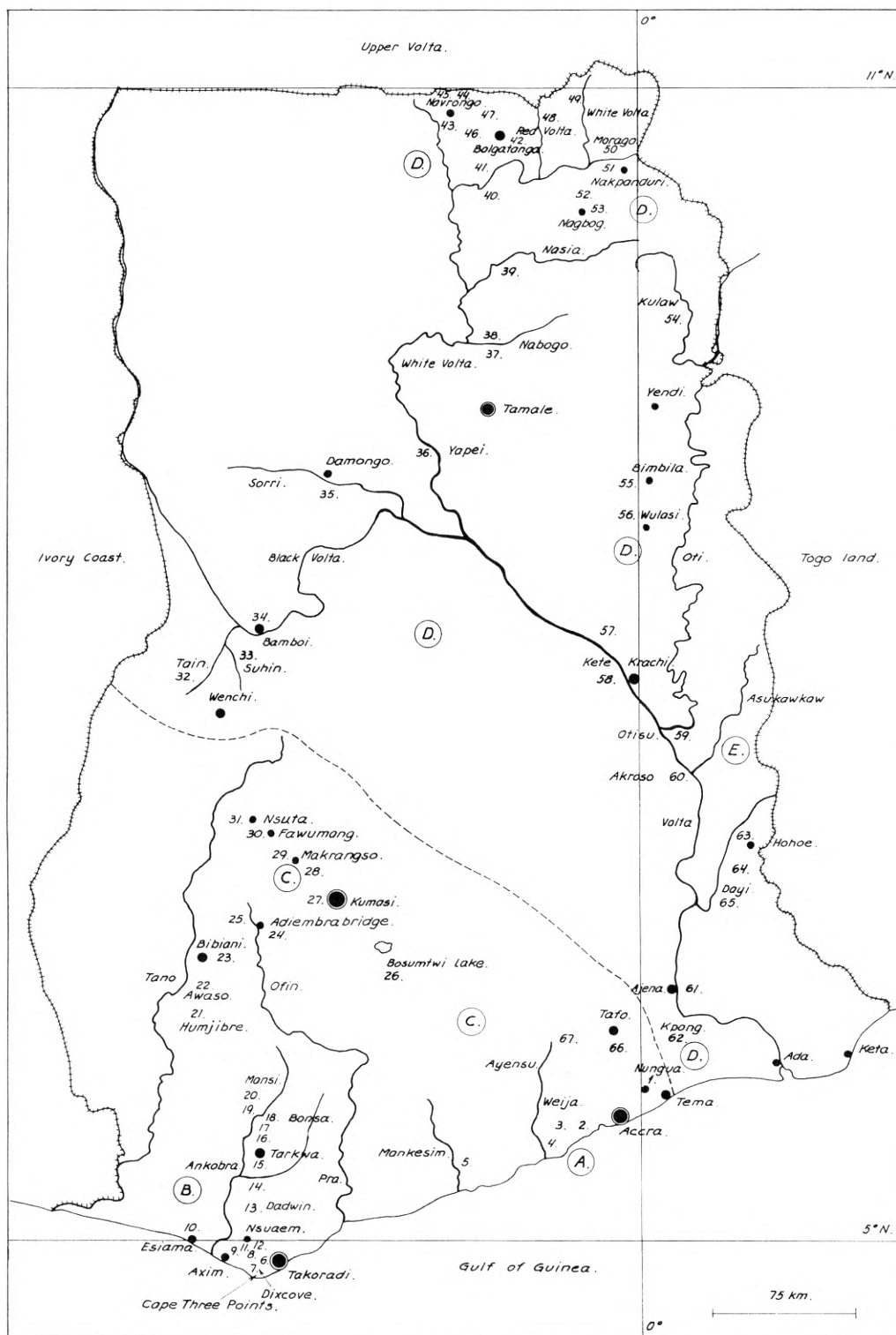
The line Wenchi–Ajena (NW.–SE.) constitutes an approximate boundary between areas rich and areas poor in precipitation, between forest and savannah, and between Pre-Cambrian deposits and the Voltaian formation. It also denotes an orographical boundary, a more or less pronounced escarpment, the divide between the Volta river system and the other much smaller river systems running towards the southwest. The flow of water in all rivers, even in the rain forest, is highly alternating from rainy season to dry season, so that only the main rivers and the larger tributaries are water-bearing the whole year, while the smaller tributaries either dry up completely in the dry season or are reduced to larger or smaller pools in the often deeply cut-down river valleys.

The only large freshwater lake proper in the country is Bosumtwi Lake, southeast of Kumasi in the Ashanti country. It is nearly circular, with a size stated to be from 35 to 100 square km. Its banks are very steep, the highest point at the edge being about 500 m. above the surface of the water. The maximum depth is said to be about 70 m. and the bottom of the lake is supposed to go down to some 10 m. above sea level. There is no inflow proper, nor any outlet. The lake and its nearest surroundings are the only region in Ghana which is without any direct outlet to the sea. Still it is a pronounced freshwater lake. Its surface is stated at present to rise by about 30 cm. per year. Several terraces at its edge suggest a previously higher water level, presumably during the pluvial periods of the Quaternary Era. It is supposed to be a caldera (explosion crater). The natural conditions are still little known, as more detailed investigations have been hampered by the aversion of the neighbouring, rather dense population to them. The lake is considered to be sacred and is worshipped as such.

In other places in the country there are smaller, generally very shallow lakes, pools and marshy areas, which in the dry season often dry up completely. New water biotopes are in process of formation in connexion with the digging of ponds for use at irrigation, watering of cattle, and supply of water for the population. Such ponds are especially found in the southern, densely populated part of the country, or farthest north in the also rather densely populated Bolgatanga region.

In the coastal area there are salt- and brackish water lagoons, a number of which are of rather a considerable size.





Map of Ghana.

The figures 1-67 denote the localities from which material is mentioned in the paper. A-E: vegetation areas.

## LOCALITIES AND SAMPLES

In the following list of the localities these are placed in five groups according to area of the macro-vegetation. The list is arranged as follows: the areas near the coast (A. Coastal Scrub and Coastal Zone), Rain Forest (B), Semideciduous Forest (C), Guinea Savannah (D), and finally Semideciduous Forest (E) in the eastern part of the country.

The distribution of localities and samples then will be as follows:

	Localities Nos.	Samples (Number)
A. Coastal Scrub and Coastal Zone . . . .	1-5	14
B. Rain Forest . . . . .	6-17	32
C. Semideciduous Forest (West) . . . . .	18-31	33
D. Guinea Savannah . . . . .	32-62	60
E. Semideciduous Forest (East) . . . . .	63-67	11
In all . . .	67	150

A brief characterization is given of each locality and sample. The number of forms of diatoms and the number of genera found to occur in the sample are counted for each sample. The genera represented by most species in the sample are also mentioned, in the way that the genera with most species occurring are mentioned first. The forms from the sample which have been pictured are indicated by numbers of plates and figures.

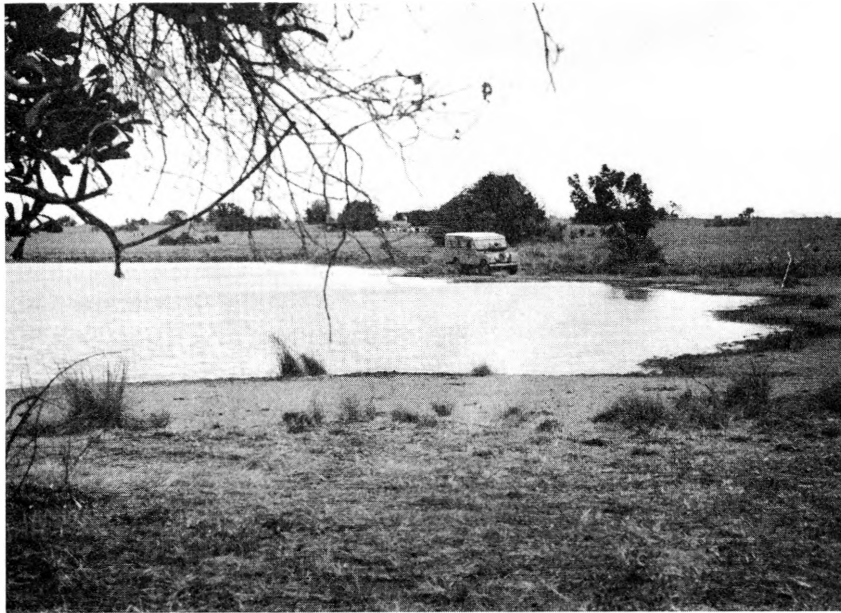
The situation of all localities is indicated on the map fig. 1 by the number of the locality.

### A. Coastal Scrub and Coastal Zone

Locality No. 1 (20.II.1961).

Nungua University Farm, northeast of Accra.

- a. Cattle pool: shallow, natural depression filled with water, 200×50 m. Greenish, opaque water, which was highly polluted by cattle grazing in the neighbourhood. Sample No. 33: withered stems of *Juncus*. 58 species from 15 genera (*Navicula*, *Nitzschia*, *Pinnularia*).



Cattle pool at Nungua Farm (University of Ghana), east of Accra. Coastal scrub and grassland with *Euphorbia* shrubs and trees. – Loc. No. 1. (20.II.1961). (All the pictures taken by Niels Foged in 1961).

*Navicula nunguaensis* X: 5, *N. hungarica* XV: 14, *Gomphonema wulsiense* var. *nunguaensis* XXI: 9, *Nitzschia nunguaensis* XXI: 16, *Pinnularia dubitabilis* XVIII: 8.

b. Large Pond. Artificial, made by the construction of a dam across a shallow valley.

Sample No. 34: small green lump of algae and scrapings from the soil, both from the edge of the pond. 48 species from 17 genera (*Navicula*, *Nitzschia*, *Pinnularia*). Common: *Diploneis ovalis*, *Gyrosigma spencerii*, *Nitzschia sigma*. *Navicula mutica* var. *cohnii* XI: 19.

Sample No. 35: crusts on cement wall at the locks in the dam.

*Navicula demissa* IX: 5.

Sample No. 36: scrapings from stones and slimy coating from the bank of the pond near the locks. Zone of *Phragmites* and reed swamp of *Typha*. 46 species from 17 genera (*Navicula*, *Nitzschia*).

Sample No. 37: foam and coating on the sandy beach near No. 36. 47 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*). Very common: *Diploneis ovalis*, *Melosira granulata* var. *angustissima*.

*Navicula mutica* var. *cohnii* forma XI: 13, *N. auriculata* XI: 1.



## c. Fishpond, artificial, near Large Pond.

Sample No. 39: coatings on stems and leaves of *Phragmites*. 13 species from 9 genera (*Nitzschia*, *Pinnularia*).

*Pinnularis nunguaensis* XVII: 1, *P. nunguaensis* forma XVII: 2, *Caloneis macedonica* VI: 3.

## Locality No. 2 (25.II.1961).

Weija Waterworks, west northwest of Accra.

Large basin: formed by the construction of a dam across a shallow river valley.

Sample No. 69: scrapings from the cement sides of the basin. 58 species from 21 genera (*Navicula*, *Neidium*, *Pinnularia*, *Surirella*).

Sample No. 70: *Azolla* sp. and scrapings from the ground beside the edge of the basin.

79 species from 19 genera (*Gomphonema*, *Navicula*, *Nitzschia*, *Pinnularia*). Very common: *Achnanthes hungarica* (from *Azolla*), *Pleurosigma subsalsum*, *Thalassiosira fluviatilis*.

*Eunotia tschirchiana* I: 18, 19. *E. bisulcatum* var. *baicalensis* VI: 9, *Navicula insociabilis* XI: 2, *Gomphonema farakulumense* XXI: 10.

Sample No. 72: scrapings from the edge of the basin. 45 species from 14 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Pinnularia*). With *Gomphonema wulasiense* var. *voltaensis* and var. *nunguaensis*.

## Locality No. 3 (25.II.1961).

The Densu river at a village south of Weija.

Sample No. 73: Scrapings from rock surface beside the river bank. The water in the river completely covered by leaf rosettes from *Pistia* sp. 99 species from 19 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*, *Gomphonema*). Fairly common: *Pleurosigma subsalsum*.

*Navicula densuensis* XII: 7, *Nitzschia densuensis* XXIV: 9, *Caloneis vehemens* VI: 1, *Navicula omissa* IX: 6, *N. seminulum* X: 9, *N. pseudofaceta* X: 18, *Pinnularia braunii* XVI: 15, *Nitzschia paleaeformis* XXIII: 12, *N. obtusa* var. *scalpelliformis* XXIV: 4.

## Locality No. 4 (7.III.1961).

## a. Pond in the river bed near the Ayensu river, about 45–50 km. west of Accra.

Sample No. 112: scrapings from branches in the pond. Water undoubtedly polluted from neighbouring village. 59 species from 20 genera (*Navicula*, *Nitzschia*,



Weija Waterworks, northwest of Accra. Pond. Coco-palms. Coastal scrubs and grassland. – Loc. No. 2.  
(25.II.1961).



The Densu river west of Accra. Pool in the river bed, which is covered by leaf rosettes of *Pistia*. – Loc. No. 3.  
(25.II.1961).

*Pinnularia*). Fairly common: *Bacillaria paradoxa*, *Thalassiosira fluviatilis*, and *Navicula perotetti*.

*Cyclotella meneghiniana* I: 4, *Navicula quadripartita* XIV: 3, *Nitzschia mankesimensis* XXI: 17, *N. lawsonii* XXII: 13.

- b. The Ayensu river, east of the village Mankesim, 65–70 km. west of Accra.

Sample No. 107: scrapings from largish tree trunk in running water in the river. 36 species from 16 genera (*Navicula*, *Nitzschia*).

Common: *Nitzschia punctata* var. *coarctata*. Fairly common: *Biddulphia levis*. Also in this sample: *Thalassiosira fluviatilis*.

*Amphora ayensuensis* XIX: 7, *Pinnularia* sp. XVIII: 9.

Sample No. 108: scrapings from clay on the river bank. 54 species from 19 genera (*Navicula*, *Nitzschia*). With *Biddulphia levis*, *Thalassiosira fluviatilis*, and *Navicula perotetti*.

Locality No. 5 (7.III.1961).

The Amisa river near the village Mankesim.

Sample No. 111: scrapings from clayey bottom and branches in slowly running water. The clayey bottom covered by fine air bubbles, but no visible layer of algae. 54 species from 17 genera (*Navicula*, *Nitzschia*, *Pinnularia*).

*Pinnularia mankesimensis* XVIII: 10, *Nitzschia amisaensis* XXI: 15.

## B. Rain Forest

Locality No. 6 (8.III.1961).

- a. River 1 west of Takoradi with clear, running water.

Sample No. 114: scrapings from stones in the river bed and from cement wall on bridge across the river. 39 species from 14 genera (*Navicula*, *Nitzschia*, *Amphora*). Common: *Cymbella cesatii*.

*Cymbella takoradiensis* XX: 5, *Nitzschia apowaensis* XXIV: 7, *N. towutensis* XXIV: 11, *Navicula mutica* var. *cohnii* X: 30, *N. inserta* var. *undulata* XI: 20, *N. costulata* XV: 15, *Nitzschia syrachii* XXII: 12.

- b. River 2 west of Takoradi with fairly clear, running water.

Sample No. 115: scrapings from stones in the river bed. 66 species from 21 genera (*Navicula*, *Nitzschia*). Common: *Achnanthes ankobraensis*. In the sample: *Terpsinoë musica*.

Sample No. 116 a: withered leaves with coatings from the bottom of the river. 58 species from 22 genera (*Navicula*, *Nitzschia*, *Achnanthes*).

With *Biddulphia levis* and *Tropidoneis* sp.





River west of Takoradi in Rain Forest. Bamboo and oil palms. – Loc. No. 6 a. (8.III.1961).



River west of Takoradi. Oil palms, etc. – Loc. No. 6 b. (8.III.1961).

Sample No. 116 b: moss from cement wall in bridge across the river. 47 species from 13 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Eunotia*, *Gomphonema*). Common: *Achnanthes lanceolata* and var. *rostrata*. Rather common: *Navicula seminuloides*, *N. submolesta*. Also with *Biddulphia levis*.  
*Navicula butreensis* IX: 11.

Locality No. 7 (8.III.1961).

Minor pond in Dixcove Rubber Plantation.

Sample No. 118: Floating masses of algae between *Nymphaea* sp. 30 species from 14 genera (*Navicula*, *Pinnularia*, *Nitzschia*). Common: *Navicula towutiensis*.  
*Navicula towutiensis* XII: 15.

Locality No. 8 (8.III.1961).

- a. Minor stream in the rain forest between Takoradi and Axim.

Sample No. 119: scrapings from dead branches from the stream. 50 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*).

Very common: *Achnanthes minutissima*. Furthermore: *Caloneis schroederi*, *Nitzschia perversa*, and *Tropidoneis* sp.

*Surirella takoradiensis* XXV: 4, *Navicula feuerborni* fo. *africana* XVI: 2, *Caloneis schroederi* VI: 2.

- b. Small river between Takoradi and Axim with fairly clear and fast running water.

Sample No. 121: scrapings from stones in the river. 44 species from 15 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Neidium*, *Gomphonema*).

*Navicula finitum* XII: 2, *N. constans* var. *symmetrica* XIV: 7.

Sample No. 122: green algae and mosses from the river bed. 62 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Gomphonema*, *Eunotia*).

*Navicula bansoensis* XIV: 4, *N. feuerborni* XVI: 1, *Pinnularia takoradiensis* XVI: 13.

Sample No. 123: scrapings from stones in the river bed. 88 species from 25 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Stauroneis*, *Surirella*).

*Nitzschia abraensis* XXII: 7, *N. ghanaensis* XXIV: 15, *Navicula submolesta* X: 4, *N. exiguiformis* (?) XIV: 14.

Sample No. 124: mosses from stones in the river bed. 37 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Achnanthes*).

*Navicula abraensis* XV: 12.

Sample No. 125: green algae from the river bed. 79 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*). *Navicula perotetti* is not rare, and *Tropidoneis lepidoptera* var. *proboscidea* has also been found in this sample.

*Eunotia tarkwaensis* II: 5.

## Locality No. 9 (8.III.1961).

River near Axim (east of the town).

Sample No. 127: scrapings from stones, and green algae from the river bed. 79 species from 23 genera (*Navicula*, *Nitzschia*, *Cymbella*, *Gomphonema*, *Neidium*, *Pinnularia*, *Surirella*).

## Locality No. 10 (8.III.1961).

Pool in meadow between Esiam and Nkrofo.

Sample No. 131: *Chara* sp. from rather a dense growth in the pool. Only 13 species from 8 genera. *Navicula cryptocephala* common. *Eunotia trigibba* I: 20, *E. similis* III: 10.

## Locality No. 11 (9.III.1961).

- a. Small stream between Abra and Tomento, west of Takoradi.

Sample No. 132: scrapings from stones from the bottom of the river and from the sides of a cement bridge. 44 species from 21 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Pinnularia*).

- b. Small stream in bamboo scrub between Abra and Tomento.

Sample No. 133: green algae and scrapings from stones in the river bed. 70 species from 22 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Synedra*, *Gomphonema*, *Achnanthes*).

*Eunotia asymmetrica* I: 14, *Pinnularia tomentoensis* XIX: 3.

Sample No. 135: green algae from clear, almost stagnant water by the river bed. 76 species from 25 genera (*Navicula*, *Eunotia*, *Nitzschia*, *Pinnularia*, *Gomphonema*, *Cymbella*). Very common: *Cymbella kolbei*. Fairly common: *Anomoeoneis exilis* var. *lanceolata*. *Stauroneis nobilis* var. *alabamae* has also been found in this sample.

*Nitzschia vedelii* XXII: 5, *N. subvitrea* var. *capensis* XXIII: 2.

- c. Fairly large stream between Abra and Tomento. The water almost clear and almost stagnant.

Sample No. 136: scrapings from a large tree trunk (old, rotting) in the river bed. 72 species from 26 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Caloneis*, *Amphora*). *Frustulia weinholdi* fo. *ghanaensis* V: 1, *Navicula aketechiensis* X: 33, *Nitzschia aketechiensis* XXII: 2, *N. pretoriensis* XXII: 1, *Navicula consentanea* X: 7, *N. rotunda* X: 16, *N. obstinata* XI: 5, *Amphora luciae* XIX: 9, *Nitzschia irresoluta* fo. *minor* XXIV: 10.



## Locality No. 12 (9.III.1961).

Streams between the villages Agona and Nsuaem.

## a. Small stream in bamboo scrub.

Sample No. 141: scrapings from the bottom of the stream. 77 species from 23 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*, *Achnanthes*). Common: *Frustulia weinholdi*, *Nitzschia sigma*, *Navicula lagerheimii*. Fairly common: *Tropidoneis lepidoptera* var. *proboscidea*. Furthermore found: *Amphiprora gigantea*. *Neidium agonaense* VI: 11, *N. nsuaemense* VI: 12, *Surirella agonaensis* XXV: 3, *Navicula vitabunda* IX: 13, *N. longicephala* XVI: 8.

## b. Small stream, stagnant water.

Sample No. 142: *Cyanophyceae* coatings. 96 species from 21 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Stauroneis*, *Eunotia*). Common: *Navicula cryptocephala* var. *intermedia*. *Pinnularia nsuaemensis* XVI: 14, *N. zanoni* XV: 2.

## c. Small stream with slowly flowing, clear water.

Sample No. 143: green algae and scrapings from the bottom of the river. 86 species from 21 genera (*Eunotia*, *Navicula*, *Pinnularia*, *Surirella*, *Gomphonema*). Fairly common: *Anomoeoneis exilis* and var. *lanceolata*.

Sample No. 144: green algae from the river bed. 97 species from 24 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*, *Gomphonema*, *Surirella*, *Stauroneis*). *Stauroneis slateri* VII: 3, *Nitzschia bansoensis* XXII: 4, *Surirella esamangensis* XXV: 2, *Navicula manguini* XV: 3, *N. pseudolagerstedtii* XVI: 6, *Amphora fontinalis* XIX: 10.

## d. Small stream without running water.

Sample No. 145: scrapings from cement side of bridge across the stream. 70 species from 22 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*, *Surirella*). Common: *Navicula contenta* fo. *biceps*. *Eunotia oliffii* III: 5, *Navicula quadripartita* XIV: 1, *Pinnularia* sp. XVIII: 6, *Nitzschia lorenziana* var. *subtilis* XXIV: 6.

## Locality No. 13 (9.III.1961).

Streams in or near the village Dadwin.

## a. Stream in Dadwin with stagnant, very turbid water in pools in the river bed.

Sample No. 147: coatings on withered palm leaves in pools. 52 species from 22 genera (*Navicula*, *Nitzschia*, *Surirella*, *Gomphonema*). Very common: *Navicula rhynchocephala*. *Cymbella dadwinensis* XX: 3.

Sample No. 149: scrapings from sides of cement bridge across the stream. 55 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Stauroneis*, *Gomphonema*). Common: *Navicula submolesta* and *N. invicta*.

*Nitzschia dadwinensis* XXIII: 10, *Navicula invicta* VIII: 19, *N. submolesta* (?) X: 2.

b. Very small stream near Dadwin with "milky", stagnant water in pools.

Sample No. 150: green algae and scrapings from cement sides of bridge. 83 species from 24 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Gomphonema*). Common: *Bacillaria paradoxa*. Also *Ceratoneis arcus*.

*Pinnularia polygonca* XVIII: 1, *P. suchlandti* XIX: 5.

Locality No. 14 (9.III.1961).

The Bonsa river.

Tributary to the Ankobra river. Large river abounding in water, with rocky bottom and sides, south of the town Tarkwa.

Sample No. 151: scrapings from old tree trunks in the river. 74 species from 25 genera (*Navicula*, *Eunotia*, *Nitzschia*, *Gomphonema*, *Surirella*). In this sample: *Neidium ladogensense* var. *densestriata*.

*Eunotia bonsaensis* III: 7, *Neidium affine* var. *bonsaensis* VI: 5, *Surirella bonsaensis* XXV: 1, *Eunotia epithemioides* II: 8, *Stauroneis wislouchii* VII: 10, *Pinnularia mesolepta* XVI: 16.

Sample No. 152: scrapings from surface of rock beside the river bank. 84 species from 21 genera (*Navicula*, *Nitzschia*, *Eunotia*, *Achnanthes*, *Pinnularia*, *Gomphonema*, *Stauroneis*, *Surirella*). Very common: *Navicula cryptocephala*, *Cocconeis ankobraensis*.

*Eunotia tarkwaensis* II: 7, *Pinnularia acoricola?* XVII: 11, *P. obscura* XVIII: 7.

Locality No. 15 (9.III.1961).

Pools in marshy area about 9 km. south of the town Tarkwa.

a. Pool 1 with *Nymphaea* sp.

Sample No. 153: floating masses of algae. 45 species from 14 genera (*Navicula*, *Pinnularia*, *Eunotia*, *Nitzschia*). Common: *Anomoeoneis exilis*.

*Pinnularia braunii* XVI: 11.

b. Pool 2 with *Nymphaea* sp.

Sample No. 154: floating masses of algae. 34 species from 15 genera (*Navicula*, *Eunotia*, *Pinnularia*). Very common: *Anomoeoneis exilis* and *Frustulia rhomboides* var. *saxonica*.

*Cymbella raytonensis* XX: 10.



River north of Tarkwa in Rain Forest. *Musanga* branch on the left in the river. – Loc. No. 17. (10.III.1961).

Locality No. 16 (10.III.1961).

Roadside ditch, 3–4 km. north of the town Tarkwa, with fast running, fairly clear water.

Sample No. 155: coatings on vegetation in the ditch. 57 species from 18 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*). Fairly common: *Navicula ammophila*, *Nitzschia closterium*, and *Anomoeoneis exilis*.

*Pinnularia acoricola* (?) XVII: 6.

Locality No. 17 (10.III.1961).

The Huni river, 12–13 km. from the town Tarkwa, with fast running, clear water.

Sample No. 157: scrapings from stones in the river bed. 75 species from 20 genera (*Navicula*, *Nitzschia*, *Surirella*, *Achnanthes*, *Gomphonema*, *Pinnularia*, *Cocconeis*). Very common: *Navicula salinarum*.

*Navicula huniensis* X: 1, *N. ingoldii* XII: 3, *Nitzschia huniensis* XXIV: 17, *Navicula submolesta* X: 3, *N. iniqua* X: 24, *N. decussis* XVI: 5.

Sample No. 158: scrapings from rock in the river bed near the place where No. 157 was taken. 57 species from 20 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Cymbella*, *Achnanthes*, *Eunotia*).



### C. Semideciduous Forest (West)

Locality No. 18 (10.III.1961).

Small streams 15–35 km. north of the town Tarkwa.

- a. Smallish stream 15–20 km. north of Tarkwa. The water slightly “milky”.

Sample No. 159: green algae from stones in the stream. 85 species from 22 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Pinnularia*, *Surirella*). Fairly common: *Navicula grimmei* var. *rostellata*.

*Caloneis voltaensis* var. *tarkwaensis* V: 5, *Navicula perlucida* VIII: 18, *N. lagerheimii* XI: 9, *N. ancisa* (?) XI: 16.

Sample No. 160: crusts of *Cyanophyceae* on stones in the stream. 64 species from 16 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Achnanthes*, *Cymbella*).

- b. Small stream 25 km. north of Tarkwa. Slightly “milky” water.

Sample No. 161: green algae from bottom and sides. 41 species from 19 genera (*Navicula*, *Nitzschia*). Very common: *Navicula confervacea*. In this sample also *Bacillaria paradoxa* and *Tropidoneis* sp.

*Diploneis pseudovalis* IV: 9, *Navicula confervacea* XII: 6.

- c. Small ditch 30–35 km. north of Tarkwa. Stagnant water.

Sample No. 163: coatings on leaves in the ditch. 54 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Gomphonema*).

*Neidium hercynicum* fo. *bogosoensis* VI: 6, *Pinnularia bogosoensis* XIX: 1, *Cocconeis feuerborni* IV: 11, *Navicula bannajensis* (?) XII: 4, *N. quadripartita* XIV: 2, *N. bicephala* XVI: 7.

Locality No. 19 (10.III.1961).

- a. The river Mansi, about 45 km. north of the town Tarkwa. Abounding in fast running, clear water.

Sample No. 165: scrapings from stones on the bottom of the river. 78 species from 21 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Cymbella*, *Eunotia*, *Gomphonema*). *Eunotia lawsonii* III: 12, *Navicula bawdiaensis* X: 26, *Pinnularia mansiensis* XVIII: 5, *Navicula thienemanni* IX: 8, *N. nyassensis* IX: 14, *N. seminuloides* X: 14, *N. minima* X: 22.

Sample No. 166: scrapings from old, rotten tree trunk in the river. 69 species from 23 genera (*Navicula*, *Achnanthes*, *Amphora*, *Cymbella*, *Eunotia*). Common: *Achnanthes ankobraensis*. Also with *Biddulphia levis*.

*Achnanthes mansiensis* IV: 3, *Cymbella ankobraensis* XIX: 11, *Eunotia mansiensis* II: 4, *Cymbella theronii* XX: 6, *Navicula mansiensis* XI: 3.



The Mansi river north of Tarkwa in Semideciduous Forest. – Loc. No. 19 a. (10.III.1961).

- b. Small tributary to the Mansi river. No running water. Small pools in the river bed with turbid water.

Sample No. 167: floating cakes of *Cyanophyceae* and scrapings from old tree trunk in pool. 56 species from 19 genera (*Achnanthes*, *Gomphonema*).

Locality No. 20 (10.III.1961).

Marsh near the Ankobra river, about 7 km. west of the town Bawdia. Dried-up bottom of pool.

Sample No. 168: scrapings from clayey surface at the bottom of the pool. 63 species from 21 genera (*Navicula*, *Nitzschia*, *Pinnularia*). With *Stauroneis schinzii*.

*Cocconeis ankobraensis* IV: 8, *Amphora mansiensis* XX: 1, *Eunotia rabenhorsti* fo. *monodon* I: 15, *Caloneis incognita* V: 2, 6.

Locality No. 21 (10.III.1961).

River near the town Humjibre. Little and only slowly flowing water.

Sample No. 170: scrapings from the bottom of the river. 58 species from 19 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Amphora*). In this sample *Bacillaria paradoxa*

and *Thalassiosira fluviatilis*. Fairly common: *Achnanthes pinnata*, *Navicula pupula* var. *elliptica* and *N. exigua* var. *signata*.  
*Achnanthes pinnata* III: 15.

Sample No. 171: green algae from the bottom of the river. 58 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*). In this sample *Biddulphia levis*, *Thalassiosira fluviatilis*, *Nitzschia closterium*, *Hantzschia distincte-punctata*.  
*Navicula humjibreensis* XV: 8, *N. schweickerdti* XI: 6, *N. exigua* var. *signata* XIV: 10, *Cymbella aspera* var. *bengalensis* XX: 8, *Cyclotella meneghiniana* I: 8, *Cocconeis schröderii* IV: 7, *Hantzschia distincte-punctata* XXII: 3.

Locality No. 22 (11.III.1961).

- a. Fairly large river, 3–4 km. north of the town Awaso. The water very turbid, stagnant.

Sample No. 172: scrapings from the bottom. 57 species from 19 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Amphora*).  
*Navicula ankobraensis* VIII: 10, *Achnanthes pinnata* III: 14.

- b. Small river, 6–7 km. north of Awaso. No running water.

Sample No. 173: scrapings from dead branch in the river bed and from cement side of bridge across the river. 69 species from 20 genera (*Navicula*, *Nitzschia*). Fairly common: *Cocconeis subdirupta*. Furthermore: *Bacillaria paradoxa*, *Thalassiosira fluviatilis*, *Gomphocymbella ruttneri*.  
*Navicula asanwinsoensis* XIV: 15, *N. bannajensis* XII: 5, *N. dugaensis* X: 27, *Cocconeis subdirupta* IV: 4, *Nitzschia ovalis* XXI: 12.

- c. Small river, 10–11 km. north of Awaso. No running water.

Sample No. 175: scrapings and moss from cement side of bridge across the river. 74 species from 19 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Pinnularia*, *Surirella*). In this sample *Terpsinoë musica*, *Gomphocymbella ruttneri*.

Locality No. 23 (11.III.1961).

- a. Small stream about 3 km. north of the town Bibiani. Little and very slowly flowing water.

Sample No. 178: Flakes of *Cyanophyceae*. 34 species from 14 genera (*Navicula*, *Nitzschia*). Common: *Neidium gracile*. Also with *Diatomella balfouriana*.  
*Neidium gracile* fo. *aequalis* VII: 1.

- b. Small stream about 4 km. north of Bibiani. No running water. Small pools in the river bed, with *Typha* sp. and *Nymphaea* sp.

Sample No. 180: green algae from stems and leaves. 38 species from 12 genera (*Navicula*, *Pinnularia*, *Gomphonema*, *Nitzschia*, *Achnanthes*). With *Frustulia weinholdi*.

*Navicula tranciloba* X: 19.

Sample No. 181: green algae from withered leaves and stems of *Typha* and *Nymphaea* in another pool near the place where No. 180 was found. 41 species from 17 genera (*Navicula*, *Pinnularia*, *Amphora*, *Gomphonema*).

*Stauroneis subdahomensis* VII: 9. *S. tropicalis* var. *undulata* VII: 16, *Pinnularia gibba* var. *sancta* XVII: 9, *Nitzschia closterium* XXIV: 14.

Locality No. 24 (11.III.1961).

Small stream 31–32 km. northeast of Bibiani. Little and slowly flowing water.

Sample No. 185: flakes of *Cyanophyceae*. 58 species from 21 genera (*Pinnularia*, *Nitzschia*, *Achnanthes*, *Amphora*). Very common: *Navicula cryptocephala*. Here also *Thalassiosira fluviatilis*.

*Pinnularia agoensis* XVII: 7.

Locality No. 25 (11.III.1961).

The Ofin river at Adiembra bridge. Little or slowly flowing water.

Sample No. 186: Flakes of *Cyanophyceae*. 51 species from 16 genera (*Navicula*, *Achnanthes*, *Gomphonema*, *Pinnularia*). Common: *Cocconeis diminuta*. In this sample also *Cymatopleura solea* and *Thalassiosira fluviatilis*.

*Nitzschia adiembraensis* XXIV: 2, *N. ofinensis* XXIV: 12, *N. palea* var. *dubia* XXIII: 11, *Navicula seminuloides* X: 13, *N. lagerheimii* var. *intermedia* XI: 8.

Locality No. 26 (11.III.1961).

Bosumtwi Lake (see p. 8).

Sample No. 188: scrapings from tree trunk floating near the edge of the lake. 14 species from 8 genera (*Navicula*, *Nitzschia*).

*Navicula carstensenii* XIV: 11.

Sample No. 189: green algae floating near the edge of the lake. 31 species from 13 genera (*Navicula*, *Nitzschia*).

*Nitzschia bosumtwiensis* XXIII: 13.

Sample No. 190: scrapings of dead branches found on the bottom of shallow water near the edge of the lake. 20 species from 10 genera (*Navicula*, *Nitzschia*).

Sample No. 192: coatings on sand from shallow water at the edge of the lake. 35 species from 20 genera (*Navicula*, *Nitzschia*). Very common: *Achnanthes exigua*. Common: *Navicula pupula*.





Bosumtwi Lake southeast of Kumasi. Plank boats at the beach. – Loc. No. 26. (11.III.1961).

*Navicula bosumtwiensis* IX: 19, *N. lawsonii* X: 6, *Anomoeoneis sphaerophora* var. *güntheri* VIII: 2, *A. sphaerophora* forma VIII: 3.

Sample No. 193: rootlets of *Bambusa*, *Typha*, and *Scirpus* from shallow water at the edge of the lake. 19 species from 9 genera (*Navicula*, *Nitzschia*, *Cymbella*). Very common: *Gomphonema lanceolatum* var. *insignis*. Common: *Anomoeoneis sphaerophora* (+ var.), *Navicula subrhynchocephala*, *N. pupula* var. *capitata*, and *Nitzschia frustulum* var. *perpusilla*.  
*Cymbella mülleri* XX: 11.

Sample No. 194: small pool on flat (terrace) at the edge of the lake. Withered leaves with coatings. Slight oozing out of water in the side of the pool. 69 species from 23 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Gomphonema*, *Stauroneis*). With *Diatomella balfouriana*, *Meridion circulare*, and *Ceratoneis arcus*.  
*Navicula abonuenensis* XI: 4, *Caloneis bosumtwiensis* XVII: 4, *Nitzschia abonuenensis* XXII: 8, *Fragilaria leptostauron* forma I: 10, *Stauroneis borrichii* VII: 8, *Navicula tantula* (?) X: 11.

Locality No. 27 (12.III.1961).

- a. Roadside ditch 4–5 km. west of the town Kumasi. Little and slowly flowing water.  
Sample No. 195: filter of green algae from the ditch. 33 species from 12 genera (*Eunotia*, *Pinnularia*, *Navicula*, *Neidium*, *Nitzschia*, *Gomphonema*). Common:

*Frustulia rhomboides* var. *saxonica*, *Navicula cryptocephala* var. *veneta*, *Pinnularia microstauron*, *P. braunii* var. *amphicephala*. In this sample also *Meridion circulare*.

*Pinnularia interrupta* fo. *jaculata* XVI: 10.

b. Small stream 13–14 km. northwest of Kumasi with fairly fast running water.

Sample No. 196: filaments of green algae from the stream. 80 species from 21 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Achnanthes*, *Surirella*). Very common: *Achnanthes exigua*.

*Neidium kumasiense* VI: 8, *Navicula sepasiensis* XV: 4, *Nitzschia obtusa* var. *scalpelliformis* XXIV: 3.

Locality No. 28 (12.III.1961).

The Oda river, about 19–20 km. northwest of Kumasi. Fairly abounding in clear, running water.

Sample No. 198: scrapings from the bottom of the river. 83 species from 21 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Achnanthes*, *Gomphonema*, *Surirella*).

*Pinnularia odaensis* XVII: 8.

Sample No. 199: scrapings from old, rotten tree trunk and from stones in the river bed. 75 species from 20 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Gomphonema*).

Locality No. 29 (12.III.1961).

The Apropong river, tributary to the Ofin, near the village Makrangso, 28–30 km. northwest of Kumasi. No running water in the river bed, but many small pools with highly polluted water.

Sample No. 203: withered leaves with coatings from pool in the river bed. 80 species from 18 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Pinnularia*, *Gomphonema*).

*Nitzschia apropongensis* XXIV: 13, *Achnanthes kraueselii* IV: 6, *Cocconeis* sp. IV: 13, *Stauroneis crucicula* VII: 6, *Navicula seminulum* X: 10, *N.* sp. X: 15, *N. pseudographa* XI: 12, *Gomphonema brasiliense* XXI: 4, *Nitzschia ignorata* XXIV: 5.

Locality No. 30 (12.III.1961).

Small stream near the village Fawumang, about 45 km. northwest of Kumasi.

Sample No. 204: green algae from the stream. 83 species from 18 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Achnanthes*, *Stauroneis*, *Gomphonema*, *Surirella*).

*Navicula fawumangensis* XI: 17, *N. carloffii* XV: 6, *Pinnularia lawsonii* XVIII: 3, *Nitzschia svedstrupii* XXII: 14, *Surirella delicatissima* var. *ghanaensis* XXV: 9, *Navicula seminulum* X: 8, *N. pseudographa* X: 28, *N. fauta* (?) XV: 11.

Sample No. 205: green algae, etc., from the same stream near the place where No. 204 was taken. 51 species from 17 genera (*Navicula*, *Gomphonema*, *Nitzschia*, *Stauroneis*).

*Navicula chadwickii* XII: 8, *N. isertii* XII: 16, *Nitzschia ankobraensis* XXI: 13.

Locality No. 31 (12.III.1961).

- a. Smallish river course near the village Nsuta, 50–55 km. northwest of Kumasi. No running water, but some pools in the river bed.

Sample No. 207: scrapings from soil beside and in a pool. 66 species from 20 genera (*Navicula*, *Amphora*, *Achnanthes*, *Gomphonema*, *Nitzschia*, *Pinnularia*). Common: *Synedra ulna* + var. In this sample also *Biddulphia levis*, *Thalassiosira fluviatilis*.

*Navicula nsutaensis* XI: 18, *N. bertelsenii* XI: 23, *N. abuensis* XII: 10, *N. moerckii* XV: 5, *N. esamangensis* VIII: 20, *Amphora abuensis* XIX: 6, *A. crameri* XIX: 8, *Diploneis subovalis* IV: 10, *Stauroneis crucicula* VII: 7.

- b. Smallish river on the provincial border near the village Abesewa, 55–60 km. northwest of Kumasi. Rather fast running, fairly clear water.

Sample No. 210: green algae from running water in the river bed. 57 species from 19 genera (*Navicula*, *Nitzschia*). In this sample also *Cymatopleura solea* var. *rugosa* and *Surirella anassae*.

*Navicula contenta* fo. *biceps* VIII: 15, *N. ventralis* IX: 9, *Nitzschia tarda* XXIII: 1, *N. plicatula* XXIII: 3.

#### D. Guinea Savannah

Locality No. 32 (13.III.1961).

The Tain river, the Volta river system, between the villages Wenchi and Nsawkaw, 13 km. northwest of Wenchi. River fairly abounding in clear, fast running water.

Sample No. 215: scrapings from large, old, rotten tree trunk in the river. 51 species from 18 genera (*Navicula*, *Achnanthes*, *Caloneis*, *Cymbella*, *Eunotia*, *Gomphonema*). In this sample also *Biddulphia levis*, *Eunotia didyma* var. *claviculata* and var. *tuberosa*.

*Navicula kriegeri* IX: 4, *Cymbella tainensis* XX: 4, *Caloneis fasciata* V: 7, *Neidium minutissimum* VI: 10.

Sample No. 216: scrapings from cement conduit below bridge across the river near the place where No. 215 was taken. 61 species from 22 genera (*Navicula*, *Eunotia*, *Nitzschia*, *Pinnularia*). In this sample *Biddulphia levis*, *Eunotia didyma* var. *recurvata*, var. *claviculata*, and var. *tuberosa*.

*Eunotia tanosoensis* II: 9, *Nitzschia tainensis* XXIII: 14, *Cocconeis* sp. IV: 12.

Sample No. 217: *Lemna* sp. and scrapings from dead branch from the bottom of the river. 71 species from 21 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Eunotia*, *Surirella*, *Synedra*). With *Licmophora remulus*, *Synedra tabulata*, and *Gomphocymbella ruttneri*.

*Navicula tainensis* XV: 9, *N. schadei* IX: 10, *N. ammophila* XV: 13, *Eunotia didyma* fo. *genuina* II: 2, *E. didyma* var. *tuberosa* II: 3, *Stauroneis crucicula* VII: 5.

Locality No. 33 (13.III.1961).

The Suhin river, tributary to the Tain, at the village Subinso, about 20 km. northwest of Wenchi. River abounding in clear, running water.

Sample No. 218: scrapings from dead branches and from stones in running water in the river. 49 species from 18 genera (*Navicula*, *Achnanthes*, *Pinnularia*, *Surirella*, *Eunotia*).

*Navicula subinsoensis* XII: 13, *N. akimensis* XIII: 2, *N. suhinensis* XIV: 9, *Pinnularia suhinensis* XVII: 5, *Surirella takoradiensis* var. *suhinensis* XXV: 5, *Synedra rumpens* var. *fragilarioides* I: 13, *Achnanthes subhudsonis* IV: 1, *Navicula suecorum* XI: 7, *N. constans* var. *symmetrica* XIV: 6, *N. paludosa* XVI: 4.

Sample No. 219: scrapings from branches and stones in the river bed near the place where No. 218 was taken. 48 species from 19 genera (*Navicula*, *Achnanthes*, *Pinnularia*, *Eunotia*, *Gomphonema*).

*Achnanthes subhudsonis* IV: 2, *Navicula constans* var. *symmetrica* XIV: 8.

Locality No. 34 (13.III.1961).

The Black Volta river, the main river of the Volta river system, near the village Bamboi (at the Bamboi ferry). The river there is 50–100 m. broad, in the dry season at most 2–3 m. deep, with a very strong current, slightly brownish water.

Sample No. 220: coatings on *Potamogeton* sp. from clayey bottom in the river. 77 species from 23 genera (*Navicula*, *Nitzschia*, *Cymbella*, *Pinnularia*, *Caloneis*, *Stauroneis*).

*Navicula bamboiensis* X: 29, *N. langoraensis* X: 32, *N. laingii* XII: 1, *N. monradii* XII: 11, *N. ashantiensis* XIII: 5, *N. halophila* forma III: 6, *N. auriculata* X: 31, *N. kwamkuji* VIII: 11, *N. helensis* IX: 3, *N. seminuloides* X: 17, *N. exigui-formis* XIV: 13, *Caloneis desertorum* V: 10, *C. beccariana* VI: 4.

Sample No. 221: like No. 220 and taken near this sample. 77 species from 21 genera (*Navicula*, *Nitzschia*, *Caloneis*, *Cymbella*, *Pinnularia*, *Stauroneis*, *Gomphonema*).

*Stauroneis crucicula* VII: 4, *Navicula tridentula* VIII: 13, *Gomphonema africana* XXI: 6.

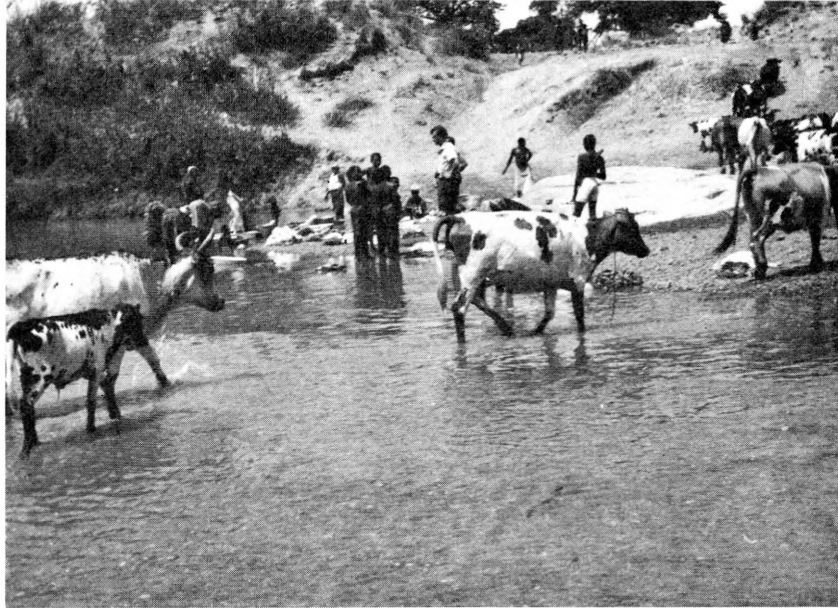




The Tain river south of Wenchi in Semideciduous Forest. At the roadside the bases of two large *Ceiba* trees are seen. – Loc. No. 32. (11.III.1961).



The Black Volta south of Bamboi in Guinea savannah and woodland on the border between the Southern and the Northern Region. Ferry in charge of the main road traffic. – Loc. No. 34. (13.III.1961).



The White Volta near the town Yapei (also called Tamale Port). Washing- and cattle watering-place. – Loc. No. 36. (16.III.1961).

Locality No. 35 (16.III.1961).

- a. The Sorri river, tributary to the Black Volta, about 15–16 km. south of the village Damongo. The river bed without running water, but with some turbid pools.

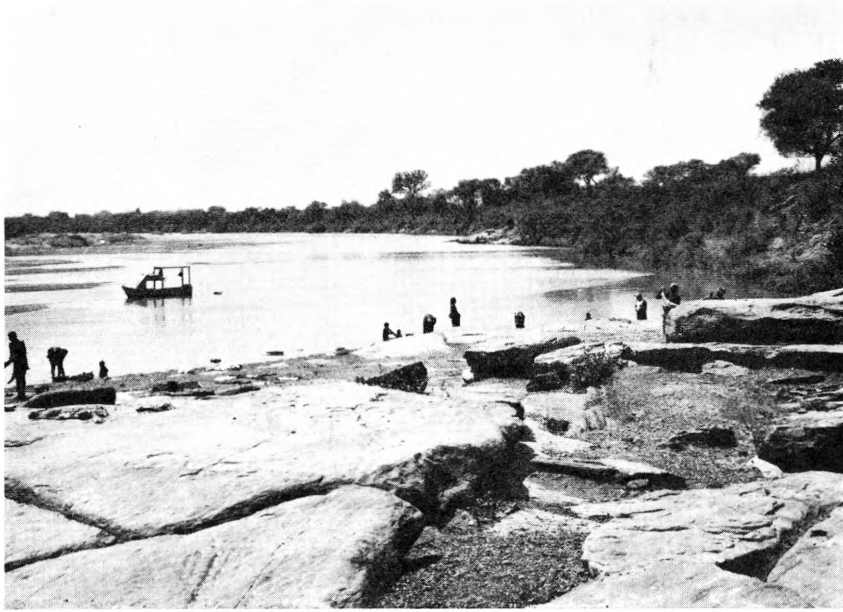
Sample No. 223: scrapings of clay from edge of pool in the river bed. 59 species from 19 genera (*Navicula*, *Surirella*, *Nitzschia*, *Eunotia*, *Gomphonema*, *Pinnularia*).

*Eunotia sorriensis* III: 8, *Navicula damongensis* XI: 14, *Surirella sorriensis* XXV: 8, *Navicula halophila* VIII: 4, *N. bella* (?) VIII: 17, *Nitzschia spiculoides* XXIII: 7.

- b. Largish lake (?), several hundred m. long, 30–40 m. broad, apparently very deep (in cleftlike valley), the water turbid. With lung fishes, mormyridae, crocodiles, etc. 15–16 km. south of Damongo.

Sample No. 227: coatings on *Phragmites* in reed swamp at the edge of the lake; drinking-place for large mammals (lions, elephants). 14 species from 10 genera (*Navicula*, *Pinnularia*, *Surirella*, *Melosira*).

*Navicula sorriensis* XII: 12.



The White Volta at the town Yapei in Guinea savannah and woodland. – Loc. No. 36. (16.III.1961).



The reserve south of Damongo with savannah and woodland. The Sorri river, tributary to the Black Volta. River bed with small pools. – Loc. No. 35 a. (16.III.1961).



Edge of lake with drinking-place for lions and elephants. The reserve south of Damongo with savannah and woodland. – Loc. No. 35 b. (16.III.1961).

Locality No. 36 (16.III.1961).

The White Volta river, the largest tributary to the Black Volta, at Yapei, also called Tamale Port, southwest of the town Tamale.

Sample No. 232: sand in slowly flowing water at washing-place.

*Cyclotella pseudostelligera* I: 2, *Navicula tridentulaeformis* VIII: 14.

Locality No. 37 (17.III.1961).

The Nabogo river, tributary to the White Volta, at the village Nabogo, north of Tamale. Turbid, polluted water at washing-place.

Sample No. 234: green algae and coatings on the bottom at the washing-place in slowly running water. 53 species from 18 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Gomphonema*, *Neidium*, *Stauroneis*). With *Melosira herzogi*.

*Eunotia vumbae* III: 9, *Navicula halophila* fo. *nabogoensis* VIII: 9, *N. platycephala* IX: 17.

Locality No. 38 (17.III.1961).

Largish swampy area about 35 km. north of the town Pong Tamale. Fairly large expanses of open water or with a growth of *Utricularia* sp. and blue water-lilies and *Typha* sp.



Lake between the villages Disiga and Nasia, north of Tamale. Reed swamp at the edge of the lake, with *Utricularia* sp. and blue water-lilies. – Loc. No. 38 (17.III.1961).

Sample No. 236: coatings on *Utricularia* and *Typha*. 20 species from 11 genera (*Navicula*, *Stauroneis*, *Gomphonema*, *Eunotia*).

Sample No. 237: like No. 236, but taken in another place in the swamp. 31 species from 16 genera (*Eunotia*, *Gomphonema*, *Pinnularia*, *Melosira*).

Sample No. 238: like No. 236 from a third place in the reed swamp. 41 species from 12 genera (*Pinnularia*, *Eunotia*, *Navicula*, *Stauroneis*, *Gomphonema*).

Sample No. 239: like No. 236, but from a fourth place in the same swamp. 42 species from 14 genera (*Navicula*, *Pinnularia*, *Gomphonema*, *Nitzschia*, *Eunotia*).  
*Eunotia rhomboidea* I: 16.

Locality No. 39 (17.III.1961).

The Nasia river, tributary to the White Volta, at the village Nasia, about halfway between the towns Tamale and Bolgatanga. No running water in the river, but some pools.

Sample No. 240: coatings on vegetation in pool. 39 species from 13 genera (*Navicula*, *Melosira*, *Gomphonema*, *Surirella*, *Nitzschia*).

*Melosira ikapöensis* var. *minor* I: 5, *M. herzogi* I: 6, *Eunotia flexuosa* III: 2.



Sample No. 241: coatings on vegetation in pool near the place where No. 240 was taken. 49 species from 19 genera (*Navicula*, *Eunotia*, *Gomphonema*, *Synedra*). With *Licmophora remulus*.  
*Eunotia lunaris* III: 3.

Locality No. 40 (17.III.1961).

The White Volta river between the villages Pwalagu and Kolugo, about 23 km. south of Bolgatanga. No running water in the river bed, but pools of various sizes.

Sample No. 242: scrapings of sand from the bottom and from coatings on vegetation in large pool. 55 species from 18 genera (*Navicula*, *Cymbella*, *Gomphonema*, *Neidium*, *Nitzschia*, *Pinnularia*, *Surirella*).

Locality No. 41 (17.III.1961).

Largish marshy area with dense grass vegetation near the village Kolugo, a little north of the White Volta river and above the river valley.

Sample No. 243: brown coatings on vegetation in the marsh. 37 species from 16 genera (*Pinnularia*, *Navicula*, *Melosira*, *Gomphonema*, *Eunotia*).  
*Navicula platycephala* forma IX: 18, *Pinnularia gibba* var. *subundulata* XVIII: 2.

Sample No. 244: like No. 243 and near the place where this was taken. 37 species from 17 genera (*Pinnularia*, *Navicula*, *Gomphonema*, *Eunotia*).  
*Pinnularia bogosoensis* forma XIX: 2, *P. parva* var. *lagerstedtii* fo. *interrupta* XVII: 3, *Eunotia gracilis* III: 1, *Pinnularia montana* XVII: 10, *Navicula kolugensis* XII: 9.

Locality No. 42 (18.III.1961).

Large artificial pond near Bolgatanga, belonging to the Bolgatanga waterworks.

Sample No. 245: scrapings from the edge of the pond. 19 species from 11 genera (*Gomphonema*, *Navicula*, *Neidium*, *Stauroneis*, *Cymbella*, *Synedra*).

Locality No. 43 (18.III.1961).

Area belonging to the Tono Agricultural Station at the town Navrongo near the northern frontier of the country.

a. Pond No. 17 (dammed in 1959), about 3 m. deep.

Sample No. 246: scrapings of clay at the edge of the pond. 30 species from 10 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*).

b. Minor pool in irrigated area near the place where No. 246 was taken.

Sample No. 248: scrapings of clay from the edge of the pool. 27 species from 8 genera (*Navicula*, *Nitzschia*).



The Nasia river, tributary to the White Volta, approximately halfway between Tamale and Bolgatanga. –  
Loc. No. 39. (17.III.1961).



Waterwork pond at Bolgatanga in savannah and woodland. Cattle and crocodile at the edge of the pond. –  
Loc. No. 42. (18.III.1961).

## Locality No. 44 (18.III.1961)

Area with ponds (artificial) some km. northeast of Navrongo.

- a. Pond No. 14, on the west side of the road through the area.

Sample No. 249: scrapings from the ground at the edge of the pond. 39 species from 14 genera (*Navicula*, *Surirella*, *Nitzschia*, *Neidium*).

*Nitzschia navrongensis* XXIII: 6, *Stauroneis schinzii* VII: 14, *Hantzschia amphioxys* var. *africana* XXI: 14.

- b. Fishpond near Pond No. 14.

Sample No. 250: scrapings from stones and clay at the edge of the pond. 43 species from 15 genera (*Navicula*, *Pinnularia*, *Nitzschia*, *Gomphonema*, *Neidium*).

- c. Pond No. 15, near No. 14, but on the east side of the road.

Sample No. 251: scrapings from clay at the edge of the pond. 51 species from 14 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Stauroneis*, *Neidium*).

## Locality No. 45 (18.III.1961).

Experimental and irrigation area north of Navrongo. Pond No. 46 (dammed in 1960).

Sample No. 252: scrapings from clay at the edge of the pond. 35 species from 14 genera (*Nitzschia*, *Navicula*, *Stauroneis*, *Gomphonema*).

*Nitzschia tonoensis* XXIII: 5, *Synedra montana* I: 11, *Stauroneis spicula* VIII: 1.

## Locality No. 46 (19.III.1961).

Ponds in the neighbourhood of Navrongo.

- a. Watering-pond south-east of the town. Turbid water.

Sample No. 254: scrapings from clay at the edge of the pond. 60 species from 15 genera (*Navicula*, *Pinnularia*, *Nitzschia*, *Stauroneis*, *Neidium*).

*Navicula abelioensis* XI: 22, *Nitzschia chuchiligaensis* XXIV: 8, *Navicula navrongensis* XI: 11.

- b. Pond in irrigation area southeast of Navrongo.

Sample No. 256: coatings on vegetation and scrapings from clay at the edge of the pond, 45 species from 14 genera (*Navicula*, *Nitzschia*, *Pinnularia*). With *Meridion circulare*.

*Nitzschia palea* XXIII: 8.

Sample No. 258: like No. 256 and taken near the place of this. 48 species from 13 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Cymbella*). With *Rhizosolenia eriensis*.

*Stauroneis navrongensis* VII: 12, *Navicula halophila* fo. *tenuirostris* VIII: 7.



Sacred crocodile pond at the village Paga near the border of the Upper Volta state. Characteristic cultivated savannah land. – Near Loc. No. 45. (18.III.1961).



Pond at the village Asong, east of Bolgatanga in savannah and woodland. The trees withered after the damming of the water. – Loc. No. 47 a. (20.III.1961).

## Locality No. 47 (20.III.1961).

- a. Largish artificial pond 8–9 km. east of Bolgatanga.

Sample No. 259: scrapings of clay from the edge of the pond. 35 species from 16 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Caloneis*, *Cymbella*).

- b. Oasis with smallish stream about 13–14 km. east of Bolgatanga. Clear running water in the stream.

Sample No. 260: Clay slurry and scrapings from stones in the stream. 54 species from 19 genera (*Navicula*, *Nitzschia*, *Caloneis*, *Gomphonema*).

*Caloneis aequatorialis* V: 8, *C. sansomei* V: 9, *Stauroneis borrichii* VII: 11, *Navicula grimmei* XI: 15.

## Locality No. 48 (20.III.1961).

The Red Volta river, tributary to the White Volta, about 5 km. east of the village Nangodi. Rocky bottom. No running water, but some pools.

Sample No. 262: scrapings from stones and rocky surface in the river bed. 34 species from 15 genera (*Navicula*, *Gomphonema*, *Surirella*, *Nitzschia*).

*Navicula navrongensis* XI: 10.

## Locality No. 49 (20.III.1961).

The White Volta river between the villages Saka and Bazua. No running water, but very large pools, where the population caught fish and collected bivalves.

Sample No. 265: scrapings and green algae from cement wall in bridge across the river. 68 species from 20 genera (*Navicula*, *Gomphonema*, *Nitzschia*, *Cymbella*).

Sample No. 266: like No. 265 and taken near the same place. 38 species from 16 genera (*Navicula*, *Melosira*, *Cymbella*, *Gomphonema*, *Surirella*, *Synedra*).

*Nitzschia sakaensis* XXIV: 16.

## Locality No. 50 (20.III.1961).

The Morago river, the White Volta river system, on the plain north of the escarpment 4–5 km. north of the town Nakpanduri. No running water, but many smallish pools with turbid water, which was highly polluted by stray cattle.

Sample No. 268: coatings on vegetation in highly polluted pool. 49 species from 19 genera (*Navicula*, *Surirella*, *Gomphonema*, *Nitzschia*, *Cymbella*, *Eunotia*).

*Navicula halophila* fo. *subcapitata* VIII: 8, *Cymbella moragoensis* XX: 9.





The Red Volta, east of Navrongo. Dr. G.W. Lawson among boulders in the dried-up river bed. – Loc. No. 48. (20.III.1961).

Locality No. 51 (21.III.1961).

Small stream in meadowy area 6–7 km. west of Nakpanduri, used for the watering of cattle, but the water not very much polluted, running.

Sample No. 271: brown coatings on small flowering *Utricularia* species. 14 species from 8 genera (*Navicula*, *Eunotia*, *Melosira*). *Surirella delicatissima* var. *africana* is common.

Locality No. 52 (21.III.1961).

Much polluted small stream immediately west of the village Sakogu, 12 km. southwest of Nakpanduri.

Sample No. 273: crusts of *Cyanophyceae* from the stream. 21 species from 12 genera (*Navicula*, *Eunotia*, *Melosira*, *Pinnularia*).

Locality No. 53 (21.III.1961).

Small stream south of the village Nagbog, 22–23 km. southwest of Nakpanduri. No running water. Small pool with dirty, turbid water.

Sample No. 279: scrapings from the ground at the edge of the pool. 49 species from 16 genera (*Navicula*, *Pinnularia*, *Nitzschia*, *Eunotia*).

*Navicula nagbogensis* XV: 1, *Nitzschia nagbogensis* XXII: 6, *Surirella nagbogensis* XXV: 7, *Eunotia rhomboidea* I: 17, *Pinnularia rivularis* (?) XIX: 4.

Locality No. 54 (22.III.1961).

The Kulaw river, tributary to the Oti river, between the villages Wapuli and Benja, 30–35 km. northeast of the town Yendi. No running water in the dry season, but very large, narrow pools (the largest are several hundred metres in length). The water very turbid.

Sample No. 282: coatings on stones and dead branch in pool. 51 species from 20 genera (*Navicula*, *Pinnularia*, *Eunotia*, *Nitzschia*, *Surirella*).  
*Eunotia asterionelloides* III: 13.

Locality No. 55 (23.III.1961).

Waterwork pond, 4–5 km. west of the village Bimbila. 2–3 m. deep. Turbid water.  
(Sample No. 284: scrapings from clayey expanse at the edge of the pool.

*Navicula platycephala* IX: 16).

Sample No. 285: scrapings from clayey expanse at the edge of the pool, near the place where No. 284 was taken. 23 species from 12 genera (*Navicula*, *Gomphonema*, *Stauroneis*, *Surirella*).

*Stauroneis obtusa* VII: 13.

Locality No. 56 (23.III.1961).

Pond immediately south of the village Wulasi, 22–23 km. south of Bimbila. The water highly polluted, used for washing, bathing, and irrigation.

Sample No. 287: green algae from soil at the edge of the pond. 37 species from 9 genera (*Eunotia*, *Navicula*, *Gomphonema*, *Pinnularia*, *Nitzschia*).

*Gomphonema wulasiense* XXI: 7, *Eunotia garussica* III: 4, *E. diodon* III: 6, *E. hugenottarum* III: 11.

Locality No. 57 (23.III.1961).

Small tributary to the Volta river between the village Chindiri and the town Kete Krachi, about 20 km. north of the latter. Dried-up in the dry season, apart from some smallish pools with highly polluted water.

Sample No. 291: cakes of algae in turbid water. 23 species from 8 genera (*Navicula*, *Nitzschia*, *Cymbella*). Common: *Nitzschia mamataensis*. Fairly common: *Cymbella mülleri*.

*Nitzschia mamataensis* XXII: 10.



The Volta river at Kete Krachi. Ferry at main road. – Loc. No. 58 c. (23.III.1961).

Locality No. 58 (23.III.1961).

The Volta river at the town Kete Krachi. In this place a deep stream abounding in water and with a rapid current. Almost clear water.

a. Lagoon with deep water at the edge of the river.

Sample No. 292: green algae on the rocky side of the lagoon. 42 species from 16 genera (*Navicula*, *Nitzschia*, *Achnanthes*). With *Licmophora remulus*.

Sample No. 293: vegetation with coatings. 71 species from 21 genera (*Navicula*, *Nitzschia*, *Cymbella*, *Surirella*, *Gomphonema*). *Gomphonema wulsiense* var. *voltaensis* XXI: 8, *Nitzschia voltaensis* XXII: 11, *N. krachiensis* XXIV: 1, *Navicula nyassensis* IX: 15.

b. Main course of the river, the east bank.

Sample No. 294: crusts of *Cyanophyceae* on rock surface in fast running water. 62 species from 21 genera (*Navicula*, *Cymbella*, *Gomphonema*, *Nitzschia*). Fairly common: *Navicula kwamkuji*, *Gomphonema africanum*. Also with *Navicula perotetti* var. *enervis*, *Navicula ajenaensis* IX: 1, *Gomphonema suhmii* XXI: 1, *Navicula seminuloides* X: 12, *N. omegopsis* XIII: 1.

c. Main course of the river, the west bank.

Sample No. 295: green algae on rocky surface at the edge of the river. 53 species from 17 genera (*Navicula*, *Cymbella*, *Gomphonema*, *Nitzschia*, *Achnanthes*).



The Oti river, tributary to the Volta river, at the village Otisu, south of Kete Krachi. – Loc. No. 59. (24.III.1961).

*Navicula meyeri* XIV: 12, *Nitzschia sansomei* XXIII: 4, *Navicula standeri* VIII: 12, *Gomphonema suhmii* XXI: 2, *G. lingulatum* XXI: 3.

Sample No. 296: *Ceratophyllum* sp. with coatings from shallow water at the edge of the river. 64 species from 19 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Cymbella*).

*Navicula voltaensis* VIII: 16, *Nitzschia schiellerupii* XXII: 9, *Cyclotella stelligera* I: 3, *C. kützingiana* fo. *minor* I: 7, *Eunotia tarkwaensis* II: 6.

Locality No. 59 (24.III.1961).

The Oti river, tributary to the Volta, at the village Otisu, about 20 km. southeast of Keti Krachi. River fairly abounding in clear water.

Sample No. 297: scrapings from rock surface at the edge of the river. The water nearly stagnant there. 29 species from 16 genera (*Navicula*, *Gomphonema*, *Cymbella*, *Melosira*, *Synedra*). Fairly common: *Cymbella theronii*.

Sample No. 298: scrapings from rock surface in slowly flowing water in the river bed. 41 species from 14 genera (*Navicula*, *Nitzschia*, *Cymbella*, *Gomphonema*, *Melosira*, *Pinnularia*).

*Pinnularia otiensis* XVIII: 4.

## Locality No. 60 (24.III.1961).

The Asukawkaw river, major tributary to the Volta, at the village Akroso, 50–55 km. southeast of Kete Krachi. Fast running water, clear.

Sample No. 299: Scrapings from stones in rapid current in the river bed. 54 species from 18 genera (*Navicula*, *Nitzschia*, *Amphora*, *Achnanthes*, *Cymbella*). *Gomphocymbella ruttneri* very common here.

*Stauroneis akrosoensis* VII: 2, *Navicula grundtvigii* XIII: 6, *Caloneis incognita* V: 3, *Navicula modica* IX: 7, *N. subminuscula* X: 21, *Gomphocymbella ruttneri* XX: 7.

Sample No. 300: scrapings from stones in less rapid current in the river bed near the place where No. 299 was taken. 58 species from 18 genera (*Navicula*, *Achnanthes*, *Nitzschia*, *Gomphonema*, *Pinnularia*, *Caloneis*). With *Scolioleura tumida* and *Tropidoneis* sp.

## Locality No. 61 (1.III.1961).

The Volta river near and at the Volta River Project dam. River highly abounding in fast running, clear water.

a. The Volta river, 4–5 km. north of the project dam.

Sample No. 92: coatings of algae on sandy loam at the edge of the river. 40 species from 16 genera (*Navicula*, *Nitzschia*, *Gomphonema*, *Cymbella*). Common: *Navicula cryptocephala*.

*Caloneis voltaensis* V: 4, *Neidium alpinum* VI: 13, *Nitzschia obsidialis* XXIII: 9.

b. Small stream with very little running water on slope near the place where No. 92 was taken.

Sample No. 93: scrapings from the bottom of the stream. 31 species from 13 genera (*Nitzschia*, *Navicula*, *Pinnularia*, *Caloneis*).

c. The Volta river at the project dam.

Sample No. 94: scrapings from stones in fast running water in the river. 45 species from 18 genera (*Navicula*, *Gomphonema*, *Nitzschia*, *Cymbella*).

Sample No. 95: scrapings from rock surface at the edge of the river near the place where No. 94 was taken. 37 species from 14 genera (*Navicula*, *Cyclotella*, *Gomphonema*, *Achnanthes*, *Cymbella*).

*Navicula sansomei* IX: 12, *N. syrachi* XI: 24, *N. ajenaensis* IX: 2, *Cyclotella stelligeroides* I: 1, *Synedra rumpens* var. *fragilarioides* I: 12.



## Locality No. 62 (1.III.1961).

The University farm at Kpong west of the Volta river.

## a. Small stream with almost stagnant water.

Sample No. 101: scrapings from bottom and vegetation. 53 species from 17 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Gomphonema*). With *Bacillaria paradoxa* and *Gyrosigma wandsbeckii*.

*Navicula kpongensis* XII: 14, *N. fauta* (?) XV: 10.

## b. Large, artificial watering basin, the water of which is used for irrigation and the watering of cattle of the University farm.

Sample No. 102: crusts of algae on the cement sides of the basin at the pumping place. 60 species from 19 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Caloneis*, *Achnanthes*, *Surirella*).

*Navicula adampeensis* XIII: 4.

c. Trench in *Phragmites* swamp. Dried-up in the dry season.

Sample No. 106: scrapings from soil at the bottom of the trench. 50 species from 15 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Neidium*, *Gomphonema*).

*Navicula dodowaensis* XV: 7, *Surirella dodowaensis* XXV: 6.

**E. Semideciduous Forest (East)**

## Locality No. 63 (24.III.1961).

Small river (tributary to the Dayi river, the Volta river system) at the village Hohoe. Clear, running water.

Sample No. 301: scrapings from old, rotten tree trunk and stones in fast running water in the river bed. 34 species from 14 genera (*Navicula*, *Gomphonema*, *Achnanthes*).

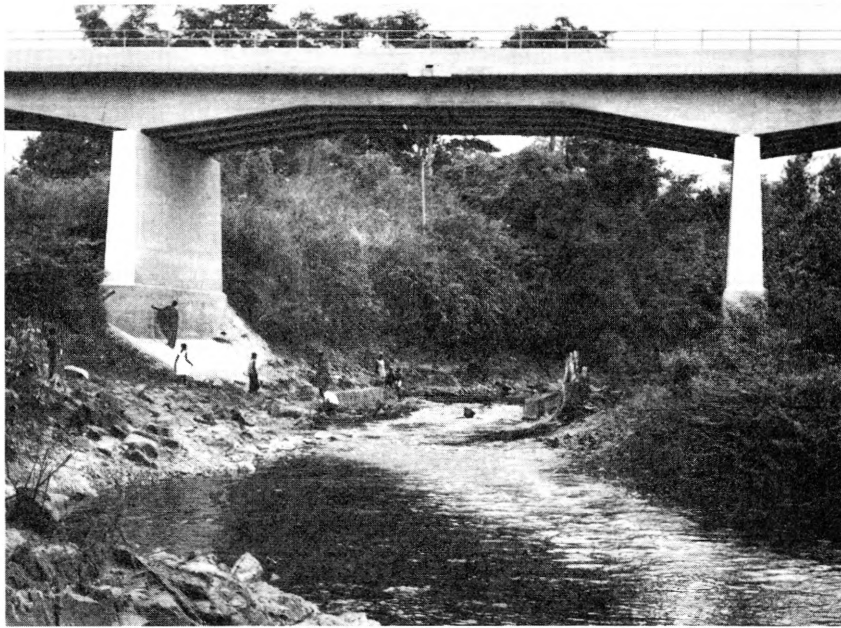
*Navicula pseudagrestis* X: 23.

## Locality No. 64 (24.III.1961).

## a. Stream from the waterfall between Duga and Wuinta. The bottom of the river with very coarse gravel or pebbles and running, clear water.

Sample No. 305: scrapings from stones in running water. 46 species from 16 genera (*Navicula*, *Pinnularia*, *Achnanthes*, *Surirella*). Common: *Gomphonema brasiliense*.

*Navicula dugaensis* X: 25, *N. feuerborni* fo. *africana* XVI: 3, *Pinnularia molaris* XVI: 9, *Gomphonema brasiliense* XXI: 5.



The Dayi river, tributary to the Volta river, south of Kpandu, in Semideciduous Forest. – Loc. No. 65. (25.II.1961).

- b. Small mountain river at the road between the villages Wuinta and Amedzofe, with clear, running water.

Sample No. 306: green algae in the river. 43 species from 16 genera (*Eunotia*, *Navicula*, *Pinnularia*, *Surirella*, *Gomphonema*).

*Eunotia monodon* var. *bidens* II: 1, *Achnanthes kraeuselii* IV: 5.

Sample No. 307: Moss from stones in the river bank near the place where No. 306 was taken. 38 species from 16 genera (*Pinnularia*, *Gomphonema*, *Eunotia*, *Navicula*, *Surirella*).

*Stauroneis kriegei* VII: 15.

Locality No. 65 (25.III.1961).

The Dayi river, tributary to the Volta, about 18–19 km. south of the town Kpandu. Fairly large river bed with little running, clear water.

Sample No. 308: Green algae. 60 species from 20 genera (*Navicula*, *Nitzschia*, *Achnantes*, *Gomphonema*, *Stauroneis*, *Surirella*, *Synedra*).

*Navicula densa* XIII: 3.

Sample No. 309: like No. 308 near the place of this sample. 76 species from 19 genera (*Navicula*, *Nitzschia*, *Pinnularia*, *Surirella*, *Stauroneis*, *Achnanthes*).

*Neidium dayiensis* VI: 7, *Navicula exiguiformis* (?) XIV: 5.

## Locality No. 66 (16.II.1961).

Waterwork pond at the Tafo Cocoa Research Station.

Sample No. 4: scrapings from clay at the edge of the pond. 32 species from 14 genera (*Navicula*, *Pinnularia*, *Gomphonema*, *Nitzschia*).

*Pinnularia mesolepta* (?) XVI: 12.

Sample No. 6: like No. 4, taken near this sample. 56 species from 18 genera (*Navicula*, *Pinnularia*, *Gomphonema*, *Nitzschia*).

*Pinnularia tafoensis* XVIII: 11.

Sample No. 7: like No. 4, taken near this sample. 50 species from 14 genera (*Pinnularia*, *Nitzschia*, *Achnanthes*, *Gomphonema*).

*Fragilaria pinnatoides* I: 9.

## Locality No. 67 (28.II.1961).

- a. The Dobra river between the town Nsawam and the village Asuboi, about 35 km. north northwest of Accra. No running water in the dry season, but pools with *Nymphaea* in the river bed.

Sample No. 78: green algae from pool. 47 species from 14 genera (*Navicula*, *Nitzschia*, *Gomphonema*). With *Pleurosigma subsalsum*, *Bacillaria paradoxa*, and *Thalassiosira fluviatilis*.

*Navicula vanidica* X: 20, *Gomphonema farakulumense* forma XXI: 11.

- b. Minor river through the town Nsawam with some, slowly flowing water.

Sample No. 81: coatings on algae at the river bank. 48 species from 19 genera (*Navicula*, *Nitzschia*, *Achnanthes*, *Amphora*, *Pinnularia*). With *Biddulphia levis*, *Bacillaria paradoxa*, *Thalassiosira fluviatilis*, *Gyrosigma distortum* var. *parkeri*.

*Navicula nsutaensis* XI: 21, *Amphora ovalis* forma (?) XX: 2.

## TAXONOMIC SECTION

At the following listing of the diatom forms observed the systematic classification and arrangement in HUSTEDT 1930–63, I–III, and HUSTEDT 1930 has, as far as possible, been used.

For each form found in the material its occurrence is indicated with use of the numbers of localities indicated in Localities and Samples (p. 10–46), which may all be found on the map pag. 9.

No chemical analyses or determination of pH from the localities examined are available. Ecological data are restricted to information as to what species are especially halophilous, mesohalobous, or polyhalobous. In the case of most species information about geographical distribution is restricted to information about demonstration of the species in question in other regions in tropical Africa, mainly as established by HUSTEDT 1949 a (Congo) and MÖLDER 1962 (Sierra Leone).

English diagnoses of new species and varieties are communicated together with information about drawings and occurrence of the forms in question as placed among the other species in the systematic succession. The specimens used for drawing and description of new species, varieties and forms are all to be found in the Foged Collection, Odense. The no. of the slide is given at each diagnosis. The Latin diagnoses are all gathered in New species (pag. 128–152) with observance of the systematic succession. Index to Species (pag. 153–161) is an alphabetical list of all the forms mentioned with reference to page in the Taxonomic Section (pag. 47–127) and in Latin diagnoses (pag. 128–152). Synonyms indicated have in the Index to Species been marked by " and novae species by \*.

As in my previous works a large number of drawings have been used, which have all been made from specimens of diatoms in the Ghanese material examined. They are found in Plates (p. 171–220). The purpose is partly to offer a certain documentation with the restriction that will always be due to the imperfection of drawing and the inevitably subjective character, in spite of careful application of a drawing apparatus (OPL), partly to give other workers, who may have another view especially of the large number of "critical" species a possibility of appraising these.

## A. Centrales

### Melosira Agardh.

*Melosira ambigua* (Grun.) O. Müller. HUSTEDT 1930-62, I, p. 256, fig. 108.

Loc. Nos. 1, 3, 15.

Very common in lakes in East Africa (HUSTEDT 1949 a, p. 53).

— *distans* (Ehr.) Kütz. Ibid. p. 262, figs. 110 a-f.

Loc. Nos. 1, 26, 27, 31, 32, 39, 40, 49, 58.

Not rare in Sierra Leone (MÖLDER 1962, p. 28).

— — var. *alpigena* Grun. Ibid. p. 263, fig. 110 g.

Loc. Nos. 54, 59, 62.

— — var. *africana* O. Müller. Ibid. p. 263, fig. 110 h.

(Syn.: *M. pfaffiana* Reinsch).

Loc. No. 58.

Found, but rarely, in tropical Central Africa (O. MÜLLER 1904, p. 293. HUSTEDT 1949, p. 54). Rather common in Sierra Leone (MÖLDER 1962, p. 28).

— *granulata* (Ehr.) Ralfs. Ibid. p. 248, fig. 104.

Loc. Nos. 1-4, 6-23, 26, 28-31, 33-56, 58-66.

Very frequent in East African lakes (HUSTEDT 1949 a, p. 53). Also found in Sierra Leone (MÖLDER 1962, p. 28), where the valves of the species are more robust and larger than usual. The point structure on the valves in the Ghanese material is often somewhat deviating from the structure on valves from Europe and elsewhere.

— — var. *angustissima* Müller. Ibid. p. 250, fig. 104 d.

Loc. Nos. 1-3, 6, 8-19, 21, 22, 24, 26-28, 31, 33, 36-41, 43-50, 66, 67.

Very common in lakes in East Africa (HUSTEDT 1949 a, p. 53) and in Sierra Leone (MÖLDER 1962, p. 28).

— *herzogi* Lemmermann. HUSTEDT 1952 a, p. 367, figs. 6, 7.

Loc. Nos. 37, 39.

First found by LEMMERMANN 1910 in plankton from South America (Paraguay). According to HUSTEDT 1952 a, p. 367, the species is widely distributed in tropical and subtropical South America, "und gehört zu den charakteristischen Endemismen jener Gewässer, die auch in manchen Seen der Amazonas-Gebietes sehr häufig ist." According to CLEVE-EULER 1951, p. 29, this characteristic species has also been found (very rarely) in the lake Mälaren in Sweden, June 1910. HUSTEDT 1952 a, p. 367, rejects this finding in Sweden on the ground that the species probably occurs only in South America.

The finds from Ghana, where the species is common in two samples (No. 240, 17.III.1961, Loc. No. 39, from the Nasia river in North Ghana, and No. 282, 22.III.1961, Loc. No. 54, from the Kulaw river in Mid West Ghana) would seem to indicate that the species has a much wider distribution than originally supposed. There can be no doubt that the species is autochthonous in Ghana. Scattered finds in Europe, which may be due to transportation by migratory birds, therefore can no more be precluded, especially considering that the valves are very hyaline and consequently easily overlooked, even if they should escape destruction at the preparation of slides.

Plate I, fig. 6: cell  $16.7 \times 6.5 \mu$ . Fine dots in about 40 longitudinal striae in  $10 \mu$  (not indicated on the drawing). (Sample No. 240, Loc. No. 39).

— *ikapöensis* O. Müller var. *minor* Cholnoky. CHOLNOKY 1959, p. 33.

Loc. No. 39.

Plate I, fig. 5: height of cell  $2.4-2.6 \mu$ , breadth  $6.0 \mu$ .

Sample No. 240, Loc. No. 39.



This very small form of *Melosira* is very rare in the material, but it seems to be in agreement with the South African variety (CHOLNOKY 1959, p. 33).

*Melosira islandica* O. Müller. HUSTEDT 1930-62, I, p. 252, fig. 106 a.

Loc. No. 26.

Not rare in Sierra Leone (MÖLDER 1962, p. 28).

— — subsp. *helvetica* O. Müller. Ibid. p. 254, fig. 107.

Loc. Nos. 1, 4, 8, 9, 10, 15, 17, 18, 22, 31, 32, 35, 38, 39, 41-44, 46, 48, 49, 65.

Not rare in Sierra Leone (MÖLDER 1962, p. 28).

— *nummuloides* (Dillw.) Ag. Ibid. p. 221, fig. 95.

Loc. No. 11.

Mesohalobous.

— *roeseana* Rabenh. Ibid. p. 266, fig. 112.

Loc. Nos. 4, 5, 8, 13, 15, 17, 19, 22, 27, 28, 30, 32, 65-67.

According to HUSTEDT 1949 a, p. 54, this species is rare in tropical East Africa, and this also applies to Sierra Leone (MÖLDER 1962, p. 29). Its frequent occurrence in Ghana suggests a wider distribution in Africa.

### **Cyclotella** Kütz.

*Cyclotella comta* (Ehr.) Kütz. HUSTEDT 1930-62, I, p. 354, fig. 183.

Loc. Nos. 2, 11, 32, 62.

Not common in the Tropics (HUSTEDT 1949 a, p. 56).

— *kützingiana* Thwaites. Ibid. p. 338, fig. 171.

Loc. Nos. 1, 2, 6, 11, 12, 19, 24, 31, 49, 58-61, 64-66.

— — fo. *minor* Hust. HUSTEDT 1946-50, p. 446, fig. 9.

Loc. No. 58.

Plate I, fig. 7: Valve diam.: 4.7  $\mu$ . (Sample No. 296, Loc. No. 58).

Shape and structure approximately as in *C. wollerecki* Hust. (HUSTEDT 1942, p. 16, figs. 11-13), but I:7 lacks the marginal spines characteristic of *C. wollerecki*.

— — var. *planetophora* Fricke. HUSTEDT 1930-62, I, p. 339, fig. 171 c.

Loc. No. 11.

Found, but rarely, in Sierra Leone (MÖLDER 1962, p. 29).

— — var. *radiosa* Fricke. Ibid. p. 338, fig. 171 b.

Loc. No. 14.

— *meneghiniana* Kütz. Ibid. p. 341, fig. 174.

Loc. Nos. 1-6, 14-32, 34, 35, 38, 41, 48, 49, 58-62, 64-67.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 56), and in Sierra Leone (MÖLDER 1962, p. 29).

Plate I, fig. 4: Valve diam.: 8.2  $\mu$ . About 10 striae in 10  $\mu$ .

A small specimen. (Sample No. 112, Loc. No. 4).

Plate I, fig. 8: Valve diam.: 17  $\mu$ . 12-13 striae in 10  $\mu$ .

Halophilous.

Radial punctuation of the central field, approximately as in KRASSKE 1939, p. 553.

— *ocellata* Pant. Ibid. p. 340, fig. 173.

Loc. Nos. 2-4, 8-13, 16, 17, 19, 20, 26, 28, 31, 34, 38, 49, 52, 53, 58, 61, 64.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 56), and also rare in Sierra Leone (MÖLDER 1962, p. 29).

— *pseudostelligera* Hust. HUSTEDT 1939, p. 581, figs. 1, 2. 1946-50, p. 445, fig. 8.

Loc. Nos. 2, 6, 33, 36, 58, 62, 66.

Plate I, fig. 2: Valve diam.: 6.7  $\mu$ . (Sample No. 232, Loc. No. 36).

*Cyclotella stelligera* Cleve & Grun. HUSTEDT 1930-62, I, p. 339, fig. 172.

Loc. Nos. 1, 2, 14, 33, 36, 37, 40, 49, 58, 61, 62.

According to HUSTEDT 1949 a, p. 55, widely distributed in the tropics, where this species should be much more frequent than the other *C.* species.

Plate I, fig. 3: Valve diam.: 9.4  $\mu$ . About 18 striae in 10  $\mu$ , and about 10 marginal spines in 10  $\mu$ . (Sample No. 296, Loc. No. 58).

Almost identical with GUERMEUR 1954, I: 5.

— *stelligeroides* Hust. HUSTEDT 1945, p. 899, 42: 68, 69.

Loc. No. 61.

Closely related to *C. stelligera* var. *tenuis* Hust. (HUSTEDT 1937-39, p. 143, 9: 5).

Plate I, fig. 1: Valve diam.: 4.7  $\mu$ . (Sample No. 95, Loc. No. 61).

Some shorter striae are inserted, but there are no marginal spines as in *C. stelligera*.

### Stephanodiscus Ehr.

*Stephanodiscus astraea* (Ehr.) Grun. HUSTEDT 1930-62, I, p. 368, figs. 193 a-c.

Loc. Nos. 1, 2, 6, 8, 9, 11-13, 16, 18, 19, 22, 23, 26, 28, 31-33, 36-38, 41, 44, 46, 49, 52, 53, 58, 59, 64-67.

Very common in East African lakes, less common in the Congo area (HUSTEDT 1949 a, p. 57). Also occurring in Sierra Leone (MÖLDER 1962, p. 29).

— var. *minutula* (Kütz.) Grun. Ibid. p. 369, figs. 193 d, e.

Loc. Nos. 1, 4, 7, 8, 10-20, 22, 24, 26-28, 32, 34, 38, 39, 41, 43, 45, 47-50, 53-55, 58, 59, 61, 62, 65.

Rare in Sierra Leone (MÖLDER 1962, p. 29).

— *hantzschii* Grun. Ibid. p. 370, fig. 194.

Loc. Nos. 1, 2, 34, 49.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 58).

### Thalassiosira Cleve.

*Thalassiosira fluviatilis* Hust. HUSTEDT 1930-62, I, p. 329, fig. 165.

Loc. Nos. 2, 4, 21, 22, 24, 25, 28, 31, 67.

Halophilous-mesohalobous.

### Coscinodiscus Ehr.

*Coscinodiscus* sp.

Loc. Nos. 6, 11-13, 15, 17, 18, 26, 28, 35, 39, 41, 54, 58, 66.

Polyhalobous.

The species *C. rudolfi* Bachmann and *C. rothii* var. *subsalsa* (Juhl-Dannf.) Hust. have been found, but are rare in the East African lakes (HUSTEDT 1949 a, p. 58). In Sierra Leone *C. lacustris* Grun. has been found (MÖLDER 1962, p. 29).

### Rhizosolenia Ehr.

*Rhizosolenia eriensis* H. L. Smith. HUSTEDT 1930-62, I, p. 595, fig. 341.

Loc. No. 46.

### Biddulphia S. F. Gray.

*Biddulphia levis* Ehr. HUSTEDT 1930-62, I, p. 852, figs. 506, 507.

Loc. Nos. 4, 6, 14, 19, 21, 31, 32, 67.

Polyhalobous.

The species, which may be fairly common in slightly haline localities near the coast, is rather common in Natal, South Africa (CHOLNOKY 1960, p. 27).

*Biddulphia* sp.

Loc. Nos. 6, 17.

Polyhalobous.

### **Terpsinoë Ehr.**

*Terpsinoë musica* Ehr. HUSTEDT 1930–62, I, p. 898, fig. 540.

Loc. Nos. 6, 8, 19, 22.

Polyhalobous.

## **B. Pennales**

### **I. Araphideae**

#### **Tabellaria Ehr.**

*Tabellaria fenestrata* (Lyngbye) Kütz. HUSTEDT 1930–62, II, p. 26, fig. 554.

Loc. No. 54.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 59).

— *flocculosa* (Roth) Kütz. Ibid. p. 28, fig. 538.

Loc. Nos. 1, 11, 13, 26, 32, 34, 38, 39, 45, 49, 52, 58, 61, 62.

Little distributed in the tropics and according to HUSTEDT (1949 a, p. 59) still rarer than *T. fenestrata*. Rare in Sierra Leone. The cells of the species found there are extraordinarily large (MÖLDER 1962, p. 29).

#### **Licmophora Agardh.**

*Licmophora remulus* Grun. HUSTEDT 1930–62, II, p. 57, fig. 580.

Loc. Nos. 32, 58.

Polyhalobous.

#### **Meridion Agardh.**

*Meridion circulare* (Grev.) Agardh. HUSTEDT 1930–62, I, p. 93, figs. 627 a–f.

Loc. Nos. 26, 27, 28, 46.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 60).

#### **Diatoma De Candolle.**

The elsewhere widely distributed species *D. vulgare* Bory, *D. elongatum* (Lyngbye) Ag., and *D. hiemale* (Lyngbye) Hérib. have been found, but are of rare occurrence in the Congo area (HUSTEDT 1949 a, p. 60). So far no *D.* species have been found in Ghana, nor in Sierra Leone (MÖLDER 1962).

#### **Opephora P. Petit.**

*Opephora martyi* Hérib. var. *capitata* (Hérib.) Hust. HUSTEDT 1946–50, 46: 33.

Loc. Nos. 6, 8.

#### **Fragilaria Lyngbye.**

*Fragilaria bidens* Heiberg. HUSTEDT 1930–62, II, p. 147, fig. 661.

Loc. No. 58.

Very rare in Sierra Leone (MÖLDER 1962, p. 30).

- Fragilaria capucina* Desmaz. Ibid. p. 144, figs. 659 a–e.  
 Loc. Nos. 11, 17, 26, 32, 37, 41, 42, 44, 45, 46, 54, 58, 59, 64, 66.  
 Rare in Sierra Leone (MÖLDER 1962, p. 30).  
 — — var. *lanceolata* Grun. Ibid. p. 144, figs. 659 f, g.  
 Loc. No. 45.  
 — *construens* (Ehr.) Grun. Ibid. p. 156, fig. 669.  
 Loc. Nos. 11, 21, 22, 26, 38.  
 Widely distributed in the Tropics, but hitherto found rarely in the Tropics in Africa (HUSTEDT 1949 a, p. 61. MÖLDER 1962, p. 30).  
 — *inflata* (Heid.) Hust. Ibid. p. 155, figs. 669 a, d, f–i.  
 Loc. No. 1.  
 — *intermedia* Grun. Ibid. p. 152, fig. 666.  
 Loc. Nos. 14, 17, 26.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 62), but very common in Sierra Leone (MÖLDER 1962, p. 30).  
 — *lapponica* Grun. Ibid. p. 170, fig. 678.  
 Loc. No. 26.  
 — *leptostauron* (Ehr.) Hust. var. *dubia* Grun. forma.  
 Loc. No. 26.  
 Rare in Sierra Leone (MÖLDER 1962, p. 30).  
 Plate I, fig. 10:  $29.3 \times 7.3 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 194, Loc. No. 26).  
 — *pinnata* Ehr. HUSTEDT 1930–62, II, p. 160, figs. 671 a–i.  
 Loc. Nos. 18, 58, 61.  
 Rare in lakes in East Africa (HUSTEDT 1949 a, p. 61).  
 — *pinnatoides* Cholnoky. CHOLNOKY 1960 a, p. 43, fig. 136.  
 Loc. No. 66.  
 Plate I, fig. 9:  $18.9 \times 3.4 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 7, Loc. No. 66).  
 Previously found only in South Africa (CHOLNOKY 1960 a, p. 43).  
 — *vaucheriae* Boye Petersen. BOYE PETERSEN 1938, p. 167, fig. 1.  
 Loc. No. 2.  
 — *virescens* Ralfs. HUSTEDT 1930–62, II, p. 162, fig. 672 A, a, b.  
 Loc. No. 64.  
 — — var. *capitata* Østrup. Ibid. p. 163, fig. 672 A, d.  
 Loc. No. 64.  
 MÖLDER (1962, p. 30) has found the varieties *elliptica* Hust., *mesolepta* Schönf. and *subsalina* Grun. in Sierra Leone, but they are all very rare there.

#### Ceratoneis Ehr.

- Ceratoneis arcus* (Ehr.) Kütz. HUSTEDT 1930–62, II, p. 179, figs. 684 a, b.  
 Loc. Nos. 13, 26.  
 Rare in lakes in East Africa (HUSTEDT 1949 a, p. 63). Fairly rare in Sierra Leone (MÖLDER 1962, p. 29).

#### Synedra Ehr.

- Synedra acus* Kütz. HUSTEDT 1930–62, II, p. 201, fig. 693 a.  
 Loc. No. 3.  
 Fairly rare in Sierra Leone (MÖLDER 1962, p. 30).  
 — *montana* Krasske. Ibid. p. 204, fig. 694.  
 Loc. Nos. 46, 47, 55.  
 Plate I, fig. 11:  $60 \times 2.7 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 256, Loc. No. 46).

According to HUSTEDT 1930–62, p. 204, the species has only been found in the Alps. The best characteristic of the species is the expanded central part of the valve, which has a slight constriction at the poles of the transapical axis.

*Synedra pulchella* (Ralfs) Kütz. Ibid. p. 191, fig. 688 a.

Loc. Nos. 1, 3.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 63), and also rare in Sierra Leone (MÖLDER 1962, p. 30).

Mesohalobous.

— *rumpens* Kütz. Ibid. p. 207, figs. 697 a, b.

Loc. No. 59.

Not rare in Sierra Leone (MÖLDER 1962, p. 30).

— — var. *fragilarioides* Grun. Ibid. p. 208, fig. 697 c.

Loc. Nos. 1, 2, 8, 11, 14, 17–19, 27, 30, 33–35, 37, 39, 46, 49, 50, 58, 61–63, 65, 66.

Plate I, fig. 12:  $56.6 \times 3.4 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 95, Loc. No. 27).

Plate I, fig. 13:  $31.3 \times 4.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 218, Loc. No. 33).

This variety shows a considerable similarity to *S. goulardi* Bréb., which i.a. has been found in tropical West Africa (GUERMEUR 1954, p. 27). The specimens found in Ghana are all considerably smaller than the dimensions stated for *S. goulardi* and therefore have with some doubt been referred to *S. rumpens* var. *fragilarioides*. According to HUSTEDT (1949 a, p. 65) this variety is especially common in the tropics. However, it is rare both in the East African lakes (HUSTEDT 1949 a, p. 65) and in Sierra Leone (MÖLDER 1962, p. 30).

— *tabulata* (Ag.) Ehr. Ibid. p. 218, figs. 710 a–d.

Loc. Nos. 1, 32, 39.

Rare in Sierra Leone (MÖLDER 1962, p. 30).

Mesohalobous.

— var. *fasciculata* (Kütz.) Grun. Ibid. p. 218, figs. 710 i–c.

Loc. No. 39.

Mesohalobous.

— *ulna* (Nitzsch) Ehr. Ibid. p. 195, figs. 691 A, a–c.

Loc. Nos. 1–9, 11–28, 31–37, 39–42, 44, 46–50, 54, 57–67.

Not common in lakes in East Africa (HUSTEDT 1949 a, p. 64), but very common in Sierra Leone (MÖLDER 1962, p. 31).

— — var. *aequalis* (Kütz.) Hust. Ibid. p. 199, figs. 691 A, d.

Loc. Nos. 3, 6–9, 11–15, 17–19, 22–24, 28, 30–32, 46, 49, 58, 62–65, 67.

Rare in Sierra Leone (MÖLDER 1962, p. 31).

— — var. *biceps* (Kütz.) von Schönfeldt. Ibid. p. 200, fig. 691 A, g.

Loc. No. 11.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 64), and very rare in Sierra Leone (MÖLDER, p. 31).

— — var. *danica* (Kütz.) Grun. Ibid. p. 200, fig. 691 A, f.

Loc. Nos. 8, 11, 13, 14, 18, 19, 21, 23, 28, 30, 32, 34–37, 39–42, 44, 46, 47, 49, 54, 58, 59, 62, 66, 67.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 64).

— — var. *oxyrhynchus* (Kütz.) Van Heurck. Ibid. p. 198, fig. 691 B, q.

Loc. Nos. 11, 14, 19, 31, 32, 49, 58–61, 63, 65, 66.

Rare in Sierra Leone (MÖLDER 1962, p. 31).

— — var. *spatulifera* Grun. forma.

Loc. No. 53.



### Asterionella Hass.

No species of this genus has been shown to occur in Ghana. *A. formosa* Hass. has been found, but very rarely, in the Congo area (HUSTEDT 1949 a, p. 65) as well as in Sierra Leone (MÖLDER 1962, p. 31).

### Eunotia Ehr.

*Eunotia alpina* (Naeg.) Hust. HUSTEDT 1930–62, II, p. 304, fig. 770.

Loc. Nos. 12, 38.

Rare in Sierra Leone (MÖLDER 1962, p. 31).

— *arcus* Ehr. Ibid. p. 282, figs. 748 a–c.

Loc. Nos. 2, 6, 11, 12, 58.

Rare in Sierra Leone (MÖLDER 1962, p. 31).

— *asterionelloides* Hust. HUSTEDT 1952 a, p. 138, figs. 18, 19.

Loc. No. 54.

Plate III, fig. 13:  $26.0 \times 2.3 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 282, Loc. No. 54).

First found by HUSTEDT (1952 a, p. 158) in fresh water in the Amazonas region in South America. It forms colonies like *Asterionella* and *Diatoma*. The *Asterionella africana* described by CHOLNOKY (1958 a, p. 103, figs. 2–5) resembles the present species very much.

— *asymmetrica* Cholnoky. CHOLNOKY 1954 d, p. 209, fig. 21.

Loc. No. 11.

Plate I, fig. 14:  $26.1 \times 5.6 \mu$ . 8 striae in  $10 \mu$ . (Sample No. 133, Loc. No. 11).

A similar asymmetrical *E.* form is *E. tenella* (Grun.) Hust. var. *capensis* Cholnoky (CHOLNOKY 1959, p. 25) from South Africa, which is identical with the widely distributed (cosmopolitan?) *E. rhomboidea* Hust. (CHOLNOKY 1960 b, p. 249). Other species of *E.* are often found with asymmetrically developed valves. Thus *E. faba* (Ehr.) Grun. in many places is found more frequently with asymmetrical than with isopolar valves.

— *bonsaensis* no. spec. Plate III, fig. 7.

Valves with a straight ventral margin and a convex dorsal margin; strongly decreasing in breadth from the middle towards the bluntly rounded ends,  $32 \mu$  long,  $8\text{--}9 \mu$  broad. Branches of raphes very short; they take a course very close to the ventral margin at the ends of the valves and reach little on to the surface of the valve. 12 transapical striae in  $10 \mu$  in the middle of the valve, a little denser towards the apices. Pseudoraphe found in the ventral margin and not visible from the surface of the valve.

Type locality: West Ghana. Fresh water (the Bona River, Loc. No. 14). Illustration slide: Ghana No. 151/1961.

Plate III, fig. 7:  $32 \times 8.2 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 151, Loc. No. 14).

Loc. Nos. 8, 14, 28, 58, 65.

— *didyma* Grun. var. *claviculata* Hust. A. SCHMIDT. Atlas 285: 16.

Loc. No. 32.

The species and its many varieties have previously mainly been found in tropical Asia (HUSTEDT 1937–39, p. 175) and tropical South America. None of the forms are common in Ghana, where they have only been found in two localities (Nos. 2 and 32), which are situated far apart.

— fo. *genuina* Hust. Ibid. 285: 19–22.

Loc. No. 32.

Plate II, fig. 2:  $67 \times 12 \mu$ . 9–10 striae in  $10 \mu$ . (Sample No. 217, Loc. No. 32).

Deviating from typical specimens by having a straight ventral margin in the middle of the valve. The usual is a concave ventral margin.

- Eunotia didyma* var. *tuberosa* Hust. Ibid. 285: 10.  
 Loc. Nos. 2, 32.  
 Plate II, fig. 3:  $93 \times 16 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 217, Loc. No. 32).  
 Known from East Africa (ZANON 1941, I: 11).
- *diodon* Ehr. HUSTEDT 1930–62, II, p. 276, fig. 742.  
 Loc. Nos. 15, 56.  
 Plate III, fig. 6:  $34 \times 5.8 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 287, Loc. No. 56).  
 Fairly rare in Sierra Leone (MÖLDER 1962, p. 31).
- *dissimilis* Hust. HUSTEDT 1937–39, p. 164, 11: 10, 11. A. SCHMIDT. Atlas 382: 101, 102.  
 Loc. Nos. 3, 54, 58.  
 Freshwater species resembling *E. praerupta* Ehr. So far shown to occur in Java (HUSTEDT 1937–39, p. 165).
- *epithemoides* Hust. A. SCHMIDT. Atlas 287: 16–19. HUSTEDT 1937–39, p. 174–75.  
 Loc. Nos. 8, 14, 16–20, 34, 60–63, 65, 67.  
 Plate II, fig. 8:  $41.3 \times 10.0 \mu$ . 9–12 striae in  $10 \mu$ . (Sample No. 151, Loc. No. 14).  
 A few previous findings in Africa (first in lagoon in the Cameroons, later found in Lake Edward (HUSTEDT 1949 a, p. 70)). More common in Southeast Asia (HUSTEDT 1937–39, p. 174–75). It has especially been found in alkaline springs and waterfalls and ecologically resembles *E. tschirschiana* O. Müller.
- *faba* (Ehr.) Grun. HUSTEDT 1930–62, II, p. 301, fig. 767.  
 Loc. No. 8.  
 Very rare in the Congo territory (HUSTEDT 1949 a, p. 70), but very common in Sierra Leone (MÖLDER 1962, p. 31).
- *fallax* A. Cleve. Ibid. p. 288, fig. 753 a.  
 Loc. Nos. 12, 13.  
 Rather common in Sierra Leone (MÖLDER 1962, p. 31).
- *flexuosa* (Bréb) Kütz. Ibid. p. 312, fig. 778.  
 Loc. Nos. 3, 8, 15, 35, 38, 39, 41, 44, 55, 56.  
 Rather common in Sierra Leone (MÖLDER 1962, p. 31), but very rare in the Congo territory (HUSTEDT 1949 a, p. 71).  
 Plate III, fig. 2:  $106.7 \times 3.9 \mu$ . (The diameter of capitae is about  $6.0 \mu$ ). 15 striae in  $10 \mu$ .  
 III: 2 perhaps is closely related to *E. mesiana* Cholnoky (CHOLNOKY 1955 b, p. 166, figs. 35, 36), where, however, it is said to be possible to see the dots in the striae distinctly by phase contrast.
- *garussica* Cholnoky. CHOLNOKY 1954 d, p. 210, fig. 29.  
 Loc. Nos. 25, 32, 41, 56.  
 Found in many localities in South Africa (CHOLNOKY), and is also rather common in Sierra Leone (MÖLDER 1962, p. 32).  
 Plate III, fig. 4:  $40 \times 8.7 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 287, Loc. No. 56).
- *gracilis* (Ehr.) Rabenh. HUSTEDT 1930–62, II, p. 308, fig. 775.  
 Loc. Nos. 18, 19, 23, 26, 27, 38, 41, 64.  
 Rather common in Sierra Leone (MÖLDER 1962, p. 30).  
 Plate III, fig. 1:  $105 \times 6 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 244, Loc. No. 41).
- *hugenottarum* Cholnoky. CHOLNOKY 1959, p. 22, figs. 130–135.  
 Loc. Nos. 44, 56.  
 Plate III, fig. 11:  $16.0 \times 3.4 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 287, Loc. No. 56).  
 First shown in South Africa (CHOLNOKY 1959, p. 22).
- *lawsonii* nov. spec. Plate III, fig. 12.  
 Valves with approximately straight ventral margin and very slightly convex dorsal margin, sides almost parallel, and valves not decreasing in breadth towards the apices, 20–23  $\mu$

in length,  $4 \mu$  in breadth. Raphe branches very close to the ventral margin of the valve near the apices; they reach very little on to the surface of the valve. 12 transapical striae in  $10 \mu$ , only a little increasing in density towards the apices. Pseudoraphe not visible from the surface of the valve. The species is closely related to *E. tenella* (Grun.) Hust., but differs by having a greater distance between the striae. Loc. No. 19.

Plate III, fig. 12:  $21.3 \times 4.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 19).

Illustration slide: Ghana No. 165/1961.

Type locality: West-Ghana. Fresh water (Mansi river, Loc. No. 19). Dedicated to the botanist, Dr. G. W. LAWSON, University of Ghana.

*Eunotia lunaris* (Ehr.) Grun. HUSTEDT 1949 a, p. 70, 2: 11–15. 1930–62, II, p. 302, fig. 769. Loc. Nos. 3, 8, 11, 12, 15, 16, 21, 23, 38, 39, 55, 67.

Not rare in the Congo territory (HUSTEDT 1949 a, p. 70), and common in Sierra Leone (MÖLDER 1962, p. 32).

Plate III, fig. 3:  $90 \times 3.7 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 241, Loc. No. 39).

The form pictured is characteristic by the recurrent fissures at the raphe ends.

— — var. *subarcuata* (Naeg.) Grun. HUSTEDT 1930–62, p. 304, figs. 769 f–h.

Loc. Nos. 2, 12, 15, 16, 23, 38, 39, 56.

Rather common in Sierra Leone (MÖLDER 1962, p. 32).

— *mansiensis* nov. spec. Plate II, fig. 4.

Valves with a slightly concave ventral margin and a convex dorsal margin. Breadth of the valve greatly decreasing from the middle towards the obtusely rounded apices;  $45\text{--}50 \mu$  long,  $8\text{--}9 \mu$  broad. Fairly long raphe branches, which from the ventral margin reach little on to the surface of the valve. 12 transapical striae in  $10 \mu$ , only a little denser towards the apices. Pseudoraphe close to the ventral margin and forming a very narrow zone.

Loc. No. 19.

Plate II, fig. 4:  $48.3 \times 8.7 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 166, Loc. No. 19).

Illustration slide: Ghana No. 166/1961.

Type locality: West-Ghana. Fresh water (Mansi river, Loc. No. 19).

— *monodon* Ehr. HUSTEDT 1930–62, II, p. 305, figs. 772 a, b. ZANON 1941, 1: 34.

Loc. Nos. 4, 12, 13, 54.

Rather common in Sierra Leone (MÖLDER 1962, p. 32).

— — var. *bidens* (Greg.) W. Smith. Ibid. p. 306, fig. 772 d.

Loc. No. 64.

Rare in Sierra Leone (MÖLDER 1962, p. 32).

Plate II, fig. 1:  $68 \times 9.3 \mu$ . 13–14 striae in  $10 \mu$ . (Sample No. 306, Loc. No. 64).

— — var. *tropica* Hust. HUSTEDT 1937–39, p. 171. A. SCHMIDT. Atlas 381: 3–8.

Loc. No. 51.

Rather common in Sierra Leone (MÖLDER 1962, p. 32).

— *oliffii* Cholnoky. CHOLNOKY 1956, p. 66, figs. 39–45. 1957 a, figs. 69–73.

Loc. Nos. 12, 28.

Hitherto only shown to occur in South Africa (CHOLNOKY 1956, p. 66).

Plate III, fig. 5:  $40 \times 7.0 \mu$ . 13 striae in  $10 \mu$ . (Sample No. 145, Loc. No. 12).

— *parallela* Ehr. HUSTEDT 1930–62, II, p. 302, fig. 768.

Loc. Nos. 27, 54.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 32).

— *pectinalis* (Dillw.?. Kütz.). Rabenh. Ibid. p. 296, figs. 763 a, k.

Loc. Nos. 1, 8, 11, 12, 18, 24, 33, 38–40, 46, 53, 54, 58, 62, 64, 65.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 70). Rather common in Sierra Leone (MÖLDER 1962, p. 32).

- Eunotia pectinalis* var. *minor* (Kütz.) Rabenh. Ibid. p. 298, figs. 763 d–f.  
 Loc. Nos. 8, 11, 12, 15, 17, 60, 64.  
 Very rare in the Congo territory (HUSTEDT 1949 a, p. 70), but very common in Sierra Leone (MÖLDER 1962, p. 32).
- — — fo. *impressa* (Ehr.) HUSTEDT Ibid. p. 298, figs. 763 g, h.  
 Loc. Nos. 15, 27, 35, 39, 55, 64.  
 Rather common in Sierra Leone (MÖLDER 1962, p. 32).
- — — fo. *intermedia* Krasske. Ibid. p. 298, figs. 763 l–o.  
 Loc. Nos. 2, 26.  
 Rare in Sierra Leone (MÖLDER 1962, p. 32).
- — var. *ventralis* (Ehr.) Hust. Ibid. p. 297, figs. 763 b, c.  
 Loc. Nos. 1, 3, 6, 8, 9, 12–14, 17–20, 22, 24, 25, 28, 30, 44, 46, 53, 64, 67.  
 Very rare in the Congo territory (HUSTEDT 1949 a, p. 70).
- — var. *undulata* Ralfs. A. SCHMIDT. Atlas 271: 26–28. 289: 26–34.  
 Loc. Nos. 1, 6, 12, 14, 19.  
 Rare in Sierra Leone (MÖLDER 1962, p. 32).
- *praerupta* Ehr. HUSTEDT 1930–62, II, p. 280, figs. 747 A, a–e.  
 Loc. Nos. 3, 4, 6, 8, 11, 12, 14, 16, 17, 28, 38, 39, 43.  
 Very rare in the Congo territory (HUSTEDT 1949 a, p. 67), but not rare in Sierra Leone (MÖLDER 1962, p. 32).
- — var. *bidens* (W. Smith) Grun. Ibid. p. 281, figs. 747 A, i–m.  
 Loc. Nos. 4, 12.  
 Rare in the Congo territory (HUSTEDT 1949 a, p. 67).
- *rabenhorsti* Cleve et Grun. fo. *monodon* Cleve et Grun. A. SCHMIDT. Atlas 285: 7, 8. HUSTEDT 1949 a, p. 68, 2: 1–3.  
 Loc. Nos. 12, 13, 16, 18–20, 22, 28, 30.  
 Rare in the Congo territory (HUSTEDT 1949 a, p. 60), and fairly rare in Sierra Leone (MÖLDER 1962, p. 33).  
 Plate I, fig. 15:  $21.3 \times 8.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 168, Loc. No. 20).
- *rhomboidea* Hust. HUSTEDT 1946–50, p. 435, 36: 34–41.  
 Loc. Nos. 8, 11, 12, 14, 17, 22, 27, 38, 39, 51–54, 56, 64.  
 Plate I, fig. 16:  $12.6 \times 6.2 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 279, Loc. No. 53). In girdle view.  
 Plate I, fig. 17:  $12.6 \times 3.0 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 279, Loc. No. 53). In valve view.  
 Recorded from South Africa (CHOLNOKY 1959, p. 25, figs. 143–150, here called *E. tenella* (Grun.) Hust. var. *capensis* Cholnoky; and 1960 b, p. 249).
- *similis* Hust. CHOLNOKY 1954 b, fig. 24. HUSTEDT 1937–39, p. 165. A. SCHMIDT. Atlas 382: 11–24.  
 Loc. No. 10.  
 Previously reported from Southeast Asia (HUSTEDT 1937–39, p. 165) and South Africa (CHOLNOKY 1954 b).  
 Plate III, fig. 10:  $26.7 \times 4.7 \mu$ . 14 striae in  $10 \mu$ . (Sample No. 131, Loc. No. 10).
- *sorriensis* nov. spec. Plate III, fig. 8.  
 Valves with a slightly concave ventral margin and a convex dorsal margin; evenly and slightly tapering from the middle of the valve towards the apices, which are obtusely rounded,  $30 \mu$  long,  $4\text{--}5 \mu$  broad. Raphe branches short and near the apices running from the ventral margin a little on to the side of the valve. Transapical striae 15–16 in  $10 \mu$  in the middle, only a little denser towards the apices. Pseudoraphe not visible from the surface of the valve.  
 Loc. Nos. 3, 11, 12, 27, 35, 52, 56, 60.

Plate III, fig. 8:  $30 \times 4.7 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 223, Loc. No. 35).

Illustration slide: Ghana No. 223/1961.

Type locality: Central Ghana. Freshwater (Sorri river, Loc. No. 35).

*Eunotia subaequalis* Hust. HUSTEDT 1937–39, p. 170; 12: 1–4. CHOLNOKY 1954 d, figs. 42–49. A. SCHMIDT. Atlas 382: 5–10.

Loc. Nos. 11, 13.

Very rare in Sierra Leone (MÖLDER 1962, p. 33).

— *sudetica* O. Müller. HUSTEDT 1930–62, II, p. 299, figs. 764 a, b.

Loc. Nos. 2, 3, 6, 8, 12, 13, 14, 17–20, 22, 23, 26, 30, 32–34, 49, 50, 53, 62, 64, 67.

Rather common in Sierra Leone (MÖLDER 1962, p. 33).

— *tanosoensis* nov. spec. Plate II, fig. 9.

Valves with a concave ventral margin and a convex dorsal margin. Apices retroflected towards the dorsal side.  $33\text{--}38 \mu$  long,  $7\text{--}8 \mu$  broad. Very short raphe branches situated near the apices and only reaching a little on to the surface of the valve. 8–10 transapical striae in  $10 \mu$  in the middle of the valve, denser towards the apices. Pseudoraphe close to the ventral margin.

Loc. No. 32.

Plate II, fig. 9:  $35.3 \times 7.3 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 216 (1), Loc. No. 32).

Illustration slide: Ghana No. 216 (1)/1961.

Type locality: West Ghana. Fresh water (the Tain river, Loc. No. 32).

This taxon is similar to *E. siolii* Hust. and *E. fastigiata* Hust.

— *tarkwaensis* nov. spec. Plate II, fig. 7.

Valves with a straight or very slightly convex ventral margin and a highly convex dorsal margin. Evenly decreasing in breadth from the middle of the valve towards the obtusely rounded apices,  $15\text{--}26 \mu$  long,  $5\text{--}10 \mu$  broad. Raphe branches fairly close to the apices on the ventral side, only a little prolonged on to the surface of the valve. 9–10 transapical striae in  $10 \mu$  in the middle of the valve, increasing to 15–20 in  $10 \mu$  towards the apices. Pseudoraphe in the ventral margin, not visible from the surface of the valve.

Loc. Nos. 14, 58.

Plate II, fig. 7:  $25.3 \times 9.4 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 152, Loc. No. 14).

Illustration slide: Ghana No. 152/1961.

Type locality: Southwest Ghana. Fresh water (Bonsa river at the village Tarkwa, Loc. No. 14).

Closely related to *E. faba* (Ehr.) Grun., but *E. tarkwaensis* has considerably fewer striae in  $10 \mu$  than *E. faba*.

Plate II, fig. 5:  $15.3 \times 4.8 \mu$ . 11–12 striae in  $10 \mu$ . (Sample No. 152, Loc. No. 14).

Plate II, fig. 6:  $18.0 \times 5.3 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 296, Loc. No. 58).

II: 5 and II: 6 are both very small specimens of this species.

— *tenella* (Grun.) Hust. HUSTEDT 1930–62, II, p. 284, fig. 749.

Loc. Nos. 12, 17, 35, 37, 38, 45, 51, 52, 54, 56, 64.

Not rare in the Congo territory (HUSTEDT 1949 a, p. 69). Rather common in Sierra Leone (MÖLDER 1962, p. 33).

— *trigibba* Hust. CHOLNOKY 1957 b, p. 349, figs. 40, 41.

Loc. No. 10.

Very rare in Sierra Leone (MÖLDER 1962, p. 33).

Plate I, fig. 20:  $25.3 \times 9.3 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 131, Loc. No. 10).

— *tschirchiana* O. Müller. A. SCHMIDT. Atlas 382: 98–100. HUSTEDT 1937–39, p. 173, 12: 23–29. 1949 a, p. 70. 1945, p. 904.

Loc. Nos. 2, 3, 6, 8, 9, 12–15, 17, 33, 38, 44, 46, 47, 50, 56, 59, 60, 64, 66, 67.

Somewhat similar to *E. epithemioides* Hust.

Widely distributed in Southeast Asia (HUSTEDT 1937–39, p. 173), but rare in the Congo territory (HUSTEDT 1949 a, p. 70), and very rare in Sierra Leone (MÖLDER 1962, p. 33). In Ghana it is widely distributed, and in many localities very common.

Plate I, fig. 18:  $83 \times 10 \mu$ . 6–7 striae in  $10 \mu$ . (Sample No. 70, Loc. No. 2).

Plate I, fig. 19:  $72 \times 8.7 \mu$ . 11–12 striae in  $10 \mu$ . (Sample No. 70, Loc. No. 2).

*Eunotia veneris* (Kütz.) O. Müller. HUSTEDT 1930–62, II, p. 300, fig. 766.

Loc. Nos. 2, 3, 8, 11, 13, 18, 28, 38, 39, 67.

Very common in Sierra Leone (MÖLDER 1962, p. 33).

— *vumbae* Cholnoky. CHOLNOKY 1956, p. 70, figs. 58–60.

Syn.: *E. rabenhorsti* Cleve et Grun. var. *africana* Hust. (HUSTEDT 1949 a, p. 69, 2: 7–9).

Loc. No. 37.

Plate III, fig. 9:  $30.6 \times 7.3 \mu$ . About 9 striae in  $10 \mu$ . (Sample No. 234, Loc. No. 37).

Previously only recorded from South Africa (CHOLNOKY 1956, p. 70).

## II. Achnanthaceae

### Cocconeis Ehr.

*Cocconeis ankobraensis* nov. spec. Plate IV, fig. 8.

Valves elliptical, 20–25  $\mu$  long, 8–10  $\mu$  broad. Rapheless valve with radial, vigorous, coarsely punctate transapical striae, 14–15 in  $10 \mu$ . Pseudoraphe rather narrow. Raphe valve with 15 radial, prominent, coarsely punctate transapical striae in  $10 \mu$ . Rather broad axial area, which from the middle of the valve, which is without any specially indicated central area, is evenly tapering towards the apices. Raphe branches straight, thin, without special appendices in the middle of the valve or towards the apices.

Loc. Nos. 6, 12, 14, 15, 17, 19, 20, 22, 23, 28, 33, 60, 63, 65.

Plate IV, fig. 8:  $23.3 \times 9.0 \mu$ . 14–15 striae in  $10 \mu$ . (a: rapheless valve, b: raphe valve). (Sample No. 168, Loc. No. 20).

Illustration slide: Ghana No. 168/1961.

Type locality: Southwest Ghana. Fresh water (the Ankobra river, Loc. No. 20).

— *diminuta* Pantocsek. HUSTEDT 1930–62 II, p. 346, fig. 800.

Loc. Nos. 14, 18, 19, 22, 25, 26, 34.

Very rare in Sierra Leone (MÖLDER 1962, p. 34).

— *disculus* (Schum.) Cleve. Ibid. p. 345, fig. 799.

Loc. No. 17.

Very common in Sierra Leone (MÖLDER 1962, p. 34).

— *feuerborni* Hust. HUSTEDT 1937–39, p. 188, 13: 1, 2. A. SCHMIDT. Atlas 407: 44–48.

Loc. Nos. 8, 9, 11, 12, 18.

Plate IV, fig. 11 a:  $20.3 \times 10.7 \mu$ . 22 striae in  $10 \mu$ . Rapheless valve. b:  $21.3 \times 10.8 \mu$ . 24–25 striae in  $10 \mu$ . Raphe valve. (Sample No. 163, Loc. No. 18).

— *placentula* Ehr. HUSTEDT 1930–62, II, p. 347, figs. 802 a, b.

Loc. Nos. 3, 17, 21, 67.

Not common in the Congo territory (HUSTEDT 1949 a, p. 73), and fairly rare in Sierra Leone (MÖLDER 1962, p. 34).

— var. *euglypta* (Ehr.) Cleve. Ibid. p. 349, fig. 802 d.

Loc. Nos. 31, 41, 63, 64, 65.

Rare in the Congo territory (HUSTEDT 1949 a, p. 73), and very rare in Sierra Leone (MÖLDER 1962, p. 34).

— *schröderii* nov. spec. Plate IV, fig. 7.

Valves elliptical, 15–20  $\mu$  long, 10–12  $\mu$  broad. Rapheless valve with distinct, radial, coarsely dotted transapical striae, 12 in  $10 \mu$ . Pseudoraphe very narrow. Raphe valve



with radial, very finely punctate transapical striae, 18 in  $10\ \mu$ . Very narrow axial area, which is very little expanded in the middle of the valve. Raphe branches straight, thin. Loc. No. 21.

Plate IV, fig. 7:  $18.7 \times 10.7\ \mu$ . a: rapheless valve, 12 striae in  $10\ \mu$ . b: raphe valve, 18 striae in  $10\ \mu$ . (Sample No. 171, Loc. No. 21).

Illustration slide: Ghana No. 171/1961.

Type locality: Southwest Ghana. Fresh water (a tributary of the Ankobra river, near the village Humjibre, Loc. No. 21).

Dedicated to the Danish Veterinary Officer KAJ SCHRÖDER, who established the contact to the University of Ghana the result of which was the travels during which the material for the present paper was collected.

The species resembles *C. disculus* (Schum.) Cleve somewhat, but it is rather deviating, i. a. as regards the number of striae.

*Cocconeis scutellum* Ehr. var. *parva* Grun. HUSTEDT 1930–62, II, p. 338, fig. 791.

Loc. No. 32.

Mesohalobous.

— *subdirupta* Cholnoky. CHOLNOKY 1959, p. 16, figs. 102–104. 1960, p. 30, figs. 75–78.

Loc. Nos. 2, 4–6, 8, 9, 11–14, 17–24, 26–34, 41, 58.

Previously only reported from South Africa (CHOLNOKY 1959, p. 16. 1960, p. 30).

Plate IV, fig. 4 a, b:  $10.7 \times 6.0\ \mu$ . 21 striae in  $10\ \mu$ , both on rapheless and raphe valve. (Sample No. 173, Loc. No. 23).

— sp.

Plate IV, fig. 12:  $18.7 \times 11.3\ \mu$ . 12 striae in  $10\ \mu$ . (Sample No. 216, Loc. No. 32).

Plate IV, fig. 13:  $18.6 \times 12.0\ \mu$ . 12 striae in  $10\ \mu$ . (Sample No. 203, Loc. No. 29).

Only rapheless valves have been found, which have some resemblance to rapheless valves of *C. disculus*, but the number of striae is rather deviating, so there is hardly any identity.

### **Achnanthes Bory.**

*Achnanthes coarctata* (Bréb.) Grun. HUSTEDT 1930–62, II, p. 419, figs. 872 a, b.

Loc. Nos. 6, 11.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 76).

— *exigua* Grun. Ibid. p. 386, figs. 832 a, b.

Loc. Nos. 1–4, 6, 8, 9, 11, 12, 14, 17–19, 21–36, 40, 44, 47, 49–52, 55, 57, 58, 60–62, 64–47. Somewhat rare in Sierra Leone (MÖLDER 1962, p. 34). Much distributed, but not very frequent in the Congo area (HUSTEDT 1949 a, p. 75). In the Congo area as well as Sierra Leone var. *heterovalvata* Krasske is more frequent than the species.

— var. *constricta* Torka. Ibid. p. 386, fig. 832 g.

Loc. Nos. 11, 29, 64.

Rare in hot springs in East Africa (HUSTEDT 1949 a, p. 75).

— *hungarica* Grun. Ibid. p. 383, fig. 829.

Loc. Nos. 2–4, 23, 24, 32, 44.

Widely distributed but never common in the Congo territory (HUSTEDT 1949 a, p. 74).

— *inflata* (Kütz.) Grun. Ibid. p. 421, fig. 873.

Loc. Nos. 2, 4, 5, 6, 8, 12–14, 17, 19, 20, 22–24, 27–29, 62, 64–67.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 76).

— *krauselii* Cholnoky. CHOLNOKY 1954 c, p. 271, figs. 5–10.

Loc. Nos. 6, 14, 29, 64.

Previously recorded from South Africa (CHOLNOKY 1954 c, p. 271).

Plate IV, fig. 5:  $9.3 \times 3.6\ \mu$ . About 21 striae in  $10\ \mu$ . (Sample No. 306, Loc. No. 64).

Plate IV, fig. 6:  $14.7 \times 5.0\ \mu$ . About 21 striae in  $10\ \mu$ . (Sample No. 203, Loc. No. 29).

Differs from the closely related *A. subhudsonis* Hust. by having distinctly punctate striae, which are radial on both valves, whereas the rapheless valve of *A. subhudsonis* has striae at right angles to the pseudoraphe.

*Achnanthes lanceolata* (Bréb.) Grun. HUSTEDT 1930-62, II, p. 408, figs. 863 a-d.

Loc. Nos. 1, 2, 4-6, 8, 9, 11-14, 16-37, 40, 41, 49, 50, 58-67.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 75), and in Sierra Leone (MÖLDER 1962, p. 34).

— var. *elliptica* Cleve. Ibid. p. 410, figs. 863 n, o.

Loc. Nos. 22, 34.

Rather common in Sierra Leone (MÖLDER 1962, p. 34).

— — var. *rostrata* (Østrup) Hust. Ibid. p. 410, figs. 863 i-m.

Loc. Nos. 1, 2, 4-6, 8, 11-14, 16-22, 24, 25, 27-34, 36, 39-41, 49, 58-67.

Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 75), but rather common in Sierra Leone (MÖLDER 1962, p. 34).

— *linearis* (W. Smith) Grun. Ibid. p. 378, figs. 381 a, b.

Loc. No. 14.

Very common in Sierra Leone (MÖLDER 1962, p. 34).

— *mansiensis* nov. spec. Plate IV, fig. 3.

Valves linear-elliptical with obtusely rounded apices, 18  $\mu$  long, 6-7  $\mu$  broad. Rapheless valve with a narrow pseudoraphe, without any specially indicated central area. Transapical striae radial, finely punctate, about 24 in 10  $\mu$ . Raphe valve with filiform, straight raphe, narrow axial area with specially indicated central area. Transapical striae radial, finely punctate, about 24 in 10  $\mu$ , somewhat denser towards the apices.

Loc. No. 19.

Plate IV, fig. 3: 18.0  $\times$  6.7  $\mu$ . 24 striae in 10  $\mu$ . (Sample No. 166, Loc. No. 19).

Illustration slide: Ghana No. 166/1961.

Type locality: Southwest Ghana. Fresh water (the Mansi river, a tributary to the Ankobra river, Loc. No. 19).

— *minutissima* Hust. HUSTEDT 1930-62, II, p. 376, fig. 802.

Loc. Nos. 7, 8, 11, 12, 15, 17, 18, 26, 30, 53.

Fairly rare in the Congo territory (HUSTEDT 1949 a, p. 74), but very common in Sierra Leone (MÖLDER 1962, p. 35).

— — var. *cryptocephala* Grun. Ibid. p. 377, figs. 820 d, e.

Loc. Nos. 11-13, 44.

Very common in Sierra Leone (MÖLDER 1962, p. 35).

— *pinnata* Hust. HUSTEDT 1937-39, p. 201, 13: 54-57.

Loc. Nos. 12, 19, 21, 22, 27.

Plate III, fig. 14: 8.7  $\times$  4.0  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 172, Loc. No. 22).

Plate III, fig. 15: 9.4  $\times$  4.0  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 170, Loc. No. 21).

— *subhudsonis* Hust. HUSTEDT 1910, p. 144, 1: 10-12. 1937-39, p. 195, 13: 58, 59. 1949 a, p. 74.

Loc. Nos. 14, 19, 22, 25, 27, 28, 30-33, 36, 60, 63-65.

Fairly rare in the Tropics in Africa and Asia (HUSTEDT 1949 a, p. 74).

Plate IV, fig. 1: 22.0  $\times$  4.3  $\mu$ . 18-20 striae in 10  $\mu$ . (Sample No. 218, Loc. No. 33).

Plate IV, fig. 2: 13.3  $\times$  4.0  $\mu$ . a: 17-18 striae in 10  $\mu$ , b: 18-20 striae in 10  $\mu$ . (Sample No. 299, Loc. No. 60).

### **Rhoiscosphenia** Grun.

*Rhoiscosphenia curvata* (Kütz.) Grun. HUSTEDT 1930-62, II, p. 430, fig. 879.

Not shown to occur in Ghana. Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 76), but very rare in Sierra Leone (MÖLDER 1962, p. 35).

### III. Naviculaceae

#### Diatomella Greville.

*Diatomella balfouriana* Grev. HUSTEDT 1930-62, II, p. 440, fig. 822.  
Loc. Nos. 23, 26.

#### Mastogloia Thwaites.

No species of this genus has with certainty been shown to occur in the material investigated. HUSTEDT (1949 a, p. 76) has found *M. elliptica* (Ag.) Cleve and var. *dansei* (Thwaites) Cleve very rarely and rarely, respectively, in lakes in East Africa. In South Africa CHOLNOKY (1960 a, p. 50) has found several species in fresh water.

#### Frustulia Agardh.

*Frustulia rhomboides* (Ehr.) De Toni var. *saxonica* (Rabenh.) De Toni. HUSTEDT 1930-62, p. 729, fig. 1099 a.

Loc. Nos. 8, 9, 11-16, 18-20, 22, 26, 27, 30, 52, 53, 57, 59-62, 64.

Widely distributed and common in the volcanic region in the northeasterly part of the Congo territory (HUSTEDT 1949 a, p. 78). Very common in Sierra Leone (MÖLDER 1962, p. 35).

— — fo. *capitata* (A. Mayer) Hust. Ibid. p. 729.

Loc. Nos. 12, 15, 16, 33, 34, 38, 61, 64.

Not rare in Sierra Leone (MÖLDER 1962, p. 36).

— *vulgaris* (Thwaites) De Toni. Ibid. p. 730, fig. 1100 a.

Loc. No. 11.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 78).

— *weinholdi* Hust. fo. *ghanaensis* nov. fo. Plate V, fig. 1.

Differs from the species in the greater distance between the striae.

Plate V, fig. 1:  $57.5 \times 9.0 \mu$ . About 24 striae in  $10 \mu$ . (Sample No. 136, Loc. No. 11).

Illustration slide: Ghana No. 136/1961.

Type locality: Southwest Ghana. Fresh water (river west of Takoradi, Loc. No. 11).

#### Gyrosigma Hassall.

*Gyrosigma acuminatum* Kütz.) Rabenh. HUSTEDT 1930, p. 222, fig. 329.

Loc. Nos. 14, 20.

— *attenuatum* (Kütz.) Rabenh. Ibid. p. 224, fig. 330.

Loc. Nos. 34, 49.

— *distortum* (W. Smith) Cleve var. *parkeri* Harrison. Ibid. p. 224, fig. 335.

Loc. Nos. 4, 5, 67.

Mesohalobous.

— *kützingii* (Grun.) Cleve. Ibid. p. 224, fig. 333.

Loc. Nos. 34, 61.

Rather common in South Africa (CHOLNOKY 1960 a, p. 48).

— *scalproides* (Rabenh.) Cleve. Ibid. p. 226, fig. 338.

Loc. Nos. 4, 6, 8, 28-30, 35, 47, 49, 62.

*Gyrosigma spencerii* (W. Smith) Cleve. Ibid. p. 225, fig. 336.

Loc. Nos. 4, 5, 12, 26, 31, 32, 33, 36, 49.

Previously reported from South Africa (CHOLNOKY 1960 a, p. 49).

Mesohalobous.

— var. *nodifera* Grun. Ibid. p. 226, fig. 337.

Loc. Nos. 4–6, 8, 9, 11–22, 24, 25, 27, 28, 33, 60, 61, 65, 67.

Reported from Lake Edward, East Africa (HUSTEDT 1949 a, p. 110), and from South Africa (CHOLNOKY 1960 a, p. 49).

Mesohalobous.

— *wansbeckii* (Donkin) Cleve. Ibid. p. 226, fig. 340.

Loc. No. 62.

Mesohalobous.

— sp.

Loc. Nos. 1, 2.

### Pleurosigma W. Smith.

*Pleurosigma subsalsum* Wislouch et Kolbe. FOGED 1949, p. 12, 2: 17.

Loc. Nos. 2, 3.

Mesohalobous.

— sp.

Loc. Nos. 11, 31.

Mesohalobous.

### Caloneis Cleve.

*Caloneis aequatorialis* Hust. HUSTEDT 1921, figs. 5, 6. 1949 a, p. 101, 11: 17–20. 1922, p. 148, 1: 5, 6. E. MANGUIN 1962, 4: 5. GUERMEUR 1954, 5: 4.

Loc. No. 47.

Scarce in the Congo territory (HUSTEDT 1949 a, p. 101), but very common in South Africa (CHOLNOKY 1960 a, p. 27).

Plate V, fig. 8:  $53.3 \times 10.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 260, Loc. No. 47).

— *bacillum* (Grun.) Cleve. HUSTEDT 1930, p. 236, fig. 360.

Loc. Nos. 1, 6, 8, 11–13, 17, 18, 21, 22, 26–29, 31, 32, 34, 38, 46, 47, 58–62, 64–66.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 99). Fairly rare in Sierra Leone (MÖLDER 1962, p. 36).

— var. *lancettula* (Schulz) Hust. Ibid. p. 236, fig. 361.

Loc. No. 50.

— fo. *inflata* Hust. HUSTEDT 1949 a, p. 99, 11: 26–31.

Loc. Nos. 8, 11, 12, 18, 19, 22, 27, 28, 31, 32, 34, 54, 58, 60–62, 65.

Reported from lakes in East Africa, but not common (HUSTEDT 1949 a, p. 99).

— *beccariana* (Grun.) Cleve. P.T. CLEVE 1894–95, I, p. 50, fig. 6. HUSTEDT 1949 b, p. 44, figs. 1–7. CHOLNOKY 1956, p. 59, figs. 11, 12. FOGED 1959, p. 49, 7: 6.

Syn.: *C. aequatorialis* var. *capitata* Hust. (CHOLNOKY 1959, p. 148, 1: 4).

Loc. No. 47.

Plate VI, fig. 4:  $32.0 \times 6.7 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 260, Loc. No. 47).

CHOLNOKY (1960, p. 27) considers it to be doubtful whether *C. aequatorialis* and *C. beccariana* can be distinguished with certainty.

— *bosumtwiensis* nov. spec. Plate XVII, fig. 4.

Valves linear-lanceolate with parallel or slightly convex sides and extended, broadly and obtusely rounded apices,  $24 \mu$  long,  $4\text{--}5 \mu$  broad. Raphe filiform, straight, with central and apical fissures deflected to the same side. The axial area very broad, half or three

fourths of the breadth of the valve, and in the middle of the valve expanded into a broad central area reaching the margin of the valve. Transapical striae radial, 15–16 in 10  $\mu$ .  
Loc. No. 26.

Plate XVII, fig. 4: 24.0  $\times$  4.7  $\mu$ . 15–16 striae in 10  $\mu$ . (Sample No. 194, Loc. No. 26).

Illustration slide: Ghana No. 194/1961.

Type locality: South Ghana. Fresh water (Bosumtwi Lake, Loc. No. 26).

*Caloneis clevei* (Lagerst.) Cleve. P. T. CLEVE 1894–95, I, p. 51. HUSTEDT 1930, p. 236, fig. 359. 1949 a, p. 98.

Loc. Nos. 11, 34, 47.

Rare in the Congo territory (HUSTEDT 1949 a, p. 98), and in Sierra Leone (MÖLDER 1962, p. 36).

— *desertorum* Hust. HUSTEDT 1949 b, p. 45, figs. 8, 9. FOGED 1959, p. 50, 2: 13.

Loc. Nos. 34, 37.

Previously reported from the Sinai Peninsula (HUSTEDT 1949 b, p. 45) and from Afghanistan (FOGED 1959, p. 50).

Plate V, fig. 10: 31.5  $\times$  8.7  $\mu$ . 20 striae in 10  $\mu$ . (Sample No. 220, Loc. No. 34).

— *fasciata* (Lagerst.) Cleve. J. W. G. LUND 1946, p. 58, figs. L, M, Q–T. FOGED 1959, p. 50, 2: 16.

Loc. No. 32.

Plate V, fig. 7: 21.3  $\times$  6.0  $\mu$ . 18–20 striae in 10  $\mu$ . (Sample No. 215, Loc. No. 32).

— *formosa* (Greg.) Cleve. HUSTEDT 1930, p. 232, fig. 350.

Loc. No. 11.

Mesohalobous.

— *incognita* Hust. HUSTEDT 1910, p. 373, 3: 7. 1937–39, p. 284. 1942, p. 79, fig. 147. CHOLNOKY 1958 a, 1: 9–12.

Loc. Nos. 3–5, 6, 8, 11–13, 17–22, 24, 27–29, 31–34, 36, 38, 44, 46, 47, 60–62, 64–67.

Recorded from, but only rare in the Congo territory (HUSTEDT 1949 a, p. 100).

Plate V, fig. 2: 66  $\times$  7.5  $\mu$ . 20 striae in 10  $\mu$ . (Sample No. 168, Loc. No. 20).

Plate V, fig. 3: 32.0  $\times$  9.0  $\mu$ . 18 striae in 10  $\mu$ . (Sample No. 299, Loc. No. 60).

Plate V, fig. 6: 28.0  $\times$  10.0  $\mu$ . 21–22 striae in 10  $\mu$ . (Sample No. 168, Loc. No. 20).

— *latiuscula* (Kütz.) Cleve var. *subholstei* Hust. HUSTEDT 1930, p. 233, fig. 352.

Loc. No. 11.

— *macedonica* Hust. HUSTEDT 1945, p. 934, 42: 27. GUERMEUR 1954, p. 37, 5: 8. FOGED 1959, p. 50, 2: 14. CHOLNOKY 1960 a, p. 29, fig. 70.

Loc. No. 1.

Widely distributed in South Africa (CHOLNOKY 1960 a, p. 29).

Plate VI, fig. 3: 30.0  $\times$  6.7  $\mu$ . 22–24 striae in 10  $\mu$ . (Sample No. 39, Loc. No. 1).

— *sansomei* nov. spec. Plate V, fig. 9.

Valves linear with parallel margins and broadly rounded apices, 55–60  $\mu$  long, 9–10  $\mu$  broad. Raphe straight, with central fissures deflected to the same side. Axial area lanceolate, rather broad, suddenly highly constricted at a short distance from the apices. Central area a broad transversal zone extended to the sides of the valves. Transapical striae radial, convergent towards the apices, 18 in 10  $\mu$ , crossed by a fine longitudinal line near the margin of the valve.

Loc. No. 47.

Plate V, fig. 9: 57.3  $\times$  9.3  $\mu$ . 18 striae in 10  $\mu$ . (Sample No. 260, Loc. No. 47).

Illustration slide: Ghana No. 260/1961.

Type locality: North Ghana. Fresh water (river between the villages Asong and Nangodi, Loc. No. 47).

Dedicated to Professor F. W. SANSOME, Ph. D., University of Ghana, who as head of the Botanical Laboratory of the University placed a car and necessary assistance at my disposal for the collections in Ghana.

*Caloneis schroederi* Hust. HUSTEDT 1930, p. 235, fig. 356.

Loc. No. 8.

Plate VI, fig. 2:  $32.6 \times 6.6 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 119, Loc. No. 8).

— *silicula* (Ehr.) Cleve. Ibid. p. 236, fig. 362.

Loc. Nos. 12, 47, 53, 65.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 100).

— fo. *minutula* Cholnoky. CHOLNOKY 1954 b, p. 410, fig. 5.

Loc. No. 32.

— — var. *alpina* Cleve. HUSTEDT 1930, p. 238, fig. 366.

Loc. No. 26.

— — var. *truncatula* Grun. Ibid. p. 238, figs. 363, 364.

Loc. Nos. 11, 33, 61.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 100). More common in South Africa (CHOLNOKY 1960 a, p. 29).

— *vehemens* Cholnoky. CHOLNOKY 1962 b, p. 15, figs. 19, 20.

Loc. No. 3.

Plate VI, fig. 1:  $53.3 \times 10.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).

— *vollaensis* nov. spec. Plate V, fig. 4.

Valves linear with parallel sides and cuneately tapering, broadly rounded apices. 25–30  $\mu$  long, 6  $\mu$  broad. Raphe straight, with central fissures slightly deflected to the same side. Axial area broadly lanceolate, about half the breadth of the valve, suddenly tapering towards the apices. Central area a broad transversal zone reaching the sides of the valves. All striae radial, 18 in  $10 \mu$ , clearly dotted, near the margin of the valve crossed by a fine longitudinal band.

Loc. No. 61.

Plate V, fig. 4:  $28.7 \times 6.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 92, Loc. No. 61).

Illustration slide: Ghana No. 92/1961.

Type locality: East Ghana. Fresh water (the Volta river at Ajena, Loc. No. 61).

— — var. *tarkwaensis* nov. var. Plate V, fig. 5.

Differs from the species by having linear-elliptical valves with pointed apices. Axial area lanceolate, about one third of the breadth of the valve.

Loc. Nos. 18, 64.

Plate V, fig. 5:  $32.0 \times 6.6 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 159, Loc. No. 18).

Illustration slide: Ghana No. 159/1961.

Type locality: Southwest Ghana. Fresh water (a small tributary of the Ankobra river near the town Tarkwa, Loc. No. 18).

### Neidium Pfitzer.

*Neidium affine* (Ehr.) Cleve. HUSTEDT 1930, p. 242, fig. 376.

Loc. Nos. 2, 3, 12, 13, 35, 37–39, 41, 42, 44, 45, 50, 52, 56, 62, 65.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 109).

Rather rare in Sierra Leone (MÖLDER 1962, p. 36).

— — var. *amphirhynchus* (Greg.) Cleve. Ibid. p. 244, fig. 377.

Loc. Nos. 4, 11–16, 18, 22, 23, 27, 30, 32, 45, 46, 60–62.



Rare in lakes in East Africa (HUSTEDT 1949 a, p. 109). Common in Sierra Leone (MÖLDER 1962, p. 36).

*Neidium affine* var. *bonsaensis* nov. var. Plate VI, fig. 5.

Differs from the species by having rather narrow, cuneately tapering apices.

Loc. Nos. 11, 12, 14, 38, 43, 44.

Plate VI, fig. 5:  $42.7 \times 8.7 \mu$ . 21–22 striae in  $10 \mu$ . (Sample No. 151, Loc. No. 44).

Illustration slide: Ghana No. 151/1961.

Type locality: Southwest Ghana. Fresh water (the Bonga river, tributary to the Ankobra river, Loc. No. 44).

Probably related to *N. affine* var. *longiceps* (Greg.) Cleve sensu REIMER 1959, p. 13.

— — var. *longiceps* (Greg.) Cleve. HUSTEDT 1930, p. 244, fig. 378.

Loc. Nos. 8, 9, 12, 18, 22, 24, 27, 28, 30, 62.

Rather rare in Sierra Leone (MÖLDER 1962, p. 36).

— *agonaense* nov. spec. Plate VI, fig. 11.

Valves elliptical with slightly protracted, pointed apices,  $84 \mu$  long,  $30 \mu$  broad. Raphe straight, with central pores deflected in the opposite direction. Axial area rather narrow and tapering towards the central area and the apices, in the middle expanded into a rounded central area. Transapical striae in the middle of the valve slightly radial, towards the apices more highly radial, rather finely punctate, about 18 in  $10 \mu$ , along the margin of the valve with several dense fine hyaline stripes.

Loc. Nos. 2, 9, 12, 19, 33, 58.

Plate VI, fig. 11:  $84 \times 30 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 141, Loc. No. 12).

Illustration slide: Ghana No. 141/1961.

Type locality: Southwest Ghana. Fresh water (a small river between the villages Agona and Nsuaem, Loc. No. 12).

Perhaps closely related to *N. apiculatum* Reimer var. *apiculatum* Reimer (REIMER 1959, p. 16, 3: 6).

— *alpinum* Hust. HUSTEDT 1943, p. 189, fig. 48. REIMER 1959, p. 15, 4: 4.

Syn.: *N. perminutum* A. Cleve-Euler 1959, p. 16, 3: 6.

Loc. No. 61.

Plate VI, fig. 13:  $18.6 \times 4.8 \mu$ . 28–30 striae in  $10 \mu$ . (Sample No. 92, Loc. No. 61).

— *binodis* (Ehr.) Hust. var. *binodis* Reimer. REIMER 1959, p. 17, 2: 4.

Loc. No. 46.

— *bisulcatum* (Lagerst.) Cleve. HUSTEDT 1930, p. 242, fig. 374.

Loc. No. 46.

— — var. *baicalensis* (Skvortzow et Meyer) Reimer. REIMER 1959, p. 18, 2: 2.

Loc. Nos. 2, 42, 46.

Plate VI, fig. 9:  $32 \times 5.7 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 70, Loc. No. 2).

— *dayiense* nov. spec. Plate VI, fig. 7.

Valves linear with obtusely rounded apices.  $25\text{--}26 \mu$  long,  $5\text{--}6 \mu$  broad. Raphe filiform, with long, straight central fissures deflected in opposite directions. Axial area narrow. Central area obliquely rectangular, about three fourths of the breadth of the valve. Transapical striae oblique, about 36–40 in  $10 \mu$ .

Loc. No. 65.

Plate VI, fig. 7:  $25.3 \times 5.7 \mu$ . 36–40 striae in  $10 \mu$ . (Sample No. 309, Loc. No. 65).

Illustration slide: Ghana No. 309/1961.

Type locality: Southeast Ghana. Fresh water (the Dayi river, a tributary to the Volta river south of Kpandu, Loc. No. 65).

Fairly closely related to *N. javanicum* Hust. (HUSTEDT 1937–39, p. 408, 16: 12, 13), which also has the characteristic long, straight central fissures, but the transapical striae here are slightly convergent towards the apices.

*Neidium dubium* (Ehr.) Cleve. HUSTEDT 1930, p. 246, fig. 384.

Loc. Nos. 58, 65.

Rather rare in Sierra Leone (MÖLDER 1962, p. 36).

— *gracile* Hust. fo. *aequalis* Hust. HUSTEDT 1937–39, p. 406, 16: 10. 1949 a, p. 110, 8: 20. Loc. No. 23.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 110). Fairly rare in Sierra Leone (MÖLDER 1962, p. 36).

Plate VII, fig. 1:  $42.7 \times 10.7 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 178, Loc. No. 23).

— *hercynicum* A. Mayer fo. *bogosoensis* nov. fo. Plate VI, fig. 6.

Differs from the species and fo. *subrostratum* Reimer by the central area being obliquely across expanded to about half the breadth of the valve.

Loc. Nos. 18, 23, 53, 56.

Plate VI, fig. 6:  $40 \times 8.0 \mu$ . About 22 striae in  $10 \mu$ . (Sample No. 163, Loc. No. 18).

Illustration slide: Ghana 163/1961.

Type locality: Southwest Ghana. Fresh water (a small tributary to the Ankobra river near the village Bogoso, Loc. No. 18).

— *iridis* (Ehr.) Cleve. HUSTEDT 1930, p. 245, fig. 379.

Loc. Nos. 12, 34, 35, 44, 51, 54, 58.

Very rare in the lakes in East Africa (HUSTEDT 1949 a, p. 109). Fairly rare in Sierra Leone (MÖLDER 1962, p. 36).

— — fo. *vernalis* Reichelt. Ibid. p. 245, fig. 380.

Loc. Nos. 1, 2, 11, 12, 19, 26, 28, 35, 38–40, 44, 46, 48, 49, 58, 61, 62, 67.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 36).

— — var. *ampliata* (Ehr.) Cleve. Ibid. p. 245, fig. 381.

Loc. Nos. 2, 32, 47.

— — var. *amphigomphus* (Ehr.) Van Heurek. Ibid. p. 245, fig. 382.

Loc. Nos. 2, 32, 34, 37, 49, 55.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 109).

— *kozłowi* Mereschk. Ibid. 247, fig. 387.

Loc. No. 2.

— — var. *parva* Mereschk. Ibid. p. 248, fig. 389. FOGED 1955, p. 45, 5: 10.

Loc. No. 44.

— *kumasiense* nov. spec. Plate VI, fig. 8.

Valves linear to slightly lanceolate with protracted, broadly rounded apices. 23–26  $\mu$  long, 8–9  $\mu$  broad. Raphe filiform with rather long central fissures deflected in opposite directions. Axial area very narrow, small slightly oblique central area. Transapical striae diagonal, 24–26 in  $10 \mu$ , with 6–9 distinct hyaline longitudinal stripes.

Loc. Nos. 8, 19, 20, 27, 29, 41, 44, 46.

Plate VI, fig. 8:  $24.6 \times 8.7 \mu$ . 24–26 striae in  $10 \mu$ . (Sample No. 196, Loc. No. 27).

Illustration slide: Ghana No. 196/1961.

Type locality: West Ghana. Fresh water (a small river northwest of the Ashanti capital Kumasi, Loc. No. 27).

— *ladogense* (Cleve) Foged var. *densistriata* Østrup. FOGED 1952 b, fig. 2 b.

Syn.: *Caloneis ladogensis* Cleve var. *densistriata* Hust.

Loc. No. 14.

Rare in Sierra Leone (MÖLDER 1962, p. 36).

*Neidium minutissimum* Krasske. KRASSKE 1932, fig. 12. J.W.G. LUND 1946, p. 59, fig. 2 n. Loc. Nos. 32, 35.

Plate VI, fig. 10:  $19.0 \times 4.2 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 215, Loc. No. 32).

— *nsuaemense* nov. spec. Plate VI, fig. 12.

Valves linear-elliptical with rounded apices.  $28-30 \mu$  long,  $6-7 \mu$  broad. Raphe filiform, straight, with long central fissures deflected in opposite directions. Axial area rather narrow, in the middle expanded into an elliptical, somewhat oblique central area. Transapical striae rather greatly diagonal, at one end at right angles to the raphe or slightly convergent, about 24 in  $10 \mu$ , with several distinct longitudinal stripes.

Loc. Nos. 12, 20, 30.

Plate VI, fig. 12:  $29.3 \times 6.7 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 141, Loc. No. 12).

Illustration slide: Ghana No. 141/1961.

Type locality: Southwest Ghana. Fresh water (a small river between the two villages Agona and Nsuaem, Loc. No. 12).

Perhaps related to *N. herrmanni* Hust. (HUSTEDT 1938, p. 408, 16: 11), which, however, has considerably denser striae ( $30-34$  in  $10 \mu$ ).

— *productum* (W. Smith) Cleve. HUSTEDT 1930, p. 245, fig. 383.

Loc. Nos. 12, 15, 38, 44, 62.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 110), rare in Sierra Leone (MÖLDER 1962, p. 36).

### Diploneis Ehr.

*Diploneis notabilis* (Grev.) Cleve. HUSTEDT 1930-62, II, p. 682, fig. 1074 a.

Loc. Nos. 2, 3, 66, 67.

Polyhalobous.

— *oculata* (Bréb.) Cleve. Ibid. p. 675, fig. 1068 a.

Loc. Nos. 1, 29.

— *ovalis* (Hilse) Cleve. Ibid. p. 671, figs. 1065 a-e.

Loc. Nos. 1-3, 8, 9, 11-13, 17, 18, 23, 27, 29, 30, 33-36, 39, 40, 47-50, 54, 58, 61, 62, 64, 66.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 78). Common in Sierra Leone (MÖLDER 1962, p. 36).

— *pseudovalis* Hust. Ibid. p. 668, fig. 1063 c.

Loc. No. 18.

Plate IV, fig. 9:  $11.3 \times 8.6 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 161, Loc. No. 18).

Mesohalobous.

The specimen pictured is very small; usual dimensions are  $16-31 \times 9-14 \mu$ .

— *subovalis* Cleve. Ibid. p. 667, figs. 1063 a, b.

Loc. Nos. 1, 4-6, 8, 9, 11-14, 17-19, 21, 22, 24-33, 36, 37, 41, 62, 64, 66.

Widely distributed in the Tropics, but only infrequently in lakes in East Africa (HUSTEDT 1949 a, p. 77).

Plate IV, fig. 10:  $20 \times 10 \mu$ . 14-15 striae in  $10 \mu$ . (Sample No. 207, Loc. No. 31).

IV: 10 has somewhat closer striae than usual ( $10-12$  in  $10 \mu$ ) in this species.

### Stauroneis Ehr.

*Stauroneis akrosoensis* nov. spec. Plate VII, fig. 2.

Valves linear-elliptical with protracted, obtusely rounded apices.  $52 \mu$  long,  $13-14 \mu$  broad. Raphe filiform, straight. Axial area narrow, immediately before the middle expanded into a central area, the midmost part of which is expanded into a very narrow transversal band extended to the sides of the valve. Transapical striae,  $26-28$  in  $10 \mu$ , in the middle

of the valve nearly at right angles to the raphe, towards the apices more and more radial; distinctly punctate.

Loc. Nos. 19, 60.

Plate VII, fig. 2:  $52 \times 13.6 \mu$ . 26–28 striae in  $10 \mu$ . (Sample No. 299, Loc. No. 60).

Illustration slide: Ghana No. 299/1961.

Type locality: East Ghana. Fresh water (the Asukawkaw river, the Volta river system, near the village Akroso, Loc. No. 60).

*Stauroneis anceps* Ehr. HUSTEDT 1930–62, II, p. 771, fig. 1120 a.

Loc. Nos. 2–5, 8, 9, 12–16, 20, 26, 34, 35, 37–39, 44–47, 49, 50, 53–56, 58, 59, 62, 65.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 79).

Not common in Sierra Leone (MÖLDER 1962, p. 37).

— *anceps* fo. *gracilis* Rabenh. Ibid. p. 771, fig. 1120 b.

Loc. Nos. 4, 6, 8, 12, 20, 26, 32, 38, 44, 46, 55, 62.

Very rare in Sierra Leone (MÖLDER 1962, p. 37).

— var. *hyalina* Brun et Peragallo. Ibid. p. 773, fig. 1120 g.

Loc. Nos. 9, 14, 28, 30, 37, 38, 44–46, 65.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 37).

— *borrichii* (Boye Petersen) Lund. J. W. G. LUND 1946, p. 63, figs. 3 C–H. HUSTEDT 1930–62, II, p. 803, fig. 1151.

Loc. Nos. 4, 26, 47.

Plate VII, fig. 8:  $20.0 \times 4.3 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 194, Loc. No. 26). This specimen has somewhat coarser striae than shown in LUND 1946.

Plate VII, fig. 11:  $15.3 \times 3.4 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 260, Loc. No. 47).

— *crucicula* (Grun.) Cleve. P. T. CLEVE 1894–95, I, p. 151, O. MÜLLER 1911. ZANON 1941, p. 55, 2: 12. CHOLNOKY 1956, p. 87, figs. 128–130.

Loc. Nos. 1, 4–6, 8, 9, 11–14, 16–25, 27–34, 40, 58, 60–65, 67.

Common in Sierra Leone (MÖLDER 1962, p. 37).

Plate VII, fig. 4:  $28 \times 7.4 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 221, Loc. No. 34).

Plate VII, fig. 5:  $23.3 \times 5.6 \mu$ . 21–22 striae in  $10 \mu$ . (Sample No. 217, Loc. No. 32).

Plate VII, fig. 6:  $13.3 \times 6.7 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 203, Loc. No. 29).

Plate VII, fig. 7:  $22 \times 6.7 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 207, Loc. No. 31).

A very variable species, common in all parts of Ghana.

— *kriegeri* Patrick. HUSTEDT 1930–62, II, p. 780, figs. 1126 a, b. GUERMEUR 1954, p. 41, 5: 13. Syn.: *S. pygmaea* Krieger. HUSTEDT 1930, p. 257, fig. 409.

Loc. Nos. 3, 12, 13, 20, 46, 64.

Plate VII, fig. 15:  $17.3 \times 4.7 \mu$ . About 20 striae in  $10 \mu$ . (Sample No. 307, Loc. No. 64).

— *legumen* (Ehr.) Kütz. HUSTEDT 1930–62, II, p. 809, fig. 1156.

Loc. No. 12.

— *lundii* (Lund) Hust. Ibid. p. 798, fig. 1146.

Syn.: *S. truncatula* Lund. J. W. G. LUND 1946, p. 59, figs. 2 U–AA.

Loc. Nos. 1, 38, 44, 49, 58.

— *navrongensis* nov. spec. Plate VII, fig. 12.

Valves linear with triundulate sides and broadly proboscoidiform, obtusely rounded apices. 20–25  $\mu$  long, 4–5  $\mu$  broad. Pseudoseptae very short. Raphe straight, filiform. Axial area narrow, somewhat expanded towards the central area, which is a very broad transversal band extended to the sides of the valve. Transapical striae all radial, 24–26 in  $10 \mu$ , distinctly punctate.

Loc. No. 46.

Plate VII, fig. 12:  $21.3 \times 4.6 \mu$ . 24–26 striae in  $10 \mu$ . (Sample No. 258, Loc. No. 46).

Illustration slide: Ghana No. 258/1961.

Type locality: North Ghana. Fresh water (an artificial pond, 6–7 km east of the village Navrongo).

*Stauroneis nobilis* Schum. HUSTEDT 1930–62, II, p. 778, fig. 1125 b.

Loc. Nos. 12, 18, 30.

— fo. *alabamae* (Heiden) A. Cleve-Euler. Ibid. p. 780, figs. 1125 a, c, d.

Loc. Nos. 11, 12, 18.

— *obtusa* Lagerst. Ibid. p. 817, fig. 1162.

Loc. Nos. 1, 46, 55.

Plate VII, fig. 13:  $28 \times 4.3 \mu$ . About 24 striae in  $10 \mu$ . (Sample No. 285, Loc. No. 55).

— *phoenicenteron* (Nitzsch) Ehr. Ibid. p. 766, fig. 1118 a.

Loc. Nos. 2, 3, 7, 11, 34, 37, 38, 41, 44, 46, 56, 61, 62.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 79), but common in Sierra Leone (MÖLDER 1962, p. 37).

— fo. *brevis* Dippel. Ibid. p. 768, fig. 1118 c.

Loc. No. 26.

— *prominula* (Grun.) Hust. Ibid. p. 802, fig. 1153.

Syn.: *S. parvula* Grun. HUSTEDT 1930, p. 260, fig. 417 a.

Loc. Nos. 12, 19, 26, 27.

Rare in Sierra Leone (MÖLDER 1962, p. 37).

— *schinzii* (Brun) Cleve. P. T. CLEVE 1894–95, I, p. 146. A. SCHMIDT Atlas 242: 9. REIMER 1961, p. 205, 2: 2. BRUN 1891, p. 38, 16: 1.

Loc. Nos. 44, 45, 54.

Previously reported from Southwest Africa and North America. REIMER 1961, p. 206, calls attention to a resemblance to the genus *Pinnularia* "when one considers the broad comma-shaped distal raphe-ends. Yet the striae are distinctly punctate."

Plate VII, fig. 14:  $93 \times 11.3 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 249, Loc. No. 44).

— *slateri* nov. spec. Plate VII, fig. 3.

Valves linear-elliptical with rather narrow, slightly protracted apices.  $51\text{--}52 \mu$  long,  $10 \mu$  broad. Raphe straight, with rather long polar fissures deflected in the same direction. Axial area narrow, near the middle of the valve slightly expanded towards a broad central area extended to the sides of the valve. All transapical striae highly radial, rather coarsely punctate, 18 in  $10 \mu$ . The midmost pair reduced to a few pores near the raphe.

Loc. No. 12.

Plate VII, fig. 3:  $51.3 \times 10.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 144, Loc. No. 12).

Illustration slide: Ghana No. 144/1961.

Type locality: Southwest Ghana. Fresh water (a small tributary to the Ankobra river between the villages Agona and Nsuaem).

Dedicated to the botanist, Dr. SLATER, University of Ghana.

— *smithii* Grun. HUSTEDT 1930–62, II, p. 810, figs. 1157 a–c.

Loc. Nos. 8, 12, 13.

— var. *borgei* (Manguin) Hust. Ibid. p. 811, figs. 1157 h–k.

Syn.: *S. borgei* Manguin. E. MANGUIN 1941 a, p. 179, fig. 69.

*S. smithii* var. *elliptica* Hust. HUSTEDT 1945, p. 914, 42: 34–36.

Loc. Nos. 8, 13.

— var. *incisa* Pantocsek. Ibid. p. 810, figs. 1157 d–g.

Loc. Nos. 6, 8, 9, 11–14, 17–19.

— *spicula* Hickie. Ibid. p. 830, fig. 1173.

Loc. Nos. 42, 44–46.

Plate VIII, fig. 1:  $46.7 \times 8.8 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 252, Loc. No. 45).

Polyhalobous.

*Stauroneis subdahomensis* Guerneur. GUERMEUR 1954, p. 41, 5: 15 e.

Loc. No. 23.

Plate VII, fig. 9:  $14.7 \times 4.3 \mu$ . 22 striae in  $10 \mu$ . (Sample nr. 181, Loc. No. 23).

Possibly this species is identical with *S. dahomensis* Hustedt 1910, p. 378, fig. 11.

— *thermicola* (Boye Petersen), Lund. HUSTEDT 1930–62, p. 800, figs. 1148 a, b.

Loc. No. 30.

— *tropicalis* Guerneur var. *undulata* Guerneur. GUERMEUR 1954, p. 42, 5: 5.

Loc. Nos. 11, 23, 33.

Plate VII, fig. 16:  $28.3 \times 5.3 \mu$ . About 28 striae in  $10 \mu$ . (Sample No. 181, Loc. No. 23).

It is very similar to *S. kriegeri* Patrick fo. *undulata* Hust. (Hustedt 1930–62, II, p. 782, fig. 1126 c).

— *undata* Hust. HUSTEDT 1930–62, II, p. 804, fig. 1152.

Loc. No. 12.

— *wislouchii* Poretzky et Anisimowa. HUSTEDT 1930–62, II, p. 792, fig. 1137.

Loc. Nos. 14, 28.

Plate VII, fig. 10:  $37.3 \times 8.7 \mu$ . 22–24 striae in  $10 \mu$ . (Sample No. 151, Loc. No. 14).

### Anomoeoneis Pfitzer.

*Anomoeoneis exilis* (Kütz.) Cleve. HUSTEDT 1930–62, II, p. 751, figs. 1114 a–c.

Loc. Nos. 7, 10–12, 14–16, 27.

Very common in Sierra Leone (MÖLDER 1962, p. 37).

— — var. *lanceolata* A. Mayer. Ibid. p. 752, fig. 1114 d.

Loc. Nos. 7, 8, 11–13, 32.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 78).

CHOLNOKY (1960 a, p. 26) points out that species and variety are connected by even transitions so that it must be considered unjustifiable to keep the distinction.

— *polygramma* (O. Müller) Hust. Ibid. p. 744.

Loc. Nos. 26, 31, 57.

Previously regarded as a variety of *A. sphaerophora*, but HUSTEDT (1930–62, II, p. 744) says: "Neuerdings durchgeführte Untersuchungen an europäischen und aussereuropäischen Natrongewässern haben mich überzeugt, das *A. polygramma* besser als eigene Art aufzufassen ist."

Mesohalobous.

— *serians* (Bréb.) Cleve var. *brachysira* (Bréb.) Cleve. Ibid. p. 748, figs. 1112 e–h.

Loc. Nos. 11, 38.

Very rare in the lakes in East Africa (HUSTEDT 1949 a, p. 79).

Not rare in Sierra Leone (MÖLDER 1962, p. 37).

— *sphaerophora* (Kütz.) Pfitzer. Ibid. p. 740, fig. 1108 a.

Loc. Nos. 2, 8, 9, 11, 22, 26, 38, 47, 59, 67.

Widely distributed and rather common in lakes in East Africa (HUSTEDT 1949 a, p. 79).

Halophilous.

— — forma.

Loc. No. 26.

Plate VIII, fig. 3:  $56 \times 13.3 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 192, Loc. No. 26).

Halophilous.

— — var. *güntheri* O. Müller. HUSTEDT 1930–62, II, p. 741, fig. 1108 b.

Loc. No. 26.

Plate VIII, fig. 2:  $26.7 \times 12.0 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 192, Loc. No. 26).

Halophilous.



## Navicula Bory.

## Naviculae orthostichae Cleve.

- Navicula cuspidata* Kütz. HUSTEDT 1930-62, III, p. 59, fig. 1206 a.  
 Loc. Nos. 4, 8, 12, 23, 25, 28, 30, 34, 39, 46.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 81).
- — var. *ambigua* (Ehr.) Cleve. Ibid. p. 62, fig. 1206 b.  
 Loc. Nos. 2, 3, 12, 40, 43, 44, 46, 47, 53, 58, 67.  
 Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 81).
- — var. *héribaudii* Peragallo. Ibid. p. 60, fig. 1207.  
 Loc. Nos. 2, 8, 12, 19, 20, 23, 33, 34, 36, 40, 44, 46-50, 58, 62.  
 Disputed form. HUSTEDT (1957, p. 264) is of opinion that it is a mutation of the species, whereas CHOLNOKY (1960 a, p. 57) considers it to be a phenotype which develops under certain ecological circumstances.
- *gregaria* Donkin. HUSTEDT 1930, p. 269, fig. 437.  
 Loc. Nos. 9, 26, 30.  
 Halophilous.  
 HUSTEDT (1957, p. 265) and CHOLNOKY (1960 a, p. 62) are of opinion that this species is extremely widely distributed, but that it has often so far been mistaken for *N. cryptocephala* Kütz. In South Africa, according to CHOLNOKY (1960 a, p. 62), it is very common.
- *halophila* (Grun.) Cleve. HUSTEDT 1930-62, III, p. 64, fig. 1209.  
 Loc. Nos. 1, 4, 7-9, 16, 22, 23, 27, 30, 34, 35, 38, 39, 43, 44, 46, 47, 50, 53-56, 58, 60, 66, 67.  
 Plate VIII, fig. 4:  $40 \times 6.0 \mu$ . 18-20 striae in  $10 \mu$ . (Sample No. 223, Loc. No. 35).  
 Halophilous.  
 Very narrow form, the ordinary breadth of the species being 8-16  $\mu$ .
- — var. *subcapitata* Østrup. ØSTRUP 1910, p. 29, 1: 22.  
 Loc. Nos. 2-4, 15, 20, 33, 36, 38, 44-46, 49, 50, 54, 55, 62.  
 Plate VIII, fig. 8:  $40 \times 7.4 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 268, Loc. No. 50).  
 Halophilous.
- *halophila* fo. *nabogoensis* nov. fo. Plate VIII, fig. 9.  
 Differs from the species by having very little protracted apices and by its "gedrungene" form.  
 Loc. Nos. 37, 43, 44.  
 Plate VIII, fig. 9:  $21.4 \times 7.5 \mu$ . 15-16 striae in  $10 \mu$ . (Sample No. 234, Loc. No. 37).  
 Illustration slide: Ghana No. 234/1961.  
 Type locality: North Ghana. Fresh water (the Nabogo river, the White Volta system, north of the town Tamale, Loc. No. 37).  
 Perhaps closely related to *N. accommoda* Hust. (HUSTEDT 1930-62, III, p. 64, fig. 1208), but as VIII: 9 has striae with the same density through the whole length of the valve, it is probably more closely related to *N. halophila*.
- — fo. *tenuirostris* Hust. HUSTEDT 1942, p. 52, fig. 76.  
 Loc. Nos. 44, 46.  
 Plate VIII, fig. 7:  $30.6 \times 7.8 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 258, Loc. No. 46).
- — forma.  
 Loc. Nos. 34, 44, 66.  
 Plate VIII, fig. 6:  $22.7 \times 6.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).
- — forma.  
 Loc. No. 35.  
 Plate VIII, fig. 5:  $28.6 \times 7.3 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 223, Loc. No. 35).

*Navicula perrotettii* Grun. HUSTEDT 1930-62, III, p. 56, fig. 1205 a.

Loc. Nos. 1, 2, 4, 5, 7-9, 24, 33, 36, 44, 46, 61, 66.

Common in the Tropics (HUSTEDT 1960-62, III, p. 59).

— — *perrotettii* var. *enervis* Hust. Ibid. p. 59, fig. 1205 c.

Loc. No. 58.

### **Naviculae subtilissimae** Hust.

*Navicula ankobraensis* nov. spec. Plate VIII, fig. 10.

Valves linear with slightly concave sides and narrowly protracted capitate apices. 16-20  $\mu$  long, 4-5  $\mu$  broad. Raphe linear, filiform. Axial area linear, narrow, no actual central area, but in the middle of the valve the transapical striae are alternately long and short. Transapical striae radial, 24-26 in 10  $\mu$ .

Loc. No. 22.

Plate VIII, fig. 10: 16.6  $\times$  4.6  $\mu$ . 24-26 striae in 10  $\mu$ . (Sample No. 172, Loc. No. 22).

Illustration slide: Ghana No. 172/1961.

Type locality: Southwest Ghana. Fresh water (a small tributary to the Ankobra river, near the village Awaso, Loc. No. 22).

Fairly great similarity to *N. subarvensis* Hust. (HUSTEDT 1930-62, III, p. 87, fig. 1230) as regards form, and to *N. kwamkuji* Hust. (HUSTEDT 1922, p. 154, fig. 19) as regards the course of the striae, especially in the middle of the valve.

— *bella* Hust. HUSTEDT 1937-39, p. 245, 17: 37.

Loc. No. 35.

Plate VIII, fig. 17: 16.5  $\times$  4.0  $\mu$ . Striae very dense. (Sample No. 223, Loc. No. 35).

— *festiva* Krasske. HUSTEDT 1930-62, III, p. 95, fig. 1242.

Loc. No. 17.

— *invicta* Hust. Ibid. p. 88, fig. 1232. 1937-39, p. 254, 17: 42. CHOLNOKY 1954 d, p. 217, fig. 77.

Loc. Nos. 12, 13, 14, 17, 32.

Plate VIII, fig. 19: 14.0  $\times$  4.0  $\mu$ . Very dense striae. (Sample No. 149, Loc. No. 13).

Somewhat similar to *N. inpunctata* Cholnoky (CHOLNOKY 1957 b, p. 353, figs. 54-57) and *N. perlucida* Hust. (HUSTEDT 1930-62, III, p. 87, fig. 1231).

— *kwamkuji* Hust. HUSTEDT 1922, p. 154, fig. 19.

Loc. Nos. 17, 19, 34, 46, 58, 59, 61, 62.

Previously reported from East Africa (HUSTEDT 1922, p. 154).

Plate VIII, fig. 11: 18.6  $\times$  4.2  $\mu$ . Striae very dense. (Sample No. 220, Loc. No. 34).

— *perlucida* Hust. HUSTEDT 1930-62, III, p. 87, fig. 1231.

Loc. No. 18.

Plate VIII, fig. 18: 13.3  $\times$  3.5  $\mu$ . Striae very dense. (Sample No. 159, Loc. No. 18).

— *standeri* Cholnoky. CHOLNOKY 1957 b, p. 354, fig. 67.

Loc. Nos. 17, 18, 58.

Previously reported from South Africa (CHOLNOKY 1957 b, p. 354).

Plate VIII, fig. 12: 16.6  $\times$  4.6  $\mu$ . 28-30 striae in 10  $\mu$ . (Sample No. 295, Loc. No. 58).

Possibly related to *N. tridentula* Krasske sensu CHOLNOKY 1954 c, figs. 84, 85 and A. SCHMIDT Atlas 400: 85-87.

— *tridentula* Krasske. HUSTEDT 1930-62, III, p. 82, figs. 1223 a-c.

Loc. Nos. 34, 49.

Plate VIII, fig. 13: 16.7  $\times$  3.4  $\mu$ . More than 30 striae in 10  $\mu$ . (Sample No. 221, Loc. No. 34).

— *tridentulaeformis* Bourelly. BOURELLE et MANGUIN 1949, p. 171, 7: 85.

Loc. Nos. 34, 36, 40, 58, 61.

Plate VIII, fig. 14: 11.5  $\times$  3.4  $\mu$ . About 36 striae in 10  $\mu$ . (Sample No. 232, Loc. No. 36).

According to BOURELLY et MANGUIN 1949, p. 172: "Differ de *N. tridentula* Krasske par l'absence d'area centrale transversalement élargie".

*Navicula voltaensis* nov. spec. Plate VIII, fig. 16.

Valves linear with almost parallel or very little convex sides, with obtusely protracted apices.  $22\ \mu$  long,  $5\text{--}6\ \mu$  broad. Raphe straight, filiform. Axial area very narrow, linear, no specially indicated central area. Transapical striae radial, about 36 in  $10\ \mu$ .

Loc. No. 58.

Plate VIII, fig. 16:  $22.0 \times 5.3\ \mu$ . About 36 striae in  $10\ \mu$ . (Sample No. 296, Loc. No. 58). Illustration slide: Ghana No. 296/1961.

Type locality: East Ghana. Fresh water (the Volta river near the town Kete Krachi, Loc. No. 58).

### *Navicula bacillares* Cleve.

*Navicula aketechiensis* nov. spec. Plate X, fig. 33.

Valves linear-elliptical with rounded apices.  $30\text{--}35\ \mu$  long,  $10\text{--}12\ \mu$  broad. Raphe filiform, straight. Axial area rather broad, slightly increasing in breadth from the poles towards the middle of the valve. No specially indicated central area. Transapical striae all radial, 21 in  $10\ \mu$ , towards the apices somewhat denser.

Loc. No. 11.

Plate X, fig. 33:  $33.6 \times 10.7\ \mu$ . 21 striae in  $10\ \mu$ . (Sample No. 136, Loc. No. 11).

Illustration slide: Ghana No. 136/1961.

Type locality: Southwest Ghana. Fresh water (a small river to the west of the town Takoradi, Loc. No. 11).

Perhaps closely related to *N. seminoides* Hust. (HUSTEDT 1927, p. 163, 5: 8 and FOGED 1959, p. 62, 6: 2), which has a narrow axial area, whereas X: 33 has rather a broad axial area very slightly increasing in breadth from the apices towards the middle of the valve.

— *americana* Ehr. HUSTEDT 1930–62, III, p. 111, fig. 1246.

Loc. Nos. 2, 4, 41, 50, 54, 58, 62.

— *bacillum* Ehr. Ibid. p. 113, figs. 1248 a–d.

Loc. Nos. 2, 6, 8, 9, 11, 14, 16–18, 33, 34, 36, 40, 48, 54, 58–60, 62, 65.

Very rare in East Africa (HUSTEDT 1949 a, p. 88), and rare in Sierra Leone (MÖLDER 1962, p. 38).

— *bosumtwiensis* nov. spec. Plate IX, fig. 19.

Valves linear-elliptical,  $20\ \mu$  long,  $5\text{--}6\ \mu$  broad. Raphe linear, with rather long polar fissures deflected to the same side. The middle of the surface of the valve is without any visible structure. Transapical striae very short, only reaching about one fourth from the margin towards the raphe, 21–22 in  $10\ \mu$ .

Loc. No. 26.

Plate IX, fig. 19:  $20.0 \times 5.4\ \mu$ . 21–22 striae in  $10\ \mu$ . (Sample No. 192, Loc. No. 26).

Illustration slide: Ghana No. 192/1961.

Type locality: South Ghana. Fresh water (Bosumtwi Lake, Loc. No. 26).

Resembles *N. lucens* Hust. (HUSTEDT 1930–62, III, p. 177, fig. 1311), which has been found at the coast of Borneo, and at the coast of South Africa (CHOLNOKY 1963 c). IX: 19, however, differs considerably from *N. lucens*, first of all by having greatly lengthened polar fissures, but also by its considerably greater dimensions and denser striae.

— *demissa* Hust. HUSTEDT 1930–62, III, p. 160, figs. 1294 a, b.

Loc. No. 1.

Plate IX, fig. 5:  $9.4 \times 5.3\ \mu$ . 18 striae in  $10\ \mu$ . (Sample No. 35, Loc. No. 1).

— *esamangensis* nov. spec. Plate VIII, fig. 20.

Valves linear-elliptical with broadly rounded apices.  $18\text{--}20\ \mu$  long,  $6\ \mu$  broad. Raphe

linear, filiform, with short polar fissures deflected to the same side. Axial area linear, narrow, in the middle of the valve expanded into a small rounded central area. Transapical striae radial, about 24 in  $10 \mu$ ; in the middle of the valve a few striae with a greater distance.

Loc. Nos. 12, 14, 19, 21, 29, 31–36, 39, 58, 61, 64.

Plate VIII, fig. 20:  $19.3 \times 6.0 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Fresh water (a small river, about 60 km. northwest of Kumasi, near the village Esamang).

*Navicula helensis* Schulz. HUSTEDT 1930–62, III, p. 179, fig. 1314.

Loc. No. 34.

Plate IX, fig. 3:  $24.0 \times 6.6 \mu$ . 21–22 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).

— *impepa* Hust. Ibid. p. 150, fig. 1282.

Loc. Nos. 4, 19, 29, 32, 34, 37, 39, 44, 46, 54, 62, 65.

Previously only reported from South Sweden (HUSTEDT 1930–62, III, p. 150).

— *insociabilis* Krasske. Ibid. p. 181, figs. 1315 a–h. A. SCHMIDT Atlas 400: 19–26, 103, 105. FOGED 1959, p. 54, 3: 11.

Syn.: *N. fritschii* (Hust.). LUND 1946, p. 77, figs. a–g. CHOLNOKY 1957, p. 62, fig. 130.

Plate XI, fig. 2:  $11.4 \times 4.7 \mu$ . 18–19 striae in  $10 \mu$ . (Sample No. 70, Loc. No. 62).

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 87).

— *kriegeri* Krasske. HUSTEDT 1930–62, III, p. 157, fig. 1290.

Loc. No. 32.

Plate IX, fig. 4:  $12.2 \times 4.2 \mu$ . 16 striae in  $10 \mu$ . (Sample No. 215, Loc. No. 32).

— *langoraensis* nov. spec. Plate X, fig. 32.

Valves linear with parallel sides and flatly rounded apices.  $20 \mu$  long, 6–7  $\mu$  broad. Raphe filiform with short polar fissures deflected to the same side. Axial area narrow, in the middle of the valve slightly expanded into a central area. Transapical striae at right angles to the raphe, about 24 in  $10 \mu$ .

Loc. Nos. 32, 34, 39, 60.

Plate X, fig. 32:  $20.0 \times 6.5 \mu$ . About 24 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).

Illustration slide: Ghana No. 220/1961.

Type locality: West Ghana. Fresh water (the Black Volta river near the village Langora, Loc. No. 34).

— *medioconvexa* Hust. HUSTEDT 1930–62, III, p. 151, fig. 1283.

Loc. No. 14.

— *modica* Hust. Ibid. p. 154, fig. 1289.

Loc. No. 60.

Plate IX, fig. 7:  $11.4 \times 5.0 \mu$ . 18–19 striae in  $10 \mu$ . (Sample No. 299, Loc. No. 60).

— *nyassensis* O. Müller. O. MÜLLER 1911, p. 83, 1: 5. A. SCHMIDT Atlas 396: 35–38. 397: 43. HUSTEDT 1949 a, p. 88, 5: 20.

Loc. Nos. 19, 33, 36, 40, 58, 60.

Widely distributed in lakes in East Africa (HUSTEDT 1949 a, p. 88).

Plate IX, fig. 14:  $48 \times 10.7 \mu$ . 21–22 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 19).

Plate IX, fig. 15:  $36.0 \times 12.7 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 293, Loc. No. 58). A somewhat deviating, wide specimen.

— *omissa* Hust. HUSTEDT 1930–62, III, p. 160, fig. 1295. 1957, p. 277, figs. 12, 13.

Loc. Nos. 3, 46, 47.

Previously reported from the Balkans and North Germany (HUSTEDT 1930–62, III, p. 160).

Plate IX, fig. 6:  $11.3 \times 5.4 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).

*Navicula pelliculosa* (Bréb.) Hilse. HUSTEDT 1930-62, III, p. 172, fig. 1305.

Loc. No. 1.

Not rare in Sierra Leone (MÖLDER 1962, p. 39).

— *platycephala* O. Müller. O. MÜLLER 1911, p. 84, 1: 12. A. SCHMIDT Atlas 396: 34. HUSTEDT 1949 a, p. 89, 5: 19, 21, 22. CHOLNOKY 1956, p. 79, fig. 94.

Loc. Nos. 2, 3, 13, 15, 17, 19, 20, 23, 26-28, 30, 31, 33-37, 40, 51, 44, 49, 51, 55, 58, 59, 62, 65.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 89).

Plate IX, fig. 16:  $46.7 \times 12.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 284, Loc. No. 55).

Plate IX, fig. 17:  $32.0 \times 8.0 \mu$ . 18-19 striae in  $10 \mu$ . (Sample No. 234, Loc. No. 37).

— forma.

Loc. No. 41.

Plate IX, fig. 18:  $57.4 \times 8.0 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 243, Loc. No. 41).

— *pseudographa* Manguin. GUERMEUR 1954, p. 56, 10: 3.

Loc. Nos. 6, 30.

Plate X, fig. 28:  $13.3 \times 6.2 \mu$ . 22-24 striae in  $10 \mu$ . (Sample No. 204, Loc. No. 30).

Plate XI, fig. 12:  $12.0 \times 5.3 \mu$ . 18-19 striae in  $10 \mu$ . (Sample No. 203, Loc. No. 30).

— *pupula* Kütz. HUSTEDT 1930-62, III, p. 120, figs. 1254 a-g.

Loc. Nos. 1-6, 8, 9, 11-15, 17-21, 24-26, 28-35, 37, 40, 43, 44, 46, 47, 49, 50-53, 57-59, 61-63, 65-67.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 88). Very common in Sierra Leone (Mölder 1962, p. 39).

— fo. *capitata* Skvortzow et Meyer. Ibid. p. 121, figs. 1254 i-m.

Loc. Nos. 1-4, 7, 8, 10-16, 18, 19, 21-23, 26-29, 31, 32, 34, 38, 41-49, 52, 53, 57, 58, 60-62, 64-67.

Not rare in lakes in East Africa (HUSTEDT 1949 a, p. 88), and in Sierra Leone (MÖLDER 1962, p. 39).

— fo. *elliptica* Hust. Ibid. p. 121, fig. 1254 h.

Loc. Nos. 12, 21, 29, 61.

— fo. *rectangularis* (Greg.) Grun. Ibid. p. 121, figs. 1254 n-q.

Loc. Nos. 2-4, 15, 16, 21, 33, 36, 38-40, 44, 46, 52, 53, 58, 61, 62, 65-67.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 88), but very common in Sierra Leone (MÖLDER 1962, p. 39).

— fo. *rostrata* Hust. Ibid. p. 121, fig. 155.

Loc. No. 58.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 88) and in Sierra Leone (MÖLDER 1962, p. 39).

— *thienemanni* Hust. HUSTEDT 1937-39, p. 235, 17: 16, 17. 1949 a, p. 82.

Loc. Nos. 13, 18-20, 32, 46, 60.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 82).

(var. *africana* Cholnoky reported, but very rare, from Sierra Leone (MÖLDER 1962, p. 40)).

Plate IX, fig. 8:  $15.3 \times 4.7 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 19).

— *ventralis* Krasske. HUSTEDT 1930-62, III, p. 140, figs. 1273 a-d. FOGED 1959, p. 56, 3: 22.

Loc. Nos. 22, 23, 28, 31.

Very rare in Sierra Leone (MÖLDER 1962, p. 40).

Plate IX, fig. 9:  $13.9 \times 5.3 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 210, Loc. No. 31). Somewhat coarser striae than usual (28 in  $10 \mu$ ).

### *Naviculæ miniscalæ* (Cleve) Hust.

*Navicula abuenis* nov. spec. Plate XII, fig. 10.

Valves rhomboid with rounded apices.  $26 \mu$  long,  $8-9 \mu$  broad. Raphe straight, filiform.

Axial area rhomboid, from the apices evenly increasing until three fourth of the breadth of the valve in the middle of the valve. Transapical striae short, ca. one fourth of the breadth of the valve, ca. 18 in 10  $\mu$ , distinctly punctate.

Loc. Nos. 1, 2, 4, 21, 22, 25–31, 33, 38, 58, 62, 65, 67.

Plate XII, fig. 10: 26.0  $\times$  8.7  $\mu$ . 18 striae in 10  $\mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Fresh water (the Abu river, a tributary to Tano river, Loc. No. 31).

*Navicula ajenaensis* nov. spec. Plate IX, fig. 1.

Valves linear-elliptical, 25–40  $\mu$  long, 5–8  $\mu$  broad. Raphe straight, filiform. Axial area narrow, linear, in the middle of the valve expanded into a rounded-off, slightly irregular central area. Transapical striae radial, 20–21 in 10  $\mu$ , in the middle of the valve a few shortened ones.

Loc. Nos. 58, 61.

Plate IX, fig. 1: 36.7  $\times$  6.7  $\mu$ . 20 striae in 10  $\mu$ . (Sample No. 294, Loc. No. 58).

Illustration slide: Ghana No. 294/1961.

Type locality: East Ghana. Fresh water (the Volta river near the town Kete Krachi, Loc. No. 58).

Plate IX, fig. 2: 26.0  $\times$  5.9  $\mu$ . 21 striae in 10  $\mu$ . (Sample No. 95, Loc. No. 61). Deviates from the *typus* by having somewhat curved raphe branches.

— *bacilliformis* Grun. HUSTEDT 1930, p. 273, fig. 446.

Loc. Nos. 2–4, 11, 23, 26, 30, 41, 53, 54, 64.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 83), and rare in Sierra Leone (MÖLDER 1962, p. 37).

— *bamboiensis* nov. spec. Plate X, fig. 29.

Valves rhombic-elliptical with obtusely rounded apices. 10  $\mu$  long, 5–6  $\mu$  broad. Raphe filiform, straight. Axial area linear, narrow, in the middle of the valve expanded into a rounded central area. Transapical striae all radial, about 20 in 10  $\mu$ , denser towards the poles.

Loc. No. 34.

Plate X, fig. 29: 10.0  $\times$  5.3  $\mu$ . 19–20 striae in 10  $\mu$ . (Sample No. 220, Loc. No. 34).

Illustration slide: Ghana No. 220/1961.

Type locality: West Ghana. Fresh water (the Black Volta river at the Bamboi ferry, Loc. No. 34).

— *bawdiaensis* nov. spec. Plate X, fig. 26.

Valves linear-elliptical with rounded apices. 16  $\mu$  long, 6  $\mu$  broad. Raphe straight, with polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into an irregular central area extended across the valve. Transapical striae slightly radial, 24–25 in 10  $\mu$ .

Loc. Nos. 19, 58.

Plate X, fig. 26: 16.0  $\times$  6.0  $\mu$ . 24–25 striae in 10  $\mu$ . (Sample No. 165, Loc. No. 19).

Illustration slide: Ghana No. 165/1961.

Type locality: Southwest Ghana. Fresh water (the Mansi river, a tributary to the Ankobra river, near the village Bawdia, Loc. No. 19).

Perhaps closely related to *N. variostrata* Krasske (HUSTEDT 1930–62, III, p. 201, fig. 1320), but the course of striae in the middle of the valve is somewhat different.

— *bicephala* Hust. HUSTEDT 1952, p. 398, fig. 106.

Loc. Nos. 18, 23.

Plate XVI, fig. 7: 21.3  $\times$  4.2  $\mu$ . 18–19 striae in 10  $\mu$ . (Sample No. 163, Loc. No. 18).

— *butreensis* nov. spec. Plate IX, fig. 11.

Valves linear-elliptical with protracted, obtusely rounded apices. 12  $\mu$  long, 5  $\mu$  broad.



Raphe filiform, straight. Axial area rather narrow, linear. No specially indicated central area. Transapical striae at right angles to the raphe or slightly radial, 24 in 10  $\mu$ .

Loc. No. 6.

Plate IX, fig. 11: 12.0  $\times$  5.0  $\mu$ . 24 striae in 10  $\mu$ . (Sample No. 116 b, Loc. No. 6).

Illustration slide: Ghana No. 116 b/1961.

Type locality: Southwest Ghana. Fresh water (the Butre river north of Cape Three Points, Loc. No. 6).

*Navicula consentanea* Hust. HUSTEDT 1939, p. 625, figs. 98–100.

Loc. No. 11.

Plate X, fig. 7: 16.0  $\times$  4.7  $\mu$ . 18–20 striae in 10  $\mu$ . (Sample No. 136, Loc. No. 11).

Mesohalobous.

Differing somewhat from the typical form of *N. consentanea*, especially as regards apical striae, which in X: 7 are slightly convergent.

— *contenta* Grun. HUSTEDT 1930–62, III, p. 209, figs. 1328 a–d.

Loc. Nos. 11, 22, 29, 30, 31, 65.

Very common in Sierra Leone (MÖLDER 1962, p. 38).

— *fo. biceps* Arnott. Ibid. p. 209, figs. 1328 h, l.

Loc. Nos. 4, 6, 8, 9, 11–14, 16–19, 22, 27, 30, 31, 33, 39, 64, 66.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 85). Fairly rare in Sierra Leone (MÖLDER 1962, p. 38).

Plate VIII, fig. 15: 7.0  $\times$  2.7  $\mu$ . Striae very dense. (Sample No. 210, Loc. No. 31).

The shape of this very small specimen is, if anything, like that of *N. aërophila* Krasske (HUSTEDT 1930–62, III, fig. 1327), but striae, axial and central areas are as usual in *N. contenta fo. biceps*.

— *fo. parallela* Boy Petersen. Ibid. p. 209, figs. 1328 e–g.

Loc. Nos. 6, 8, 11–13, 16–18, 22, 29, 31, 62, 67.

Rather common in Sierra Leone (MÖLDER 1962, p. 38).

— *confervacea* (Kütz.) Grun. Ibid. p. 205, figs. 1224 a–d. GUERMEUR 1954, p. 46, 7: 4.

Loc. Nos. 2–4, 6–19, 23, 27, 29, 31, 58, 59, 62, 67.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 97) and in Sierra Leone (MÖLDER 1962, p. 38).

Plate XII, fig. 6: 20.0  $\times$  7.5  $\mu$ . 22 striae in 10  $\mu$ . (Sample No. 161, Loc. No. 18).

— *dugaensis* nov. spec. Plate X, fig. 25.

Valves linear-elliptical with rounded apices. 20–22  $\mu$  long, 6  $\mu$  broad. Raphe filiform, with polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into a central area extended to the margins and with a few irregularly distributed striae. Transapical striae radial, about 22 in 10  $\mu$ , denser towards the apices. Loc. Nos. 22, 64.

Plate X, fig. 25: 20.6  $\times$  6.0  $\mu$ . 22 striae in 10  $\mu$ . (Sample No. 305, Loc. No. 64).

Illustration slide: Ghana No. 305/1961.

Type locality: East Ghana. Fresh water (a torrent between the villages Duga and Wuinta, Loc. No. 64).

Plate X, fig. 27: 14.7  $\times$  4.7  $\mu$ . 21 striae in 10  $\mu$ . (Sample No. 173, Loc. No. 22). I refer this specimen to *N. dugaensis* with some doubt.

— *huniensis* nov. spec. Plate X, fig. 1.

Valves linear, with parallel sides and slightly protracted, obtusely rounded apices, 18  $\mu$  long, 6  $\mu$  broad. Raphe filiform, straight. Axial area narrow, no specially indicated central area. Transapical striae in the middle of the valve at right angles to the raphe, towards the apices slightly radial, 30–32 in 10  $\mu$ .

Loc. No. 17.

Plate X, fig. 1:  $18.0 \times 6.0 \mu$ . 30–32 striae in  $10 \mu$ . (Sample No. 157, Loc. No. 17).

Illustration slide: Ghana No. 157/1961.

Type locality: Southwest Ghana. Fresh water (the Huni river, a tributary to the Ankobra river, Loc. No. 17).

Presumably this species is related to *N. abstrusa* Hust. (HUSTEDT 1930–62, III, p. 270, fig. 1378), in which all striae are radiating.

- *iniqua* Krasske. CHOLNOKY 1957 c, p. 75. A. SCHMIDT Atlas 398: 40–42.

Loc. Nos. 17, 19.

Plate X, fig. 24:  $18.0 \times 5.7 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 157, Loc. No. 17).

- *kolugoensis* nov. spec. Plate XII, fig. 9.

Valves broadly elliptical with broadly rounded apices. 17–18  $\mu$  long, 8–9  $\mu$  broad. Raphe filiform, straight. Axial area lanceolate, in the middle of the valve up to about one third of the breadth of the valve. Transapical striae radial, 12–15 in  $10 \mu$ , coarsely punctate.

Loc. Nos. 33, 41.

Plate XII, fig. 9:  $18.0 \times 8.0 \mu$ . 12–13 striae in  $10 \mu$ . (Sample No. 244, Loc. No. 41).

Illustration slide: Ghana No. 244/1961.

Type locality: North Ghana. Freshwater (swamp near the river White Volta near the village Kolugo, Loc. No. 41).

Similar to *N. confervacea* (Kütz.) Grun., but in XII: 9 the striation is considerably coarser.

- *lawsonii* nov. spec. Plate X, fig. 6.

Valves linear with slightly convex expansion in the middle of the valve and with broadly rounded apices. 16  $\mu$  long, 3–4  $\mu$  broad. Raphe filiform, straight. Axial area narrow, in the middle expanded into a small rounded central area. Transapical striae, about 24 in  $10 \mu$ , in the middle of the valve slightly radial, towards the apices fairly highly convergent.

Loc. No. 26.

Plate X, fig. 6:  $16.0 \times 3.4 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 192, Loc. No. 26).

Illustration slide: Ghana No. 192/1961.

Type locality: South Ghana. Fresh water (Bosumtwi lake, Loc. No. 26).

Dedicated to the botanist, Dr. G. W. LAWSON, University of Ghana.

- *longicephala* Hust. HUSTEDT 1944, p. 277, fig. 17.

Loc. Nos. 12, 18.

Previously only reported from the Cameroons (HUSTEDT 1944, p. 277).

Plate XVI, fig. 8:  $22.0 \times 4.2 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 141, Loc. No. 12).

- *minima* Grun. HUSTEDT 1930–62, III, p. 249, fig. 1374.

Loc. Nos. 8, 19, 30, 31.

(var. *atomoides* (Grun.) Cleve is recorded as very rare from lakes in East Africa (HUSTEDT 1949 a, p. 84), and rare from Sierra Leone (MÖLDER 1962, p. 39)).

Plate X, fig. 22:  $7.6 \times 3.5 \mu$ . 24–26 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 10).

- *nunguaensis* nov. spec. Plate X, fig. 5.

Valves broadly elliptical, with narrowly protracted apices, 18–20  $\mu$  long, 5–6  $\mu$  broad. Raphe linear, filiform. Axial area linear, narrow; no specially indicated central area. Transapical striae at right angles to the raphe, 18–20 in  $10 \mu$ .

Loc. Nos. 1, 43, 46.

Plate X, fig. 5:  $19.4 \times 6.0 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 33, Loc. No. 1).

Illustration slide: Ghana No. 33/1961.

Type locality: South Ghana. Fresh water (cattle-pool at the Nungua farm, property of the University of Ghana, Loc. No. 1).

Seems to be closely related to *N. molesta* Krasske (HUSTEDT 1930–62, III, p. 252, fig. 1359). Especially deviating by the shape of the apices.

*Navicula pseudagrestis* Lund. FOGED 1958, p. 101, 7: 16.

Loc. No. 63.

Plate X, fig. 23:  $14.7 \times 4.3 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 301, Loc. No. 63).

— *pseudofaceta* Guermeur. GUERMEUR 1954, 10: 8.

Loc. Nos. 3, 29, 66.

Plate X, fig. 18:  $9.5 \times 4.8 \mu$ . 16–18 striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).

— *rotunda* Hust. HUSTEDT 1930–62, III, p. 273, fig. 1403.

Loc. Nos. 6, 11, 35, 47, 58, 64.

Plate X, fig. 16:  $14.0 \times 8.0 \mu$ . 21–22 striae in  $10 \mu$ . (Sample No. 136, Loc. No. 11).

— *sansomei* nov. spec. Plate IX, fig. 12.

Valves elliptical with rather pointedly protracted apices.  $14 \mu$  long,  $5\text{--}6 \mu$  broad. Raphe filiform, straight. Transapical striae at right angles to the raphe or slightly radial, 18 in  $10 \mu$ . Axial area rather narrow, linear; no specially indicated central area.

Loc. Nos. 61, 62, 65.

Plate IX, fig. 12:  $14.0 \times 5.3 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 95, Loc. No. 61).

Illustration slide: Ghana No. 95/1961.

Type locality: East Ghana. Fresh water (the Volta river near the village Ajena, Loc. No. 61).

Dedicated to Professor, Dr. F. W. SANSOME.

— *schadei* Krasske. HUSTEDT 1930–62, III, p. 222, fig. 1340.

Loc. Nos. 31, 32, 46.

Plate IX, fig. 10:  $10.7 \times 5.6 \mu$ . 22–24 striae in  $10 \mu$ . (Sample No. 217, Loc. No. 32).

IX: 10 is with some doubt referred to this species, even though there is fairly good agreement as regards shape as well as structure.

— *seminuloides* Hust. Ibid. p. 244, fig. 1369 a.

Loc. Nos. 1, 6, 14, 17, 19, 25, 31, 32, 34, 58, 60.

Very rare in Sierra Leone (MÖLDER 1962, p. 40). (var. *sumatrana* Hust. is reported, but rarely, from lakes in East Africa (HUSTEDT 1949 a, p. 84)).

Plate X, fig. 12:  $12.0 \times 5.3 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 294, Loc. No. 58).

Plate X, fig. 13:  $8.0 \times 4.0 \mu$ . 24–26 striae in  $10 \mu$ . (Sample No. 186, Loc. No. 25).

Plate X, fig. 14:  $7.0 \times 3.4 \mu$ . 25–26 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 19).

Plate X, fig. 17:  $8.7 \times 4.7 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).

Presumably Plate X, fig. 15:  $10.6 \times 4.3 \mu$ . 28–30 striae in  $10 \mu$ . (Sample No. 213, Loc. No. 29) is related to this species.

— *seminulum* Grun. Ibid. p. 241, fig. 1367.

Loc. Nos. 3, 22, 26, 28–30, 43, 46, 64.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 83), and in Sierra Leone (MÖLDER 1962, p. 40).

Plate X, fig. 8:  $10.6 \times 4.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 204, Loc. No. 30).

Plate X, fig. 9:  $11.0 \times 4.4 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).

Plate X, fig. 10:  $14.7 \times 4.0 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 203, Loc. No. 29).

— *sorriensis* nov. spec. Plate XII, fig. 12.

Valves broadly elliptical with broadly protracted, obtusely rounded apices.  $22 \mu$  long,  $8 \mu$  broad. Raphe filiform, straight, with short polar fissures deflected to the same side. Axial area rather narrow, straight, in the middle of the valve expanded into an irregular, narrow central area with irregularly shortened transapical striae. Transapical striae 18 in  $10 \mu$ , crossed by 4 hyaline longitudinal stripes.

Loc. No. 35.

Plate XII, fig. 12:  $22.0 \times 8.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 227, Loc. No. 35).

Illustration slide: Ghana No. 227/1961.

Type locality: North Ghana. Fresh water (the Sorri river, a tributary to the White Volta in the Damongo reserve, Loc. No. 35).

*Navicula subminuscula* Manguin. HUSTEDT 1930-62, III, p. 257, fig. 1384. MANGUIN 1942, 2: 39. Loc. Nos. 28, 60.

Plate X, fig. 21:  $10.0 \times 4.0 \mu$ . 25-26 striae in  $10 \mu$ . (Sample No. 299, Loc. No. 60).

— *submolesta* Hust. HUSTEDT 1949 a, p. 86, 5: 16-18. 1930-62, III, p. 253, fig. 1380. Loc. Nos. 6, 8, 13, 14, 16, 17, 19, 58.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 86).

Plate X, fig. 4:  $16.6 \times 4.7 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 123, Loc. No. 8).

With some doubt referred to this species:

Plate X, fig. 2:  $13.3 \times 5.3 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 149, Loc. No. 13), and

Plate X, fig. 3:  $15.3 \times 5.4 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 157, Loc. No. 17).

X: 2 and X: 3, which both are somewhat broader than usual in this species.

In dimensions and structure these forms also remind of *N. similis* Krasske var. *strigosa* Hust. (HUSTEDT 1937-39, p. 274, 19: 18), but this species has a small rounded central area, which is missing in those pictured here.

— *tantula* Hust. HUSTEDT 1930-62, III, p. 250, fig. 1375. Loc. No. 26.

Very rare in the Congo territory (HUSTEDT 1949 a, p. 83).

Plate X, fig. 11:  $16.6 \times 4.1 \mu$ . 18-20 striae in  $10 \mu$ . (Sample No. 194, Loc. No. 26).

X: 11 has larger valves and coarser striae than indicated for the species in HUSTEDT, but it is referred to this species especially because of the characteristic central area.

— *tranciloba* Guermeur. GUERMEUR 1954, p. 59, 10: 14. Loc. Nos. 23, 31.

Previously reported from the Tropics in Africa (GUERMEUR 1954, p. 59).

Plate X, fig. 19:  $12.7 \times 4.0 \mu$ . 27-28 striae in  $10 \mu$ . (Sample No. 180, Loc. No. 23).

— *vanidica* Cholnoky. CHOLNOKY 1962 b, p. 49, fig. 69. Loc. No. 67.

Reported from South Africa (CHOLNOKY 1962 b, p. 49).

Plate X, fig. 20:  $9.4 \times 3.6 \mu$ . 20-22 striae in  $10 \mu$ . (Sample No. 78, Loc. No. 67).

This taxon is somewhat similar to *N. muraliformis* Hust. (HUSTEDT 1930-62, III, p. 156, fig. 1289. 1949 a, p. 85, 4: 29, 30).

— *variostriata* Krasske. HUSTEDT 1930-62, III, p. 201, fig. 1320. Loc. No. 34.

— *vitabunda* Hust. Ibid. p. 223, fig. 1341. Loc. Nos. 12, 31.

Plate IX, fig. 13:  $12.3 \times 5.3 \mu$ . 23-24 striae in  $10 \mu$ . (Sample No. 141, Loc. No. 12).

### **Naviculae microstigmaticae (Cleve) Hust.**

*Navicula limata* Hust. HUSTEDT 1944, p. 274, 8: 7.

Loc. No. 11.

Previously recorded from the Cameroons (HUSTEDT 1944, p. 284).

— *protracta* Grun. HUSTEDT 1930-62, III, p. 315, fig. 1433. Loc. No. 11.

According to MÖLDER (1962, p. 39) *N. protracta* Grun. is rather common in Sierra Leone. Presumably, owing to a misprint, it is *N. protracta* Grun.

Halophilous.

**Naviculæ lyratae** Cleve.

*Navicula auriculata* Hust. HUSTEDT 1944, p. 273, fig. 4.

Loc. Nos. 1–6, 8, 9, 12, 13, 17–19, 21, 22, 23, 24, 28, 29, 31, 32, 34, 58–62, 65, 67.

Plate X, fig. 31:  $12.0 \times 6.0 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).

Plate XI, fig. 1:  $15.3 \times 6.7 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 37, Loc. No. 1).

If the species found here is in agreement with the species from a lagoon in the Cameroons described by HUSTEDT (1944, p. 273, fig. 4), it must no doubt be considered a freshwater species as it is rather common in many samples from the whole country.

— *pygmaea* Kütz. HUSTEDT 1930, p. 299, fig. 513.

Loc. Nos. 1, 4, 11, 22, 31, 38, 43, 44, 46, 67.

Mesohalobous.

**Naviculæ punctatae** (Cleve) Hust.

*Navicula abelioensis* nov. spec. Plate XI, fig. 22.

Valves linear with slightly convex sides and broadly protracted, obtusely rounded apices.  $16 \mu$  long, 4–5  $\mu$  broad. Raphe filiform, straight. Axial area very narrow. Central area a rather broad transversal band extended to the margins. Transapical striae radial, about 24 in  $10 \mu$ , distinctly punctate.

Loc. No. 46.

Plate XI, fig. 22:  $16.0 \times 4.7 \mu$ . 24 striae in  $10 \mu$ . (Sample No. 254, Loc. No. 46).

Illustration slide: Ghana No. 254/1961.

Type locality: North Ghana. Fresh water (cattle-pool near the village Abelio, southwest of Navrongo, Loc. No. 46).

Very much resembles *Stauroneis borrichii* Boye Petersen var. *undulata* Boye Petersen (Syn.: *S. undata* Hust. sensu HUSTEDT 1937–39, p. 237, 17: 7) and *S. borrichii* (Petersen) Lund (HUSTEDT 1930–62, III, p. 803, fig. 1151), but XI: 22 is not seen to have pseudo-septae at the apices and amongst other things must therefore presumably be considered an *N.* species.

— *abonuensis* nov. spec. Plate XI, fig. 4.

Valves linear-elliptical, 20–25  $\mu$  long, 6–7  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area rather broad, linear, in the middle of the valve expanded into a central area extended across the valve. Transapical striae radial, about 20 in  $10 \mu$ , distinctly punctate; in the middle of the valve they are irregularly shortened.

Loc. No. 26.

Plate XI, fig. 4:  $20.8 \times 6.7 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 194, Loc. No. 26).

Illustration slide: Ghana No. 194/1961.

Type locality: South Ghana. Fresh water (pool near the shore of Bosumtwi Lake, near the village Abonu, Loc. No. 26).

Similar to *N. scabellum* Hust. (HUSTEDT 1942, p. 62, fig. 112), and *N. comoides* (Ag.?) Perag. (HUSTEDT 1930–62, III, p. 304, fig. 1423).

— *adampeensis* nov. spec. Plate XIII, fig. 4.

Valves elliptical with very shortly protracted, broadly rounded apices.  $32 \mu$  long, 17–18  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into a small rounded central area. Transapical striae radial, 12 in  $10 \mu$ , rather coarsely punctate, somewhat denser towards the apices.

Loc. Nos. 14, 15, 62.

Plate XIII, fig. 4:  $32.0 \times 17.3 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 102, Loc. No. 62).

Illustration slide: Ghana No. 102/1961.

Type locality: Southeast Ghana. Fresh water (reservoir at the University farm near the village Kpong). Adampe, the name of a tribe in Southeast Ghana.

*Navicula akimensis* nov. spec. Plate XIII, fig. 2.

Valves elliptical with obtusely probosciform apices.  $40\ \mu$  long,  $15\text{--}16\ \mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, linear. Central area rounded, irregularly delimited, on one side with two isolated stigmata. Transapical striae radial, 12 in  $10\ \mu$ , in the middle of the valve with inserted shorter striae; towards the apices a little denser; rather coarsely punctate.

Loc. No. 33.

Plate XIII, fig. 2:  $40.0 \times 15.5\ \mu$ . 12 striae in  $10\ \mu$ . (Sample No. 218, Loc. No. 33).

Illustration slide: Ghana No. 218/1961.

Type locality: West Ghana. Fresh water (a tributary to the river Black Volta, north of the town Wenchi, Loc. No. 33). Akim, the name of a tribe in the Ashanti territory.

This species has some resemblance, especially regarding the shape of the valve, to *N. densa* HUST. (HUSTEDT 1944, p. 284, fig. 28), but *N. densa* differs by having the polar fissures bent to opposite sides and having somewhat denser striae.

— *ancisa* HUST. HUSTEDT 1953, p. 150, fig. 3.

Loc. Nos. 5, 12, 18, 21, 26–28, 30, 31, 35, 45, 58, 65.

Previously reported from the south of Tunisia (HUSTEDT 1953, p. 150).

Plate XI, fig. 16:  $22.0 \times 5.4\ \mu$ . 18 striae in  $10\ \mu$ . (Sample No. 159, Loc. No. 18).

Somewhat doubtful as regards identity with *N. ancisa*, which usually is considerably smaller than the form occurring in Ghana.

— *ashantiensis* nov. spec. Plate XIII, fig. 5.

Valves elliptically lanceolate with shortly protracted and obtusely rounded apices,  $35\text{--}40\ \mu$  long,  $15\text{--}16\ \mu$ . Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, in the middle of the valve expanded into an irregular central area of one fourth to one third of the breadth of the valve. Transapical striae radial,  $12\text{--}13$  in  $10\ \mu$ , a few shorter ones being inserted in the middle of the valve, towards the apices a little denser, distinctly punctate.

Loc. Nos. 14, 34, 35, 58.

Plate XIII, fig. 5:  $37.3 \times 16.0\ \mu$ .  $12\text{--}13$  striae in  $10\ \mu$ . (Sample No. 220, Loc. No. 34).

Illustration slide: Ghana No. 220/1961.

Type locality: West Ghana. Fresh water (the Black Volta river at the Bamboi ferry, Loc. No. 34). Ashanti, the name of a native state in Ghana.

— *bannajensis* Boye Petersen. J. BOYE PETERSEN 1946, p. 86, fig. 10. FOGED 1959, p. 58, 3: 23, 24.

Loc. Nos. 1, 3, 18, 22, 29, 41, 46, 49, 62, 67.

Previously only reported from Asia (BOYE PETERSEN 1946, p. 86. FOGED 1959, p. 58).

Plate XII, fig. 4:  $16.0 \times 5.3\ \mu$ . 18 striae in  $10\ \mu$ . (Sample No. 163, Loc. No. 18).

Plate XII, fig. 5:  $19.3 \times 7.3\ \mu$ . 20 striae in  $10\ \mu$ . (Sample No. 173, Loc. No. 22).

— *bertelsenii* nov. spec. Plate XI, fig. 23.

Valves elliptical with broadly protracted, obtusely rounded apices,  $20\text{--}25\ \mu$  long,  $6\text{--}7\ \mu$  broad. Raphe filiform, straight. Axial area narrow, linear, in the middle expanded into a rounded central area of one third to half the breadth of the valve. Transapical striae radial, 18 in  $10\ \mu$ , in the middle of the valve with greater mutual distance and more coarsely punctate than at the apices.

Loc. Nos. 31, 66.

Plate XI, fig. 23:  $23.3 \times 6.7\ \mu$ . 18 striae in  $10\ \mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.



Type locality: West Ghana. Fresh water (pool, about 60–62 km's northwest of the town Kumasi, Loc. No. 31).

Dedicated to POUL BERTELSEN, M.A., Senior Tutor at the University of Ghana.

Somewhat similar to *N. grimmei* Krasske (HUSTEDT 1930, p. 274, fig. 448).

*Navicula chadwickii* nov. spec. Plate XII, fig. 8.

Valves lanceolate with slightly protracted apices. 24–26  $\mu$  long, 6–7  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area very narrow, linear, not expanded in the middle of the valve. Transapical striae all radial, 22–24 in 10  $\mu$ , very finely punctate.

Loc. No. 30.

Plate XII, fig. 8: 24.7  $\times$  6.7  $\mu$ . 22–24 striae in 10  $\mu$ . (Sample No. 205, Loc. No. 30).

Illustration slide: Ghana No. 205/1961.

Type locality: West Ghana. Fresh water (a tributary to the Apropong river, Loc. No. 30).

Dedicated to R. CHADWICK, Game Warden of the Damongo reserve.

— *damongensis* nov. spec. Plate XI, fig. 14.

Valves linear-elliptical with rounded apices. 18–20  $\mu$  long, 5–6  $\mu$  broad. Raphe filiform, straight, with polar and central fissures deflected to the same side. Axial area rather broad with a central area that is rather a broad band extended to the sides of the valves. Transapical striae with two hyaline longitudinal stripes, 20–21 in 10  $\mu$ .

Loc. No. 35.

Plate XI, fig. 14: 18.6  $\times$  5.3  $\mu$ . 21 striae in 10  $\mu$ . (Sample No. 223, Loc. No. 35).

Illustration slide: Ghana No. 223/1961.

Type locality: Central Ghana. Fresh water (the Sorri river, tributary to the Black Volta in the reserve south of the village Damongo, Loc. No. 35).

— *densa* Hust. HUSTEDT 1944, p. 284, fig. 28.

Loc. Nos. 21, 65.

Previously reported from a lagoon in the Cameroons (HUSTEDT 1944, p. 284: “wahrscheinlich eingeschleppte Süßwasserform”).

Plate XIII, fig. 3: 37.3  $\times$  15.3  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 308, Loc. No. 65).

XIII: 3: Polar fissures deflected in opposite directions. Dimensions of the valves somewhat greater than indicated by HUSTEDT (1944, p. 284), but otherwise good agreement.

— *densuensis* nov. spec. Plate XII, fig. 7.

Valves linear-elliptical with much protracted apices, 30–35  $\mu$  long, 7–8  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area very narrow, linear, not expanded in the middle of the valve. Transapical striae at right angles to the raphe, 16 in 10  $\mu$ , in the middle of the valve coarsely punctate, towards the apices more finely punctate.

Loc. No. 3.

Plate XII, fig. 7: 32.6  $\times$  7.2  $\mu$ . 16 striae in 10  $\mu$ . (Sample No. 73, Loc. No. 3).

Illustration slide: Ghana No. 73/1961.

Type locality: South Ghana. Fresh water (the Densu river, west of the capital Accra, Loc. No. 3).

Perhaps related to *N. cryptocephaloides* Hust. (HUSTEDT 1937–39, p. 261, 18: 12), which, however, deviates by having another form of central area.

— *favumangensis* nov. spec. Plate XI, fig. 17.

Valves broadly elliptical, with broadly protracted, obtusely rounded apices. 16–18  $\mu$  long, 5–6  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area very narrow, linear, with a central area with a single short stria, extended to the margins. Transapical striae radial, 16 in 10  $\mu$ , in the middle of the valve at right angles to the raphe at the apices, coarsely punctate.

Loc. No. 30.

Plate XI, fig. 17:  $16.7 \times 5.2 \mu$ . 16–17 striae in  $10 \mu$ . (Sample No. 204, Loc. No. 30).

Illustration slide: Ghana No. 204/1961.

Type locality: West Ghana. Fresh water (a small river near the village Fawumang, about 40–41 km. northwest of the town Kumasi, Loc. No. 30).

This species is somewhat similar to *N. ancisa* Hust. (HUSTEDT 1953, p. 150, fig. 9).

*Navicula finitima*. Hust. HUSTEDT 1949 a, p. 90, 4: 29, 30.

Loc. No. 8.

Very rare in the Congo territory (HUSTEDT 1949 a, p. 90).

Plate XII, fig. 2:  $20.0 \times 10.6 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 121, Loc. No. 8).

— *grimmei* Krasske. HUSTEDT 1930, p. 274, fig. 448. 1949 a, p. 83.

Loc. Nos. 22, 47.

The commonest *N.* species in the samples from the Congo territory worked up in HUSTEDT 1949 a.

Plate XI, fig. 15:  $22.0 \times 6.7 \mu$ . 18–20 striae in  $10 \mu$ . (Sample No. 260, Loc. No. 47). Striae somewhat coarser than usual.

— — var. *rostellata* Hust. HUSTEDT 1937–39, p. 236, 17: 14.

Loc. Nos. 1, 8, 12, 13, 18, 19, 22, 24, 61.

— *grundtvigii* nov. spec. Plate XIII, fig. 6.

Valves elliptical-lanceolate, with protracted, obtusely rounded apices. 34–38  $\mu$  long, 15–16  $\mu$  broad. Raphe filiform, straight. Axial area narrow, linear, in the middle of the valve expanded into a small rounded central area of about one fifth to one fourth of the breadth of the valve. Transapical striae radial, 13 in  $10 \mu$ ; in the middle of the valve a single shortened stria on each side of the valve; a little denser towards the apices, distinctly punctate.

Loc. No. 60.

Plate XIII, fig. 6:  $34.6 \times 15.9 \mu$ . 13 striae in  $10 \mu$ . (Sample No. 299, Loc. No. 60).

Illustration slide: Ghana No. 299/1961.

Type locality: East Ghana. Fresh water (the Asukawkaw river, a tributary to the Volta river, near the village Akroso, Loc. No. 60).

Named after a Dane JACOB GRUNDTVIG (1777–1800), who was a pastor in Guinea 1800.

— *ingoldii* nov. spec. Plate XII, fig. 3.

Valves elliptical with slightly protracted, obtusely rounded apices. 25–30  $\mu$  long, 10–11  $\mu$  broad. Raphe filiform, straight. Axial area narrowly lanceolate, evenly increasing in breadth from the apices to about one fifth of the breadth of the valve in the middle. Transapical striae radial, 15 in  $10 \mu$ , distinctly punctate.

Loc. Nos. 11, 17.

Plate XII, fig. 3:  $26.7 \times 10.7 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 157, Loc. No. 17).

Illustration slide: Ghana 157/1961.

Type locality: Southwest Ghana. Fresh water (the Huni river, a tributary to the Ankobra river, about 12 km. from the village Tarkwa, Loc. No. 17).

Dedicated to the English botanist, Professor C.T. INGOLD, Ph. D.

— *inserata* Hust. var. *undulata* Hust. HUSTEDT 1955 b, p. 125, figs. 16, 17. CHOLNOKY 1960 a, p. 66, figs. 206–208.

Loc. No. 6.

Plate XI, fig. 20:  $19.3 \times 10.0 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 114, Loc. No. 6).

Mesohalobous (?).

— *isertii* nov. spec. Plate XII, fig. 16.

Valves elliptical, with broadly proboscoidiform apices, flatly rounded at the poles. 30–32  $\mu$  long, 12–13  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same

side. Axial area narrow, linear. Central area small, rounded. Transapical striae radial, about 11 in  $10 \mu$ , coarsely punctate, towards the apices at right angles to the raphe and denser. In the middle of the valve a few striae are shortened.

Loc. Nos. 1, 23, 30, 66.

Plate XII, fig. 16:  $30.6 \times 12.2 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 205, Loc. No. 30).

Illustration slide: Ghana No. 205/1961.

Type locality: West Ghana. Fresh water (a small river, near the village Dwinyana, Loc. No. 30).

Named after the Dane P. E. ISERT, a Royal Danish Senior Surgeon in Guinea 1783–87. He made planting experiments, and he left valuable records concerning the flora and fauna in Guinea.

*Navicula kotschy* Grun. A. SCHMIDT Atlas 370: 31, 32. FOGED 1953, p. 43, 4: 8. HUSTEDT 1937–39, p. 235.

Loc. Nos. 6, 14, 19, 22, 28, 32, 65.

Very rare in Sierra Leone (MÖLDER 1962, p. 38).

— *kpongensis* nov. spec. Plate XII, fig. 14.

Valves lanceolate, with much protracted apices,  $30\text{--}35 \mu$  long,  $7\text{--}8 \mu$  broad. Raphe filiform, straight, with short polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into a rounded central area one third to one half of the breadth of the valve. Transapical striae radial,  $17\text{--}18$  in  $10 \mu$ , distinctly punctate, denser towards the apices.

Loc. Nos. 8, 9, 11, 12, 22, 29, 62.

Plate XII, fig. 14:  $31.3 \times 7.5 \mu$ .  $17\text{--}18$  striae in  $10 \mu$ . (Sample No. 101, Loc. No. 62).

Illustration slide: Ghana No. 101/1961.

Type locality: Southeast Ghana. Fresh water (a small river near the University Farm near Kpong, Loc. No. 62).

— *lagerheimii* Cleve. P. T. Cleve 1894–95, I, p. 131. HUSTEDT 1949 a, p. 81. A. SCHMIDT Atlas 370: 19–21.

Loc. Nos. 2, 4, 7, 8, 12–20, 22, 23, 30, 33, 56, 66.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 81).

Plate XI, fig. 9:  $24.0 \times 6.7 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 159, Loc. No. 18).

— var. *intermedia* Hust. HUSTEDT 1937–39, p. 234, 17: 12. 1955 b, p. 121–122.

Loc. No. 25.

Plate XI, fig. 8:  $38 \times 9.4 \mu$ . 21 striae in  $10 \mu$ . (Sample No. 186, Loc. No. 25).

— *laingii* nov. spec. Plate XII, fig. 1.

Valves broadly linear, with slightly convex sides and broadly rounded apices.  $40 \mu$  long,  $12 \mu$  broad. Raphe filiform, straight. Axial area rather broad and in the middle of the valve expanded into a longitudinally rounded central area, about one third of the breadth of the valve. Transapical striae radial, 18 in  $10 \mu$ , in the middle of the valve alternately short and long, near the apices at right angles to the raphe and denser; all striae coarsely punctate.

Loc. Nos. 18, 34, 58, 62.

Plate XII, fig. 1:  $40 \times 12 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).

Illustration slide: Ghana No. 220/1961.

Type locality: West Ghana. Fresh water (the river Black Volta at the Bamboi ferry, Loc. No. 34).

Dedicated to the Ghanaian botanist E. LAING, Ph. D., of the University of Ghana.

Perhaps it is related to *N. riojae* Cleve (P. T. CLEVE 1894–95, I, p. 137), and the variety of the same species var. *punctata* Frenguelli (KRASSKE 1948, p. 432, 2: 1, 2)

— *mansiensis* nov. spec. Plate XI, fig. 3

Valves broadly elliptical with protracted, obtusely rounded apices,  $18\text{--}20 \mu$  long,  $6\text{--}7 \mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area

very narrow, linear, without any specially indicated central area. Transapical striae in the middle of the valve radial, towards the apices at right angles to the raphe, about 22 in 10  $\mu$ ; in the middle of the valve a few shorter striae.

Loc. No. 19.

Plate XI, fig. 3: 18.0  $\times$  6.0  $\mu$ . 22 striae in 10  $\mu$ . (Sample No. 166, Loc. No. 19).

Illustration slide: Ghana No. 166/1961.

Type locality: Southwest Ghana. Fresh water (the Mansi river, a tributary to the Ankobra river, Loc. No. 19).

It seems to be related to *N. opressa* Hust. (HUSTEDT 1952 b, p. 397, fig. 119), which has been recorded from a river in Brazil.

*Navicula monradii* nov. spec. Plate XII, fig. 11.

Valves linear-lanceolate, 26  $\mu$  long, 6  $\mu$  broad. Raphe filiform, straight. Axial area rather narrow, straight, in the middle somewhat expanded into an oblong, elliptical central area, about one third of the breadth of the valve. Transapical striae radial, 24 in 10  $\mu$ , finely punctate.

Loc. Nos. 1, 6, 8, 9, 12, 13, 17–19, 21, 22, 24, 25, 27–34, 36, 49, 57, 58, 60–62, 67.

Plate XII, fig. 11: 26.0  $\times$  6.0  $\mu$ . 24 striae in 10  $\mu$ . (Sample No. 220, Loc. No. 34).

Illustration slide: Ghana No. 220/1961.

Type locality: West Ghana. Fresh water (the river Black Volta at the Bamboi ferry, Loc. No. 34).

Named after the Dane H.C. MONRAD, pastor at Christiansborg 1805–09.

— *mutica* Kütz. HUSTEDT 1930, p. 274, fig. 453 a.

Loc. Nos. 1–6, 8, 11–18, 20–25, 27, 30, 31, 34, 35, 38, 41, 43, 44, 46, 53, 56, 58, 60–62, 64–67.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 81). Very common in Sierra Leone (MÖLDER 1962, p. 39).

— — var. *cohnii* (Hilse) Grun. Ibid. p. 275, fig. 453 b.

Loc. Nos. 1–6, 8, 9, 11–19, 22–24, 28–32, 37, 38, 44, 46, 47, 53, 56, 59–61, 64–67.

Plate X, fig. 30: 8.7  $\times$  4.8  $\mu$ . 22–24 striae in 10  $\mu$ . (Sample No. 114, Loc. No. 6).

— — fo. *nivalis* (Ehr.) Hust. Ibid. p. 275, fig. 453 c.

Loc. Nos. 1, 6.

— — formae.

Loc. No. 1.

Plate XI, fig. 13: 12.0  $\times$  7.5  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 37, Loc. No. 1).

Plate XI, fig. 19: 12.0  $\times$  8.0  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 34, Loc. No. 1).

Both have very coarse striae. In shape they are closely related to fo. *cohnii*, but they have not the isolated stigma in the central area which is usually found in *N. mutica* and its varieties.

— *muticoides* Hust. HUSTEDT 1949 a, p. 82, 4: 33–36.

Loc. Nos. 1, 6, 19, 20, 23, 25, 27, 30, 31, 51, 53, 64.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 82), and fairly rare in Sierra Leone (MÖLDER 1962, p. 39).

— *navrongensis* nov. spec. Plate XI, fig. 11.

Valves linear-elliptical, with obtusely rounded apices. 14–25  $\mu$  long, 4–6  $\mu$  broad. Raphe filiform, straight, with central and polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into a transversely extended central area reaching halfway or three fourths of the distance to the margin. Transapical striae 20–24 in 10  $\mu$ , crossed by several hyaline longitudinal lines.

Loc. Nos. 1, 19, 45, 46, 48, 49, 66.

Plate XI, fig. 11: 21.5  $\times$  6.0  $\mu$ . 23–24 striae in 10  $\mu$ . (Sample No. 254, Loc. No. 46).

Illustration slide: Ghana No. 254/1961.

Type locality: North Ghana. Fresh water (a cattle-pool near the village Navrongo, Loc. No. 46).

Plate XI, fig. 10:  $14.6 \times 4.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 262, Loc. No. 48).

*Navicula nsutaensis* nov. spec. Plate XI, fig. 18.

Valves elliptical with rather narrowly protracted, rounded apices. 18–20  $\mu$  long, 6  $\mu$  broad. Raphe filiform, straight. Axial area narrow, linear, with an irregular, transversally extended central area. Transapical striae radial, 17–18 in  $10 \mu$ . in the middle of the valve of irregular length; punctate.

Loc. Nos. 5, 31, 44, 47, 67.

Plate XI, fig. 18:  $19.4 \times 6.0 \mu$ . 17–18 striae in  $10 \mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Fresh water (a small river near the village Nsuta, northwest of Kumasi, Loc. No. 31).

Plate XI, fig. 21:  $19.3 \times 5.3 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 81, Loc. No. 67).

— *obstinata* Krasske. KRASSKE 1939, p. 557, figs. 13, 14.

Loc. No. 11.

Previously reported from Brazil (KRASSKE 1939, p. 557).

Plate XI, fig. 5:  $12.0 \times 5.0 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 136, Loc. No. 11). Only with some doubt referred to *N. obstinata* Krasske.

— *omegopsis* Hust. HUSTEDT 1944, p. 275, fig. 8.

Loc. Nos. 58, 61.

Previously reported from a lagoon in the Cameroons (HUSTEDT 1944, p. 275).

Plate XIII, fig. 1:  $53.3 \times 21.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 294, Loc. No. 58).

Polyhalobous.

— *schweickerdtii* Cholnoky. CHOLNOKY 1952, p. 129, fig. 161.

Loc. Nos. 14, 20, 21.

Previously recorded from South Africa (CHOLNOKY 1952, p. 129).

Plate XI, fig. 6:  $12.6 \times 7.6 \mu$ . About 30 striae in  $10 \mu$ . (Sample No. 171, Loc. No. 21).

— *subinsoensis* nov. spec. Plate XII, fig. 13.

Valves broadly elliptical, with rather much protracted apices. 24–25  $\mu$  long, 7–8  $\mu$  broad. Raphe filiform, straight. Axial area narrow, linear, in the middle of the valve expanded into a transversally extended central area of about three fourths of the breadth of the valve. Transapical striae radial, 22–23 in  $10 \mu$ , distinctly punctate.

Loc. No. 33.

Plate XII, fig. 13:  $24.3 \times 7.5 \mu$ . 22–23 striae in  $10 \mu$ . (Sample No. 218, Loc. No. 33).

Illustration slide: Ghana No. 218/1961.

Type locality: West Ghana. Fresh water (the Suhin river near the village Subinso, Loc. No. 33).

— *suecorum* Carlsson. HUSTEDT 1949 b, p. 49, figs. 33–35. CHOLNOKY 1956, p. 80, fig. 97.

Loc. Nos. 4, 17, 21, 32, 33, 65.

Previously recorded from the Sinai Peninsula (HUSTEDT 1949 b, p. 49), and from South Africa (CHOLNOKY 1956, p. 80).

Plate XI, fig. 7:  $37.3 \times 10.0 \mu$ . 22 striae in  $10 \mu$ . (Sample No. 218, Loc. No. 33).

— *syrachii* nov. spec. Plate No. XI, fig. 24.

Valves broadly elliptical with obtusely rounded apices, 12–15  $\mu$  long, 5–6  $\mu$  broad. Raphe filiform, straight. Axial area narrow, in the middle expanded into a rounded, somewhat irregular central area of half to one third of the breadth of the valve. Transapical striae radial, 24–26 in  $10 \mu$ , of irregular length in the middle of the valve; punctate.

Loc. No. 61.

Plate XI, fig. 24:  $13.3 \times 5.9 \mu$ . 24–26 striae in  $10 \mu$ . (Sample No. 95, Loc. No. 61).

Illustration slide: Ghana No. 95/1961.

Type locality: East Ghana. Fresh water (the Volta river, near Ajena, Loc. No. 61).

Dedicated to the Danish forest botanist C. SYRACH LARSEN, Dr. Agro. & Dr. Phil. h. c.

### Naviculæ lineolatae Cleve.

*Navicula abraensis* nov. spec. Plate XV, fig. 12.

Valves elliptical, 32  $\mu$  long, 8–9  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, linear. Central area rounded, transversally extended to about half of the breadth of the valve. Transapical striae rather highly radial, 10 in 10  $\mu$ .

Loc. Nos. 8, 11, 21, 30, 32.

Plate XV, fig. 12: 32  $\times$  8.7  $\mu$ . 10 striae in 10  $\mu$ . (Sample No. 124, Loc. No. 8).

Illustration slide: Ghana No. 124/1961.

Type locality: Southwest Ghana. Freshwater (a small river in the rain forest near the village Abra between Takoradi and Axim, Loc. No. 8).

Closely related to *N. perobesa* Hust. (A. SCHMIDT, Atlas 295: 22–25), but XV: 12 has more radial striae, especially at the apices.

- *ammophila* Grun. P. T. CLEVE 1894–95, II, p. 29. CHOLNOKY 1960 a, p. 51, figs. 150–155. Loc. Nos. 4, 6, 8, 12, 13, 16, 21–23, 26, 28, 29, 31, 32, 39, 40, 56, 60, 61, 67.

Mesohalobous.

According to P. T. CLEVE (1894–95, II, p. 29), this species is a marine or brackish water species. The determination has mainly been made on the basis of CHOLNOKY (1960 a, figs. 150–55).

Plate XV, fig. 13: 23.2  $\times$  5.6  $\mu$ . 12–13 striae in 10  $\mu$ . (Sample No. 217, Loc. 32). Determination uncertain.

- *anglica* Ralfs. HUSTEDT 1930, p. 303, figs. 530, 531.

Loc. Nos. 26, 29–31.

Common in Sierra Leone (MÖLDER 1962, p. 37).

- *asanwinsoensis* nov. spec. Plate XIV, fig. 15.

Valves linear with slightly convex sides and rather far protracted, obtusely rounded apices. 20–22  $\mu$  long, 6–7  $\mu$  broad. Raphe filiform, linear. Axial area linear, rather broad, in the middle of the valve expanded into a central area of about half of the breadth of the valve. Transapical striae at right angles to the raphe or slightly radial, 15 in 10  $\mu$ . Loc. No. 22.

Plate XVI, fig. 15: 20.7  $\times$  6.6  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 173, Loc. No. 22.).

Illustration slide: Ghana No. 173/1961.

Type locality: Southwest Ghana. Fresh water (the Ankobra river near the village Asanwinso, Loc. No. 22).

- *bansoensis* nov. spec. Plate XIV, fig. 4.

Valves broadly elliptical, with rounded apices. 20–25  $\mu$  long, 10  $\mu$  broad. Raphe filiform, straight. Axial area rather narrow, linear, not expanded in the middle of the valve. Transapical striae radial, 12 in 10  $\mu$ , in the middle of the valve alternately long and short; denser towards the apices.

Loc. No. 8.

Plate XIV, fig. 4: 23.3  $\times$  10.0  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 122, Loc. No. 8).

Illustration slide: Ghana No. 122/1961.

Type locality: Southwest Ghana. Fresh water (a small river near the village Banso between Takoradi and Axim, Loc. No. 8).

- *carloffi* nov. spec. Plate XV, fig. 6.

Valves linear-lanceolate with obtusely protracted, rounded apices. 15–20  $\mu$  long, 3–4  $\mu$



broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, straight. Transapical striae in the middle of the valve at right angles to the raphe, towards the apices slightly convergent, 15 in  $10\ \mu$ ; denser towards the apices.

Loc. No. 30.

Plate XV, fig. 6:  $16.7 \times 3.4\ \mu$ . 15 striae in  $10\ \mu$ . (Sample No. 204, Loc. No. 30).

Illustration slide: Ghana No. 204/1961.

Type locality: West Ghana. Fresh water (a small river near the village Dwinyana, north-west of Kumasi, Loc. No. 30).

Named after H. CARLOFF, the first Danish Governor in Guinea, 1658.

*Navicula carstensenii* nov. spec. Plate XIV, fig. 11.

Valves lanceolate, tapering, and proboscifiform to capitately protracted towards the apices.  $33\text{--}35\ \mu$  long,  $8\text{--}9\ \mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, linear, in the middle of the valve expanded into a rounded central area, one third to half of the breadth of the valve. Transapical striae radial, 12 in  $10\ \mu$ , towards the apices at right angles to the raphe, coarsely punctate (in longitudinal stripes).

Loc. No. 26.

Plate XIV, fig. 11:  $33.3 \times 8.0\ \mu$ . 12 striae in  $10\ \mu$ . (Sample No. 188, Loc. No. 26).

Illustration slide: Ghana No. 188/1961.

Type locality: South Ghana. Fresh water (Bosumtwi Lake, Loc. No. 26).

Named after E. I. A. CARSTENSEN, Danish Governor in Guinea 1844.

— *cincta* (Ehr.) Kütz. HUSTEDT 1930, p. 298, fig. 510.

Loc. Nos. 2, 6, 11, 12, 17, 32, 47.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 94), and in Sierra Leone (MÖLDER 1962, p. 38).

Halophilous.

— var. *leptocephala* (Bréb.) Greg. HUSTEDT 1930, p. 299. GUERMEUR 1954, p. 47, 8: 1 b.

Loc. Nos. 43, 47, 58.

Halophilous.

— *constans* Hust. var. *symmetrica* Hust. HUSTEDT 1957, p. 289, figs. 40, 41.

Loc. Nos. 8, 12, 14, 17, 27, 28, 33, 44, 60, 64.

Plate XIV, fig. 6:  $19.3 \times 8.0\ \mu$ . 15–16 striae in  $10\ \mu$ . (Sample No. 218, Loc. No. 33).

Plate XIV, fig. 7:  $18.7 \times 8.0\ \mu$ . 15 striae in  $10\ \mu$ . (Sample No. 121, Loc. No. 8).

Plate XIV, fig. 8:  $18.7 \times 8.7\ \mu$ . 15 striae in  $10\ \mu$ . (Sample No. 219, Loc. No. 33).

All the specimens found here, have about 15–16 striae in  $10\ \mu$ , which is approximately the same as indicated for the species (14), whereas HUSTEDT (1957, p. 289) states the number of striae for the var. *symmetrica* at 10. As, however, an isolated dot in the central area has never been seen in the Ghanaian specimens, they have been referred to var. *symmetrica*.

— *costulata* Grun. HUSTEDT 1930, p. 298, fig. 505.

Loc. No. 6.

Plate XV, fig. 15:  $11.3 \times 3.3\ \mu$ . 15 striae in  $10\ \mu$ . (Sample No. 114, Loc. No. 6).

— *cryptocephala* Kütz. HUSTEDT 1930, p. 295, fig. 496.

Loc. Nos. 1–6, 8, 10–15, 17–19, 21–24, 26–31, 34, 35, 37, 38, 41, 43–47, 49–52, 55, 56, 58, 59, 61–67.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 92), and common in Sierra Leone (MÖLDER 1962, p. 38).

— var. *intermedia* Grun. Ibid. p. 295, fig. 497 b.

Loc. Nos. 2, 3, 6, 12, 23, 26, 31, 32, 46, 47, 62, 64–66.

Fairly rare in the Congo territory (HUSTEDT 1949 a, p. 92).

- Navicula cryptocephala* var. *veneta* (Kütz.) Grun. Ibid. p. 295, fig. 497 a.  
 Loc. Nos. 12, 15, 27, 37, 39, 56, 57, 66.  
 Occurs, but is never common in Sierra Leone (MÖLDER 1962, p. 38).
- *decussis* Østrup. ØSTRUP 1910, p. 77, 2: 50. A. SCHMIDT Atlas 398: 36, 37. 401: 12, 13. FOGED 1959, p. 59, 5: 5.  
 Loc. No. 17.  
 Plate XVI, fig. 5:  $20.0 \times 6.7 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 157, Loc. No. 17).
- *dicephala* (Ehr.) W. Smith. HUSTEDT 1930, p. 302, fig. 526.  
 Loc. Nos. 17, 23, 31, 32, 35.  
 Fairly rare in Sierra Leone (MÖLDER 1962, p. 38).
- *dodowaensis* nov. spec. Plate XV, fig. 7.  
 Valves linear-lanceolate, with suddenly protracted and rather pointedly rounded apices,  $25-30 \mu$  long,  $8 \mu$  broad. Raphe filiform, straight, with polar fissures deflected to the side. Axial area narrow, linear, with very little rounded expansion in the middle of the valve. Transapical striae radial, 12 in  $10 \mu$ .  
 Loc. No. 62.  
 Plate XV, fig. 7:  $26.7 \times 8.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 106, Loc. No. 62).  
 Illustration slide: Ghana No. 106/1961.  
 Type locality: Southeast Ghana. Fresh water (a small river near the village Dodowa between Kpong and Akuse, Loc. No. 62).
- *exigua* (Greg.) O. Müller. HUSTEDT 1930, p. 305, fig. 538. 1949 a, p. 97, 5: 10. FOGED 1959, p. 60, 5: 4.  
 Loc. Nos. 4, 6, 8, 14, 16, 17, 25, 32, 35, 59, 61.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 97), and fairly rare in Sierra Leone (MÖLDER 1962, p. 38).
- — var. *signata* Hust. HUSTEDT 1944, p. 287, fig. 14.  
 Loc. Nos. 21, 22, 28, 58, 60.  
 Plate XIV, fig. 10:  $27.3 \times 9.4 \mu$ . 14–15 striae in  $10 \mu$ . (Sample No. 171, Loc. No. 21).
- *exiguiformis* Hust. HUSTEDT 1944, p. 283, fig. 23. 1945, p. 929, 42: 21, 22. 1949 a, p. 95.  
 Loc. Nos. 1, 2, 4–6, 8, 9, 11, 14, 19–22, 25, 27, 28, 32–34, 36, 37, 39, 40, 49, 50, 58, 60–63, 65.  
 One of the commonest *N.* species in the Congo territory (HUSTEDT 1949 a, p. 95), but very rare in Sierra Leone (MÖLDER 1962, p. 38).  
 Plate XIV, fig. 13:  $27.3 \times 10.7 \mu$ . 11–12 striae in  $10 \mu$ . (Sample No. 220, Loc. No. 34).  
 Plate XIV, fig. 14:  $23.3 \times 11.5 \mu$ . 17–18 striae in  $10 \mu$ . (Sample No. 123, Loc. No. 8).  
 Plate XIV, fig. 5:  $32 \times 10 \mu$ . 17–18 striae in  $10 \mu$ . (Sample No. 309, Loc. No. 65).
- *fauta* Hust. HUSTEDT 1954 b, p. 273, fig. 17.  
 Loc. Nos. 4, 6, 8, 12, 13, 18, 19, 22, 26, 28–31, 39, 47, 61, 62, 65, 66.  
 Previously reported from Central America (HUSTEDT 1954 b, p. 273).  
 Plate XV, fig. 11:  $32 \times 5.4 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 204, Loc. No. 30).  
 Plate XV, fig. 10:  $32.7 \times 6.0 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 101, Loc. 62).  
 Mesohalobous.  
 Uncertain determination. There is also some similarity to *N. cancellata* Donkin and *N. ramosissima* (Ag.) Cleve.
- *feuerborni* Hust. HUSTEDT 1937–39, p. 269, 19: 9, 10.  
 Loc. Nos. 8, 9, 12, 17, 18, 64.  
 Rare in Sierra Leone (MÖLDER 1962, p. 38).  
 Plate XVI, fig. 1:  $40 \times 6.7 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 122, Loc. No. 8).
- — fo. *africana* nov. fo. Plate XVI, fig. 2.  
 Differs from the species by having more tapering and not constricted apices.  
 Loc. Nos. 8, 11, 12, 63–65.

Plate XVI, fig. 2:  $42.6 \times 5.1 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 119, Loc. No. 8).

Illustration slide: Ghana No. 119/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest between Takoradi and Axim, Loc. No. 8).

Plate XVI, fig. 3:  $44 \times 7.0 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 305, Loc. No. 64).

*Navicula gastrum* Ehr. HUSTEDT 1930, p. 305, fig. 537.

Loc. Nos. 2, 5, 6, 22, 24, 25, 28, 29, 31–34, 40, 46, 48, 49, 58, 61–63.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 97) and in Sierra Leone (MÖLDER 1962, p. 38).

— fo. *minuta* Guermeur. GUERMEUR 1954, p. 49, 9: 5.

Loc. No. 28.

— *gothlandica* Grun. HUSTEDT 1930, p. 296, fig. 499.

Loc. Nos. 2, 44, 47.

Mesohalobous.

— *gracilis* Ehr. Ibid. p. 299, fig. 514.

Loc. Nos. 5, 11, 13, 18, 19, 28, 39.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 94) and in Sierra Leone (MÖLDER 1962, p. 38).

— *humjibreensis* nov. spec. Plate XV, fig. 8.

Valves lanceolate, protracted towards the apices, obtusely rounded.  $20\text{--}25 \mu$  long,  $6\text{--}7 \mu$  broad. Raphe filiform, straight. Axial area narrow, linear, very little expanded in the middle of the valve. Transapical striae radial or at right angles to the raphe, 14 in  $10 \mu$ , distinctly longitudinally striped.

Loc. No. 21.

Plate XV, fig. 8:  $23.3 \times 6.7 \mu$ . 14 striae in  $10 \mu$ . (Sample No. 171, Loc. No. 21).

Illustration slide: Ghana No. 171/1961.

Type locality: West Ghana. Fresh water (a tributary in the Ankobra river system near the village Humjibre, Loc. No. 21).

— *hungarica* Grun. HUSTEDT 1930, p. 298, fig. 506.

Loc. Nos. 1, 2, 6, 8, 12–15, 17–19, 21, 22, 24, 27–30, 33, 35, 37, 39, 50, 54, 58, 60–63, 65. Rare in lakes in East Africa (HUSTEDT 1949 a, p. 94), and fairly rare in Sierra Leone (MÖLDER 1962, p. 38).

Plate XV, fig. 14:  $18.1 \times 4.8 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 33, Loc. No. 1).

— var. *capitata* (Ehr.) Cleve. Ibid. p. 298, fig. 508.

Loc. Nos. 12, 33.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 94).

— var. *lüneburgensis* Grun. Ibid. p. 298, fig. 509.

Loc. No. 27.

— *manguini* Guermeur. GUERMEUR 1954, p. 50, 8: 9.

Loc. Nos. 4–6, 9, 12, 18–20, 23, 26–28, 31, 49, 60, 67.

Previously reported from the Tropics in Africa (GUERMEUR 1954, p. 50).

Plate XV, fig. 3:  $40.7 \times 10.4 \mu$ . 14–15 striae in  $10 \mu$ . (Sample No. 144, Loc. No. 12).

*N. sp.* Bourelly et Manguin 1952, p. 73, 4: 98 seems to be the same species.

— *menisculus* Schum. HUSTEDT 1930, p. 301, fig. 507.

Loc. Nos. 3, 4, 6, 34, 49, 58.

Common in Sierra Leone (MÖLDER 1962, p. 38).

— *meyeri* nov. spec. Plate XIV, fig. 12.

Valves linear, with slightly convex sides and broadly protracted and broadly rounded apices.  $34\text{--}38 \mu$  long,  $12\text{--}14 \mu$  broad. Raphe filiform, slightly curved and with polar fissures deflected to the same side. Axial area narrow, linear. Central area very small, rounded.

Transapical striae radial, 9–10 in 10  $\mu$ ; a few shorter ones inserted in the middle of the valve; denser towards the apices; distinctly punctate.

Loc. No. 58.

Plate XIV, fig. 12: 34.0  $\times$  12.6  $\mu$ . 9–10 striae in 10  $\mu$ . (Sample No. 295, Loc. No. 58).

Illustration slide: Ghana No. 295/1961.

Type locality: East Ghana. Fresh water (the Volta river near Kete Krachi, Loc. No. 58).

Named after P. MEYER, Danish Commandant at Kongensten, Guinea (died in 1815).

Laid out plantations and sent entomological collections to Denmark.

*Navicula moerckii* nov. spec. Plate XV, fig. 5.

Valves linear with slightly convex sides, 16–17  $\mu$  long, 4  $\mu$  broad. Raphe filiform, slightly curved, with polar fissures deflected to the same side. Axial area broad, about half the breadth of the valve, not specially expanded in the middle of the valve. Transapical striae slightly radial, 15 in 10  $\mu$ .

Loc. No. 31.

Plate XV, fig. 5: 16.7  $\times$  4.0  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Fresh water (a small river, about 65 km. northwest of Kumasi, Loc. No. 31).

Named after F. S. MØRCK, Danish Governor in Guinea 1834–39. He founded a plantation near Frederiksgave, the Gold Coast.

— *nagbogensis* nov. spec. Plate XV, fig. 1.

Valves elliptical, with broadly protracted, obtusely rounded apices, 40–45  $\mu$  long, 12–15  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area very narrow, linear, and very little expanded in the middle of the valve. Transapical striae slightly radial, 15 in 10  $\mu$ , distinctly punctate, slightly convergent and denser towards the apices.

Loc. No. 53.

Plate XV, fig. 1: 41.3  $\times$  12.6  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 279, Loc. No. 53).

Illustration slide: Ghana No. 279/1961.

Type locality: East Ghana. Fresh water (a river near the village Nagbog, Loc. No. 53).

It is rather doubtful whether this species should be referred to this group (*lineolatae*).

— *placentula* (Ehr.) Grun. HUSTEDT 1930, p. 303, fig. 532.

Loc. Nos. 2, 60.

Rare in Sierra Leone (MÖLDER 1962, p. 39).

— fo. *latiuscula* (Grun.) Meister. Ibid. p. 304, fig. 534.

Loc. No. 58.

— fo. *rostrata* A. Mayer. Ibid. p. 304, fig. 533.

Loc. No. 21.

Rare in Sierra Leone (MÖLDER 1962, p. 39).

— *quadripartita* Hust. A. SCHMIDT. Atlas 400: 12–15. E. MANGUIN 1941, p. 155, fig. 9.

Syn.: *N. hambergi* Hust. HUSTEDT: Bacill. Sarekgeb. 1924, p. 562, 17: 2.

Loc. Nos. 4, 12, 18, 26.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 95).

Plate XIV, fig. 1: 23.4  $\times$  7.5  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 145, Loc. No. 12).

Plate XIV, fig. 2: 20  $\times$  7.3  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 163, Loc. No. 18).

Plate XIV, fig. 3: 14.7  $\times$  6.0  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 112, Loc. No. 4).

— *ramosissima* Agardh. P. T. CLEVE 1894–95, II, p. 26. HUSTEDT et A. A. ALEEM 1951, p. 185, figs. 1 A, B.

Loc. No. 11.

Polyhalobous.

*Navicula rhynchocephala* Kütz. HUSTEDT 1930, p. 296, fig. 501.

Loc. Nos. 4, 5, 8, 11–13, 18, 19, 21, 22, 24, 28, 30, 31, 34, 41, 47, 58, 61–63, 65–67.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 92) and in Sierra Leone (MÖLDER 1962, p. 39).

— var. *elongata* Mayer. BOURELLE et E. MANGUIN 1949, p. 171, 7: 83.

Loc. No. 8.

— *salinarum* Grun. HUSTEDT 1930, p. 295, fig. 498.

Loc. Nos. 6, 8, 12, 17, 23, 26.

Mesohalobous.

— *schönfeldii* Hust. Ibid. p. 301, fig. 520.

Loc. Nos. 2, 6, 8, 9, 11, 12, 14, 17, 18, 33–35, 46, 54, 58, 61, 62, 65.

Very rare in Sierra Leone (MÖLDER 1962, p. 40).

— *sepasiensis* nov. spec. Plate XV, fig. 4.

Valves elliptical-lanceolate with broadly protracted apices, 30  $\mu$  long, 10–12  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area rather narrow. Central area rounded, about half to one third of the breadth of the valve. Transapical striae rather highly radial, 12 in 10  $\mu$ ; in the middle of the valve with inserted shorter striae.

Loc. No. 27.

Plate XV, fig. 4: 30.0  $\times$  10.7  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 196, Loc. No. 27).

Illustration slide: Ghana No. 196/1961.

Type locality: West Ghana. Fresh water (a small river near the village Sepasi, northwest of Kumasi, Loc. No. 27).

— *simplex* Krasske. HUSTEDT 1930, p. 296, fig. 500.

Loc. Nos. 23, 26, 40.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 93) and in Sierra Leone (MÖLDER 1962, p. 40).

— *subrhynchocephala* Hust. HUSTEDT 1937–39, p. 262, 18: 35. 1949 a, p. 92. GUERMEUR 1954, p. 51, 8: 3.

Loc. Nos. 26, 43, 57.

Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 92).

— *suhinensis* nov. spec. Plate XIV, fig. 9.

Valves linear-elliptical, with protracted, obtusely rounded apices. 20–25  $\mu$  long, 7–8  $\mu$  broad. Raphe filiform, straight. Axial area very narrow, in the middle of the valve expanded into a transversally extended central area. Transapical striae radial, 22 in 10  $\mu$ ; denser towards the apices.

Loc. No. 33.

Plate XIV, fig. 9: 23.3  $\times$  7.4  $\mu$ . 22 striae in 10  $\mu$ . (Sample No. 218, Loc. No. 33).

Illustration slide: Ghana No. 218/1961.

Type locality: West Ghana. Fresh water (the Suhin river, north of the town Wenchi, Loc. No. 33).

— *tainensis* nov. spec. Plate XV, fig. 9.

Valves linear, with slightly convex sides, broadly protracted towards the apices, with broadly rounded poles. 40  $\mu$  long, 6–7  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area narrow, linear. Central area very small, rounded. Transapical striae very highly radial, 15 in 10  $\mu$ .

Loc. Nos. 28, 31, 32, 37, 60, 62.

Plate XV, fig. 9: 40  $\times$  6.7  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 217, Loc. No. 32).

Illustration slide: Ghana No. 217/1961.

Type locality: West Ghana. Fresh water (the Tain river, north of the town Wenchi, Loc. No. 32).

- Closely related to *N. simulata* Manguin (MANGUIN 1942, 3: 50) from the Azores, but XV: 9 has, i.a., a smaller central area than this species.
- Navicula towutiensis* (Hust.) Cholnoky. CHOLNOKY 1963 b, p. 245, fig. 24.  
Syn.: *N. Wolterecki* Hust. var. *rostrata* (Hust.) Cholnoky. CHOLNOKY 1959 a, p. 53, fig. 278. 1960 a, p. 86.  
Loc. Nos. 2, 7, 57, 58.  
Previously recorded from South Africa (CHOLNOKY 1963 b, p. 245).  
Plate XII, fig. 15:  $42 \times 8.9 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 118, Loc. No. 7).  
CHOLNOKY (1960 a, p. 86): small specimens of  $35 \times 8 \mu$  are common. The central area in CHOLNOKY's specimens and XII:15 are almost identical, but XII:15 has a coarser punctuation than the species in CHOLNOKY.
- *viridula* Kütz. HUSTEDT 1930, p. 297, fig. 503.  
Loc. Nos. 3, 6, 8, 11, 12, 23, 36, 42, 48, 60, 65.  
Rare in lakes in East Africa (HUSTEDT 1949 a, p. 93). Rather common in Sierra Leone (MÖLDER 1962, p. 40).
- var. *slesvicensis* (Grun.) Cleve. Ibid. p. 297.  
Loc. No. 8.
- *zanoni* Hust. HUSTEDT 1949 a, p. 92, 5: 1–5.  
Loc. Nos. 6, 11, 12, 13, 19, 21, 25, 28, 29, 31, 32, 53, 57, 65.  
Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 92) and in Sierra Leone (MÖLDER 1962, p. 40).  
Plate XV, fig. 2:  $46.7 \times 8.8 \mu$ . 11–12 striae in  $10 \mu$ . (Sample No. 142, Loc. No. 12).

#### **Naviculae tusculae** Hust.

- Navicula tuscula* (Ehr.) Grun. HUSTEDT 1930, p. 308, fig. 552.  
Loc. No. 65.

#### **Naviculae annulatae** Hust.

- Navicula paludosa* Hust. HUSTEDT 1957, p. 286.  
Syn.: *N. lagerstedtii* Cleve var. *palustris* Hust. A. SCHMIDT. Atlas 400: 27–29.  
Loc. No. 33.  
Plate XVI, fig. 4:  $24.0 \times 8.8 \mu$ . 15–16 striae in  $10 \mu$ . (Sample No. 218, Loc. No. 33).
- *pseudolagerstedtii* Cholnoky. CHOLNOKY 1960 a, p. 75, fig. 236.  
Loc. No. 12.  
Previously recorded from South Africa (CHOLNOKY 1960 a, p. 75).  
Plate XVI, fig. 6:  $14.0 \times 6.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 144, Loc. No. 12).

#### **Pinnularia** Ehr.

##### **a. Parallelistriata**

- Pinnularia gracillima* Greg. HUSTEDT 1930, p. 315, fig. 524.  
Loc. No. 30.  
Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 101).
- *molaris* Grun. Ibid. p. 316, fig. 568.  
Loc. Nos. 8, 12, 22, 30, 46, 60, 64.  
Common in Sierra Leone (MÖLDER 1962, p. 41).  
Plate XVI, fig. 9:  $24.7 \times 5.0 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 305, Loc. No. 64).  
Rather doubtful. Resembles *P. molaris* in some respects, *P. leptosoma* in others.
- *nunquaensis* nov. spec. Plate XVII, fig. 1.  
Valves broadly linear, sides straight or slightly concave, apices broadly rounded.  $25\text{--}30 \mu$



long, 9–10  $\mu$  broad. Raphe filiform, straight, with central and polar fissures deflected to the same side. Axial area expanding from the apices towards the middle of the valve into a broad central area, which in the middle of the valve reaches the margins as a narrow transversal band. Transapical striae at right angles to the raphe, 10 in 10  $\mu$ ; slightly convergent towards the apices.

Loc. No. 1.

Plate XVII, fig. 1: 30.0  $\times$  9.5  $\mu$ . 10 striae in 10  $\mu$ . (Sample No. 39, Loc. No. 1).

Illustration slide: Ghana No. 39/1961.

Type locality: Southeast Ghana. Fresh water (a big pond at the Nungua farm, property of the University of Ghana, Loc. No. 1).

This species is somewhat similar to *P. parva* (Greg.) Cleve.

*Pinnularia nunguaensis* forma.

Plate XVII, fig. 2: 27.3  $\times$  10.0  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 39, Loc. No. 1).

— *parva* (Greg.) Cleve var. *lagerstedtii* Cleve fo. *interrupta* Petersen. BOYE PETERSEN 1928, p. 407, fig. 28.

Loc. No. 41.

Plate XVII, fig. 3: 23.9  $\times$  6.7  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 204, Loc. No. 41).

— *suhinensis* nov. spec. Plate XVII, fig. 5.

Valves linear-lanceolate, 24–26  $\mu$  long, 4–5  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area broad, about half the breadth of the valve. Central area very broad and extended to the margin. Transapical striae at right angles to the raphe, 11–12 in 10  $\mu$ .

Loc. Nos. 33, 64.

Plate XVII, fig. 5: 24.7  $\times$  4.7  $\mu$ . 11–12 striae in 10  $\mu$ . (Sample No. 218, Loc. No. 33).

Illustration slide: Ghana No. 218/1961.

Type locality: West Ghana. Fresh water (the Suhin river near the village Subinso, Loc. No. 33).

This species seems to be related to *P. parva* (Greg.) Cleve var. *minuta* Østrup (BOYE PETERSEN 1928, p. 408, fig. 29).

— *takoradiensis* nov. spec. Plate XVI, fig. 13.

Valves narrowly linear, with broadly rounded apices. 30–32  $\mu$  long, 4–5  $\mu$  broad. Raphe filiform, straight, with central and polar fissures deflected to the same side. Central area very broad and extended to the margin. All transapical striae are convergent, 15 in 10  $\mu$ .

Loc. No. 8.

Plate XVI, fig. 13: 30.6  $\times$  4.7  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 122, Loc. No. 8).

Illustration slide: Ghana No. 122/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest between Takoradi and Axim, Loc. No. 8).

The placing of this species is very doubtful. Perhaps it is not a *P.* species, but rather a *Caloneis* form, which, however, is so characteristic that it probably represents a new species.

— sp.

Plate XVIII, fig. 6: 20.0  $\times$  3.4  $\mu$ . 15 striae in 10  $\mu$ . (Sample No. 145, Loc. No. 12).

A somewhat dubious form.

#### b. Capitatae

*Pinnularia appendiculata* (Ag.) Cleve. HUSTEDT 1930, p. 317, fig. 570 a.

Loc. Nos. 10, 12.

Rather common in Sierra Leone (MÖLDER 1962, p. 40).

— *braunii* (Grun.) Cleve. Ibid. p. 319, fig. 577.

Loc. Nos. 3, 15.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 102).

- Rare in Sierra Leone (MÖLDER 1962, p. 40).  
 Plate XVI, fig. 11:  $37.3 \times 8.2 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 153, Loc. No. 15).  
 Plate XVI, fig. 15:  $30.6 \times 6.0 \mu$ . 10 striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).
- Pinnularia braunii* var. *amphicephala* (A. Mayer) Hust. Ibid. p. 319, fig. 578.  
 Loc. Nos. 1–4, 6, 8, 10, 12, 13, 16, 18, 20, 23, 27, 28, 34, 38, 39, 41, 53, 54, 58, 62, 64.  
 Rather common in Sierra Leone (MÖLDER 1962, p. 40).
- *interrupta* E. Smith. Ibid. p. 317, fig. 573.  
 Loc. Nos. 1, 4, 5, 8–13, 16, 19, 20, 22–32, 37–39, 43, 44, 46, 47, 50, 54, 63–66.  
 Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. p. 102), but very common in Sierra Leone (MÖLDER 1962, p. 41).
- — fo. *minutissima* Hust. Ibid. p. 317, fig. 574.  
 Loc. Nos. 1–3, 6–9, 11–14, 17–19, 24–28, 32, 33, 35, 36, 38, 39, 43, 44, 46, 47, 58, 60–62, 64–67.  
 Very rare in Sierra Leone (MÖLDER 1962, p. 41).
- — var. *jaculata* Manguin. GUERMEUR 1954, p. 61, 10: 26. BOURELLE et MANGUIN 1952, p. 77, 5: 12 a, b.  
 Loc. Nos. 1, 12, 13, 15, 27, 38, 46, 56.  
 Plate XVI, fig. 10:  $25.0 \times 5.5 \mu$ . 12–13 striae in  $10 \mu$ . (Sample No. 195, Loc. No. 27).
- *krookei* (Grun.) Hust. HUSTEDT 1942 (Aërophile Diatomeen in der nordwestdeutschen Flora), p. 71.  
 Syn.: *P. globiceps* Greg. var. *krookei* Grun. (HUSTEDT 1930, p. 319, fig. 580).  
 Loc. Nos. 3, 64.  
 Halophilous (?).
- *mesolepta* (Ehr.) W. Smith. Ibid. p. 319, fig. 575 a.  
 Loc. Nos. 1, 4, 5, 7, 8, 14, 21, 28, 37, 39, 44, 46.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 102).  
 Fairly rare in Sierra Leone (MÖLDER 1962, p. 41).  
 Plate XVI, fig. 16:  $32.0 \times 6.0 \mu$ . 9–10 striae in  $10 \mu$ . (Sample No. 151, Loc. No. 14).  
 Plate XVI, fig. 12:  $36.0 \times 7.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 4, Loc. No. 66).
- *mankesimensis* nov. spec. Plate XVIII, fig. 10.  
 Valves linear with triundulate margins and protracted apices.  $30 \mu$  long, 4–5  $\mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. Axial area broad, half to two thirds of the breadth of the valve. The central area is a very broad transversal band, which extends to the margins. Transapical striae short, at right angles to the raphe, 12 in  $10 \mu$ .  
 Loc. No. 5.  
 Plate XVIII, fig. 10:  $30.0 \times 4.7 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 111, Loc. No. 5).  
 Illustration slide: Ghana No. 111/1961.  
 Type locality: Southwest Ghana. Fresh water (the river Amisa near the village Mankesim, Loc. No. 5).  
 Fairly closely related to *P. mesolepta* (Ehr.) W. Smith, but XVIII: 10 has a much broader central area extending to the margin and has much shorter striae than this species.
- *polyonca* (Bréb.) O. Müller. HUSTEDT 1930, p. 319, fig. 576.  
 Loc. No. 13.  
 Not rare in Sierra Leone (MÖLDER 1962, p. 41).  
 Plate XVIII, fig. 1:  $60 \times 8 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 150, Loc. No. 13).
- *subcapitata* Greg. HUSTEDT 1949 a, p. 101, 8: 6–15. 1930, p. 317, fig. 571.  
 Loc. Nos. 8, 13, 41, 53, 62.  
 Not rare in lakes in East Africa (HUSTEDT 1949 a, p. 101) and in Sierra Leone (MÖLDER 1962, p. 41).

c. *Divergentes*

- Pinnularia acoricola* Hust. HUSTEDT 1937-39, p. 293, 21: 11-16. A. SCHMIDT. Atlas 390, 13-16.  
 HUSTEDT 1949 a, p. 102. GUERMEUR 1954, 15: 4.  
 Loc. Nos. 9, 14, 16, 17, 20, 22, 64.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 102).  
 Plate XVII, fig. 6:  $37.3 \times 5.7 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 155, Loc. No. 16).  
 Plate XVII, fig. 11:  $36 \times 5.5 \mu$ . 10 striae in  $10 \mu$ . (Sample No. 152, Loc. No. 14).
- *bogosoensis* nov. spec. Plate XIX, fig. 1.  
 Valves linear-lanceolate with protracted, rather pointed apices.  $60 \mu$  long,  $8-9 \mu$  broad. Raphe straight, with central and polar fissures slightly deflected to the same side. Axial area increasing to half the breadth of the valve from the apices into a very broad central area extended to the margin. Transapical striae 10-11 in  $10 \mu$ , radial, convergent towards the apices.  
 Loc. Nos. 18, 20, 27, 38.  
 Plate XIX, fig. 1:  $60 \times 8.3 \mu$ . 10-11 striae in  $10 \mu$ . (Sample No. 163, Loc. No. 18).  
 Illustration slide: Ghana No. 163/1961.  
 Type locality: Southwest Ghana. Fresh water (a ditch about 5-6 km. southeast of the village Bogoso, Loc. No. 18).  
 Some similarity to *P. acoricola* Hust., which, however, i.a. is considerably smaller than XIX: 1.
- — forma.  
 Loc. No. 41.  
 Plate XIX, fig. 2:  $62.7 \times 10.0 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 244, Loc. No. 41).
- *divergens* W. Smith. HUSTEDT 1930, p. 323, fig. 589.  
 Loc. Nos. 5, 8, 11, 12, 15, 16, 18, 20-22.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 103), fairly rare in Sierra Leone (MÖLDER 1962, p. 40).
- — var. *undulata* Hérib. et Perag. Ibid. p. 323, fig. 591.  
 Loc. Nos. 5, 15, 29.
- *graciloides* Hust. HUSTEDT 1937-39, p. 293, 22: 9. A. SCHMIDT. Atlas 392: 2, 3. HUSTEDT 1942, p. 82, figs. 155-158. GUERMEUR 1954, 12: 3.  
 Loc. Nos. 21, 31.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 103). Fairly rare in Sierra Leone (MÖLDER 1962, p. 40).
- *legumen* Ehr. HUSTEDT 1930, p. 322, fig. 587.  
 Loc. Nos. 3, 5, 8, 11, 12, 17-19, 24, 27, 28, 31, 32, 46, 54, 58, 66.  
 Rather rare in Sierra Leone (MÖLDER 1962, p. 41).
- *mansiensis* nov. spec. Plate XVIII, fig. 5.  
 Valves linear-lanceolate with broadly protracted apices,  $40 \mu$  long,  $7-8 \mu$  broad. Raphe filiform, with polar fissures deflected to the same side. Axial area rather broad, expanding from the apices towards the middle into a rather broad central area extended to the margins. Transapical striae radial, 11 in  $10 \mu$  in the middle of the valve, convergent and denser towards the apices.  
 Loc. No. 19.  
 Plate XVIII, fig. 5:  $40.0 \times 7.4 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 165, Loc. No. 19).  
 Illustration slide: Ghana No. 165/1961.  
 Type locality: Southwest Ghana. Fresh water (the Mansi river, a tributary to the Ankobra river).
- *microstauron* (Ehr.) Grun. HUSTEDT 1930, p. 320, fig. 582.  
 Loc. Nos. 2, 5, 7-9, 11-15, 17, 18, 27, 28, 30, 34, 35, 37, 38, 40, 41, 44, 46-48, 50, 52-54, 56, 59-62, 65, 66.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 102). Rather common in Sierra Leone (MÖLDER 1962, p. 41).

*Pinnularia microstauron* var. *brébissonii* (Kütz.) Hust. Ibid. p. 321, fig. 584.

Loc. Nos. 1, 2, 7, 12, 15, 16, 22, 23, 27–29, 37, 38, 41, 44–46, 51, 56, 58, 62, 65–67.

Rather common in lakes in East Africa (HUSTEDT 1949 a, p. 102).

Rare in Sierra Leone (MÖLDER 1962, p. 41).

— — fo. *diminuta* Grun. p. 322, fig. 585.

Loc. No. 62.

— *nsuaemensis* nov. spec. Plate XVI, fig. 14.

Valves linear-lanceolate, 25–28  $\mu$  long, 4–5  $\mu$  broad. Raphe filiform, straight, with central and polar fissures deflected to the same side. Axial area narrow, increasing in breadth from the apices towards a very broad central area reaching the margin. Transapical striae, 17–18 in 10  $\mu$ , radial nearest to the middle of the valve, convergent towards the apices.

Loc. Nos. 12, 60.

Plate XVI, fig. 14: 26.0  $\times$  4.3  $\mu$ . 17–18 striae in 10  $\mu$ . (Sample No. 142, Loc. No. 12).

Illustration slide: Ghana No. 142/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest between the villages Nsuaem and Agona, Loc. No. 12).

— *obscura* Krasske. J. BOYE PETERSEN 1935, p. 147, fig. 6. J.W.G. LUND 1946, p. 92, figs. 12 A–J.

Loc. Nos. 14, 38, 66.

Plate XVIII, fig. 7: 20.0  $\times$  4.0  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 152, Loc. No. 14).

— *oliensis* nov. spec. Plate XVIII, fig. 4.

Valves linear with slightly convex sides and very broadly protracted and broadly rounded apices. 50–60  $\mu$  long, 12–14  $\mu$  broad. Raphe straight, with polar fissures deflected to the same side. Axial area rather broad and increasing in breadth from the apices towards the central area, which is a rather broad transversal band extended to the margins. Transapical striae radial, 9–10 in 10  $\mu$ , slightly convergent towards the apices.

Loc. Nos. 4, 43, 59, 62.

Plate XVIII, fig. 4: 54.6  $\times$  13  $\mu$ . 9 striae in 10  $\mu$ . (Sample No. 298, Loc. No. 59).

Illustration slide: Ghana No. 298/1961.

Type locality: East Ghana. Fresh water (the Oti river near the village Otisu, Loc. No. 59).

— *standeri* Cholnoky. CHOLNOKY 1957, p. 358, figs. 78–81.

Loc. No. 11.

Previously recorded from South Africa (CHOLNOKY 1957, p. 358).

— *subsolaris* (Grun.) Cleve. HUSTEDT 1930, p. 322, fig. 588.

Loc. Nos. 8, 12, 13, 16, 23, 25, 28, 30, 64, 65.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 41).

— *suchlandti* Hust. HUSTEDT 1943, p. 184, figs. 39–41. A. SCHMIDT. Atlas 388: 9–11.

Loc. No. 13.

Plate XIX, fig. 5: 46.7  $\times$  8.7  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 150, Loc. No. 13). Differs from the nominate taxon (HUSTEDT 1943, p. 184, figs. 39–41) by its somewhat slender valves.

— *tomentoensis* nov. spec. Plate XIX, fig. 3.

Valves elliptical-lanceolate with convex margins and obtusely protracted apices, 50–55  $\mu$  long, 10  $\mu$  broad. Axial area about one third of the breadth of the valve and in the middle expanded into a central area extended to the margin. Raphe with slightly curved branches and long polar fissures. Transapical striae about 9 in 10  $\mu$ , in the middle of the valve radial, convergent towards the apices.

Loc. Nos. 11, 43, 44, 45.

Plate XIX, fig. 3:  $53.3 \times 10.0 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 133, Loc. No. 11).  
Illustration slide: Ghana No. 133/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest near the village Tomento, 13–14 km. north of Cape Three Points, Loc. No. 11).

*Pinnularia* sp.

Loc. No. 4.

Plate XVIII, fig. 9:  $24.0 \times 4.6 \mu$ . 9–10 striae in  $10 \mu$ . (Sample No. 107, Loc. No. 4).

**d. Distantes**

*Pinnularia borealis* Ehr. HUSTEDT 1930, p. 326, fig. 547.

Loc. Nos. 1, 4, 11, 12, 15, 41, 44, 46, 52, 53, 65, 66.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 105).

— *dubitabilis* Hust. HUSTEDT 1949 a, p. 105, 6: 11–13.

Syn.: *P. borealis* Ehr. var. *rectangularis* Hust. (HUSTEDT 1937–39, p. 394, 21: 8).

*P. eburnea* (Carlsson) Zanon. CHOLNOKY 1960 a, p. 108, figs. 324–331.

Loc. Nos. 1, 46.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 105).

Plate XVIII, fig. 8:  $28.0 \times 5.8 \mu$ . 6 striae in  $10 \mu$ . (Sample No. 33, Loc. No. 1).

The species is between *P. borealis* Ehr. and *P. lagerstedti* (Cleve) Hust. Usually it has very short striae with a smaller mutual distance than those of *P. borealis*, and it is more delicate than this species, but more robust than the smaller *P. lagerstedtii*, which also has denser striae. XVIII: 8 has denser striae than indicated by HUSTEDT as normal to the species.

— *riularis* Hust. A. SCHMIDT. Atlas 392: 1. HUSTEDT 1937–39, p. 393, 23: 3.

Loc. Nos. 53, 62.

Previously reported from the Sunda Islands. (HUSTEDT 1937–39, p. 393).

Plate XIX, fig. 4:  $54.7 \times 8.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 279, Loc. No. 53). Differs from the common type by its somewhat more shortened striae near the central area.

**e. Tabellariae**

*Pinnularia gibba* Ehr. HUSTEDT 1930, p. 327, fig. 600.

Loc. Nos. 1, 3, 6–9, 12, 15, 19, 20, 23, 26, 28, 33, 35, 37, 38, 41, 44, 54, 56, 62.

Rare in the Congo territory (HUSTEDT 1949 a, p. 107), rather common in Sierra Leone (MÖLDER 1962, p. 40).

— var. *linearis* Hust. Ibid. p. 327, fig. 604.

Loc. No. 2.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 107).

— var. *mesogongyla* (Ehr.) Hust. Ibid. p. 327, fig. 603.

Loc. Nos. 1, 8, 34, 43.

— var. *parva* (Ehr.) Grun. Ibid. p. 327, fig. 602.

Loc. Nos. 2, 3, 35.

— var. *sancta* Grun. HUSTEDT 1937–39, 20: 35. GUERMEUR 1954, p. 64, 15: 1.

Loc. Nos. 13, 23, 29, 41, 62, 66.

Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 107).

Plate XVII, fig. 9:  $56.0 \times 10.4 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 181, Loc. No. 23).

— fo. *subundulata* Mayer. HUSTEDT 1930, p. 327, fig. 601.

Loc. Nos. 2, 8, 11, 18, 22, 28, 29, 33, 37, 41, 42, 44, 46.

Rare in Sierra Leone (MÖLDER 1962, p. 40).

Plate XVIII, fig. 2:  $57.3 \times 7.8 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 243, Loc. No. 41).

*Pinnularia stomatophora* Grun. Ibid. p. 327, fig. 605.

Loc. Nos. 8, 9, 12, 13, 15, 16, 18, 22, 23, 27, 53, 61, 62, 64–66.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 107). Fairly rare in Sierra Leone (MÖLDER 1962, p. 41).

— — var. *triundulata* Fontell. HUSTEDT 1942, p. 88, fig. 168.

Loc. Nos. 2, 5, 11–13, 19, 23, 24, 27, 29, 32, 33, 44, 53, 61, 62.

#### f. *Brevistriatae*

*Pinnularia acrosphaeria* Bréb. HUSTEDT 1930, p. 330, fig. 610.

Loc. Nos. 1–5, 8, 9, 11–15, 18, 22–24, 26–28, 30, 32, 33, 38, 40, 41, 44, 46, 48, 50, 53, 58–67.

Widely distributed, but never common in the Congo territory (HUSTEDT 1949 a, p. 108).

Fairly rare in Sierra Leone (MÖLDER 1962, p. 40).

— *agogoensis* nov. spec. Plate XVII, fig. 7.

Valves linear, with slightly convex sides and broadly rounded apices. 50–55  $\mu$  long, 8–10  $\mu$  broad. Raphe straight, with polar fissures deflected to the same side. Axial area very broad, about three fourths of the breadth of the valve. The central area is a very broad transversal band extending to the margins. Transapical striae very short, at right angles to the raphe, 9 in 10  $\mu$ .

Loc. No. 24.

Plate XVII, fig. 7: 50.7  $\times$  8.7  $\mu$ . 9 striae in 10  $\mu$ . (Sample No. 185, Loc. No. 24).

Illustration slide: Ghana No. 185/1961.

Type locality: West Ghana. Fresh water (the Agogo river between the towns Bibiani and Kumasi, Loc. No. 24).

— *brevicostata* Cleve. HUSTEDT 1930, p. 329, fig. 609.

Loc. No. 41.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 107) and in Sierra Leone (MÖLDER 1962, p. 40).

— — var. *sumatrana* Hust. HUSTEDT 1937–39, p. 358, 22: 4–6. A. SCHMIDT. Atlas 389: 7–9. Loc. Nos. 38, 41.

Previously reported from Sumatra (HUSTEDT 1937–39, p. 358).

— *lawsonii* nov. spec. Plate XVIII, fig. 3.

Valves linear, with slightly convex sides and broadly capitate apices, 45–60  $\mu$  long, 10–12  $\mu$  broad. Raphe straight, filiform, with central and polar fissures deflected to the same side. Axial area broad, about half of the breadth of the valve, straight, with no or very slight expansion in the middle of the valve. Transapical striae at right angles to the raphe, 12 in 10  $\mu$ . Loc. Nos. 2–4, 29, 30.

Plate XVIII, fig. 3: 56  $\times$  10.4  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 204, Loc. No. 30).

Illustration slide: Ghana No. 204/1961.

Type locality: West Ghana. Fresh water (a small river near the village Dwiniana, north-west of Kumasi, Loc. No. 30).

Dedicated to Dr. G.W. LAWSON. University of Ghana.

This species is presumably related to *P. brevicostata* Cleve var. *sumatrana* Hust.

— *montana* Hust. A. SCHMIDT. Atlas 399: 6.

Loc. No. 41.

Plate XVII, fig. 10: 57  $\times$  12.0  $\mu$ . 12 striae in 10  $\mu$ . (Sample No. 244, Loc. No. 41).

— *odaensis* nov. spec. Plate XVII, fig. 8.

Valves linear, with broadly rounded apices, 45–50  $\mu$  long, 7–8  $\mu$  broad. Raphe filiform, central and polar fissures deflected to the same side. Axial area very broad, about two thirds of the breadth of the valve. The central area is a very broad transversal band extending to the margins. Transapical striae at right angles to the raphe, 9 in 10  $\mu$ .



Loc. No. 28.

Plate XVII, fig. 8:  $48 \times 7.5 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 198, Loc. No. 28).

Illustration slide: Ghana No. 198/1961.

Type locality: West Ghana. Fresh water (the Oda river, northwest of Kumasi, Loc. No. 28).

*Pinnularia tafoensis* nov. spec. Plate XVIII, fig. 11.

Valves linear-elliptical,  $40-45 \mu$  long,  $12 \mu$  broad. Raphe filiform, straight, with polar fissures deflected to the same side. The axial area expands from the apices towards the middle of the valve, where it expands into a central area extended to the margins. Transapical striae slightly radial, 10 in  $10 \mu$ , towards the apices at right angles to the raphe. Loc. Nos. 2, 66.

Plate XVIII, fig. 11:  $42.7 \times 12.0 \mu$ . 10 striae in  $10 \mu$ . (Sample No. 6, Loc. No. 66).

Illustration slide: Ghana No. 6/1961.

Type locality: South Ghana. Fresh water (a waterwork pond at the Tafo Cocoa Research Station, north of Accra, Loc. No. 66).

#### g. *Maiores*

*Pinnularia maior* (Kütz.) Cleve. HUSTEDT 1930, p. 331, fig. 614.

Loc. Nos. 1, 8, 12, 30, 41, 58, 64.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 108) and in Sierra Leone (MÖLDER 1962, p. 41).

— — var. *linearis* Cleve fo. *neglecta* Mayer. Ibid. p. 331.

Loc. No. 41.

#### h. *Complexae*

*Pinnularia gentilis* (Donkin) Cleve. HUSTEDT 1930, p. 335, fig. 618.

Loc. No. 12.

Rare in Sierra Leone (MÖLDER 1962, p. 40).

— *esox* Ehr. Ibid. p. 334, fig. 616.

Loc. No. 64.

— *robusta* Hust. A. SCHMIDT. Atlas 387: 1, 2.

Loc. No. 8.

— *viridis* (Nitzsch) Ehr. HUSTEDT 1930, p. 334, fig. 617 a.

Loc. Nos. 1, 8, 12, 19, 21, 22, 26-28, 33, 34, 37, 40, 44, 46, 47, 53, 54, 61.

Fairly rare in lakes in East Africa (HUSTEDT 1949 a, p. 109) and in Sierra Leone (MÖLDER 1962, p. 41).

#### *Amphora* Ehr.

*Amphora abuensis* nov. spec. Plate XIX, fig. 6.

Valves with a straight ventral margin, a convex dorsal margin, and slightly protracted apices,  $23-25 \mu$  long,  $4-5 \mu$  broad. Raphe straight, running near the ventral margin. Axial area towards the dorsal side very narrow, without expansion in the middle of the valve, broader—to the margin of the valve—on the ventral side. Transapical striae on the dorsal side radial,  $15-16$  in  $10 \mu$ , distinctly punctate. No visible striae on the ventral side.

Loc. No. 31.

Plate XIX, fig. 6:  $23.4 \times 4.2 \mu$ .  $15-16$  striae in  $10 \mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Freshwater (the Abu river, Loc. No. 31).

— *acutiuscula* Kütz. GUERMEUR 1954, p. 67, 16: 10. P. T. CLEVE 1894-95, II, p. 121.

Loc. No. 31.

*Amphora ayensuensis* nov. spec. Plate XIX, fig. 7.

Valves with a straight ventral margin, a convex dorsal margin, and protracted capitate apices.  $25\ \mu$  long,  $4\text{--}5\ \mu$  broad. Raphe straight. Axial area very narrow, not expanded in the middle of the valve. Transapical striae on the dorsal side prominent, radial,  $14\text{--}15$  in  $10\ \mu$ . No visible striae on the ventral side.

Loc. Nos. 4, 19–23, 25, 26, 62, 66, 67.

Plate XIX, fig. 7:  $25.0 \times 4.8\ \mu$ .  $14\text{--}15$  striae in  $10\ \mu$ . (Sample No. 107, Loc. No. 4).

Illustration slide: Ghana No. 107/1961.

Type locality: South Ghana. Fresh water (the Ayensu river between the towns Accra and Takoradi, Loc. No. 4).

Presumably related to *A. cymbamphora* Cholnoky (CHOLNOKY 1960 a, p. 22, fig. 54), which species, however, has somewhat more distinct striae on the ventral side of the valve.

— *commutata* Grun. HUSTEDT 1930, p. 345, fig. 632.

Loc. No. 12.

Mesohalobous.

— *cramerii* nov. spec. Plate XIX, fig. 8.

Valves with almost straight ventral margin, highly convex dorsal margin and pointedly protracted apices.  $25\text{--}30\ \mu$  long,  $7\text{--}8\ \mu$  broad. Raphe straight. Axial area very narrow towards the dorsal side, extended to the margin on the ventral side. Transapical striae radial, 22 in  $10\ \mu$  on the dorsal side, a single shortened one in the middle. No visible striae on the ventral side.

Loc. No. 31.

Plate XIX, fig. 8:  $26.0 \times 7.4\ \mu$ . 22 striae in  $10\ \mu$ . (Sample No. 207, Loc. No. 31).

Illustration slide: Ghana No. 207/1961.

Type locality: West Ghana. Freshwater (scrapings from soil at edge of pool, 60–65 km. northwest of Kumasi, Loc. No. 31).

Named after J. CRAMER, Danish governor in Guinea 1658–59.

— *fontinalis* Hust. HUSTEDT 1937–39, p. 414, 24: 4, 5. CHOLNOKY 1957 a, p. 42, fig. 4.

Loc. Nos. 12, 22, 26.

Previously reported from the Sunda Islands. (HUSTEDT 1937–39, p. 414) and from South Africa (CHOLNOKY 1957 a, p. 42).

Plate XIX, fig. 10:  $25.3 \times 4.6\ \mu$ . 21 striae in  $10\ \mu$ . (Sample No. 144, Loc. No. 12).

— *holsatica* Hust. HUSTEDT 1930, p. 345, fig. 633.

Loc. Nos. 19, 27.

Mesohalobous.

— *luciae* Cholnoky. CHOLNOKY 1960 a, p. 23, figs. 58–61.

Loc. Nos. 6, 11, 14, 22, 24, 26, 31, 32.

Previously reported from South Africa (CHOLNOKY 1960 a, p. 23).

Plate XIX, fig. 9:  $25.3 \times 5.4\ \mu$ . 18 striae in  $10\ \mu$ . (Sample No. 136, Loc. No. 11).

— *mansiensis* nov. spec. Plate XX, fig. 1.

Valves with convex ventral and dorsal margin and protracted apices deflected towards the ventral side.  $38\text{--}50\ \mu$  long,  $8\text{--}10\ \mu$  broad (from girdle view). Raphe running in the middle of the side of the valve, somewhat curved. Axial area on the dorsal side narrow, slightly expanded in the middle of the valve, broad on the ventral side. Transapical striae prominent, slightly radial,  $12\text{--}14$  in  $10\ \mu$  on the dorsal side, not visible on the ventral side.

Loc. Nos. 6, 8, 9, 11, 17–21, 24, 27, 28, 58, 60, 66, 67.

Plate XX, fig. 1:  $49.3 \times 9.3\ \mu$ . 14 striae in  $10\ \mu$ . (Sample No. 168, Loc. No. 20).

Illustration slide: Ghana No. 168/1961.

Type locality: Southwest Ghana. Fresh water (the Mansi river, Loc. No. 20).

- Amphora montana* Krasske. GUERMEUR 1954, p. 67, 16: 4.  
 Loc. Nos. 2, 4, 5, 6, 12, 13, 19, 21–28, 30–32, 46, 60, 65, 67.  
 — *mutabunda* Manguin. GUERMEUR 1954, p. 67, 16: 7.  
 Loc. No. 6.  
 Previously reported from the Tropics in Africa (GUERMEUR 1954, p. 67).  
 — *normanni* Rabenh. GUERMEUR 1954, p. 67, 16: 4. HUSTEDT 1930, p. 343, fig. 630.  
 Loc. Nos. 4, 7, 11.  
 — *ovalis* Kütz. var. *libyca* (Ehr.) Cleve. HUSTEDT 1939, p. 342. A. SCHMIDT. Atlas 26: 102–111.  
 Loc. Nos. 1, 2, 4–6, 8, 9, 11, 12, 14, 17–19, 22, 26, 28, 31, 32, 34, 35, 37, 39, 40, 43, 44,  
 47–50, 58–62, 66, 67.  
 — — var. *pediculus* Kütz. HUSTEDT 1939, p. 343, fig. 629.  
 Loc. Nos. 6, 31, 32, 61.  
 — *ovalis* forma.  
 Plate XX, fig. 2:  $27.3 \times 6.7 \mu$ . 13 striae in  $10 \mu$ . (Sample No. 81, Loc. No. 23).  
 Almost identical with GUERMEUR 1954, 16: 4 (“Proche d’A. *ovalis* Kütz.”).  
 — *sancta-martiali* Peragallo. GUERMEUR 1954, p. 68, 16: 5. AMOSSÉ 1941, p. 147, figs. 7, 8.  
 Loc. No. 6.  
 Previously reported from the Tropics in Africa (GUERMEUR 1954, p. 68).  
 — *submontana* Hust. HUSTEDT 1949 a, p. 112, 11: 4.  
 Loc. Nos. 4, 32, 35, 46.  
 Very rare in the lakes in East Africa (HUSTEDT 1949 a, p. 112).

### *Cymbella* Agardh.

- Cymbella affinis* Kütz. HUSTEDT 1930, p. 362, fig. 671. FOGED 1959, p. 68, pl. 9: 2.  
 Loc. Nos. 45, 50.  
 Sparse in some lakes in East Africa (HUSTEDT 1949 a, p. 116).  
 — *ankobraensis* nov. spec. Plate XIX, fig. 11.  
 Valves unsymmetrical with slightly convex ventral margin, a more convex dorsal margin,  
 and obtusely rounded apices.  $28\text{--}30 \mu$  long,  $6 \mu$  broad. Raphe in the middle of the surface  
 of the valve, with polar fissures deflected towards the ventral side and the central fissures  
 slightly deflected towards the dorsal side. Axial area rather broad and not particularly  
 expanded in the middle of the valve. Transapical striae radial, about 12 in  $10 \mu$ ; distance  
 between the two midmost ones on the dorsal side greater; striae of the ventral side slightly  
 convergent.  
 Loc. No. 19.  
 Plate XIX, fig. 11:  $28.6 \times 6.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 166, Loc. No. 19).  
 Illustration slide: Ghana No. 166/1961.  
 Type locality: Southwest Ghana. Freshwater (the Mansi river, about 44 km. north of  
 the town Tarkwa, Loc. No. 19).  
 Presumably related to *C. nylstroomensis* Cholnoky (CHOLNOKY 1958 a, p. 109), which has  
 been reported from South Africa.  
 — *aspera* (Ehr.) Cleve. HUSTEDT 1930, p. 351, fig. 639.  
 Loc. No. 34.  
 — — var. *bengalensis* Grun. P. T. CLEVE 1894–95, I, p. 176. CHOLNOKY 1953 b, p. 140, fig. 4.  
 Syn.: *C. bengalensis* Grun. A. SCHMIDT Atlas 9: 11, 12. 71: 79. 375: 2, 3, 6.  
 Loc. Nos. 2, 5, 8, 19, 21, 25, 28, 33, 34, 36, 40, 49, 58, 61.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 117).  
 Plate XX, fig. 8:  $80 \times 26 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 171, Loc. No. 21).  
 — *cucumis* A. Schmidt. A. SCHMIDT Atlas 9: 21, 22. 375: 7–9.  
 Loc. No. 19.

*Cymbella dadwinensis* nov. spec. Plate XX, fig. 3.

Valves unsymmetrical, lanceolate, with a convex ventral margin with a slight expansion in the middle of the valve and a more highly convex dorsal margin. 55–60  $\mu$  long, 10–12  $\mu$  broad. Raphe straight, with rather long polar fissures deflected towards the ventral side and central fissures slightly deflected towards the dorsal side. Axial area narrowly lanceolate, without any specially indicated central area. Transapical striae radial, on the dorsal side 8, on the ventral side 9 in 10  $\mu$ .

Loc. Nos. 12, 13, 17, 18.

Plate XX, fig. 3: 57.3  $\times$  10.7  $\mu$ . 9 striae in 10  $\mu$  on the ventral side of the valve; 7 striae in 10  $\mu$  on the dorsal side. (Sample No. 147, Loc. No. 13).

Illustration slide: Ghana No. 147/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest near the village Dadwin, Loc. No. 13).

Presumably related to *C. suburgida* Hust. var. *wallaceana* Hust. (HUSTEDT 1942, p. 105, figs. 222–24).

— *gracilis* (Rabenh.) Cleve. HUSTEDT 1930, p. 359, fig. 663.

Loc. Nos. 8, 11, 12, 26, 30, 32, 47, 53, 60.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 116). Very common in Sierra Leone (MÖLDER 1962, p. 42).

— *helvetica* Kütz. Ibid. p. 364, fig. 678.

Loc. No. 43.

— *hustedtii* Krasske. Ibid. p. 363, fig. 674.

Loc. Nos. 2, 12, 26, 50, 58, 61.

— *kolbei* Hust. HUSTEDT 1949 b, p. 46, figs. 20–26.

Syn.: *C. sumatraensis* Hust. GUERMEUR 1954, p. 70, 16: 15.

Loc. Nos. 2, 5, 8–13, 23, 26, 34, 38, 46, 47, 49, 58–62.

— *leptoceros* (Ehr.) Grun. HUSTEDT 1930, p. 353, fig. 645.

Loc. Nos. 20, 33, 58, 59.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 113).

— *moragoensis* nov. spec. Plate XX, fig. 9.

Valves unsymmetrical with slightly convex ventral margin and highly convex dorsal margin, and slightly protracted, rather pointed apices. 25–30  $\mu$  long, 9–10  $\mu$  broad. Raphe slightly curved, rather close to the ventral margin, with polar fissures deflected towards the ventral margin and the central fissures slightly deflected towards the dorsal margin. Axial area rather narrow, without any specially indicated central area. Transapical striae highly radial, about 9 in 10  $\mu$ .

Loc. Nos. 2, 8, 12, 14, 18, 25, 28, 29, 42, 50, 57, 58, 60, 64, 65.

Plate XX, fig. 9: 26.7  $\times$  9.4  $\mu$ . About 9 striae in 10  $\mu$ . (Sample No. 268, Loc. No. 50).

Illustration slide: Ghana No. 268/1961.

Type locality: Northeast Ghana. Fresh water (the Morago river, the White Volta system, Loc. No. 50).

Presumably related to *C. grossestriata* O. Müller var. *obtusiuscula* O. Müller (CHOLNOKY 1953 b, p. 144, fig. 5).

— *mülleri* Hust. HUSTEDT 1937–39, p. 425, 26: 1–4.

Syn.: *C. grossestriata* O. Müller var. *obtusiuscula* O. Müller. O. MÜLLER 1905, p. 154, fig. 13. A. SCHMIDT Atlas 373: 6, 7.

Loc. Nos. 2, 17, 22, 26, 30, 46, 49, 55, 57–59, 67.

Widely distributed and common in lakes in East Africa (HUSTEDT 1949 a, p. 115. ZANON 1938, figs. 33, 34).

Plate XX, fig. 11:  $40.7 \times 12.2 \mu$ . Striae 7 in  $10 \mu$  on dorsal side, and 5 in  $10 \mu$  on ventral side of the valve. (Sample No. 193, Loc. No. 26).

*Cymbella mülleri* var. *sumatrana* Hust. GUERMEUR 1954, p. 70, 17: 2 b.

Loc. No. 2.

— *raytonensis* Cholnoky. CHOLNOKY 1954 b, p. 411, fig. 13. 1960 a, p. 34, fig. 50.

Syn.: *C. schubartii* Hust. HUSTEDT 1955 c, p. 59, figs. 22, 23.

Loc. No. 15.

Plate XX, fig. 10:  $20.0 \times 5.4 \mu$ . 10–11 striae in  $10 \mu$  on the dorsal side and 9–10 striae in  $10 \mu$  on the ventral side of the valve. (Sample No. 154, Loc. No. 15).

— *tainensis* nov. spec. Plate XX, fig. 4.

Valves unsymmetrically lanceolate, naviculoid, with convex ventral margin and with somewhat more convex dorsal margin. 38–40  $\mu$  long, 7–8  $\mu$  broad. Raphe almost in the middle of the valve, somewhat closer to the ventral side, straight, with short polar fissures deflected towards the dorsal margin. Axial area narrow, linear, with a prolonged slight expansion in the middle of the valve. Transapical striae radial, 15 in  $10 \mu$ , distinctly punctate.

Loc. No. 32.

Plate XX, fig. 4:  $38.7 \times 7.3 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 215, Loc. No. 32).

Illustration slide: Ghana No. 215/1961.

Type locality: West Ghana. Fresh water (the Tain river near the village Tanoso, Loc. No. 32).

Presumably related to *C. pseudostodderi* Cholnoky (CHOLNOKY 1959, p. 19, fig. 111).

— *takoradiensis* nov. spec. Plate XX, fig. 5.

Valves unsymmetrical, lanceolate, with almost straight (slightly convex) ventral margin and convex dorsal margin. 40–45  $\mu$  long, 5–7  $\mu$  broad. Raphe almost straight, almost in the middle of the valve, with short polar fissures deflected towards the dorsal side. Transapical striae radial, 15 in  $10 \mu$ , on the ventral side of the valve slightly convergent towards the apices.

Loc. No. 6.

Plate XX, fig. 5:  $41 \times 6.0 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 114, Loc. No. 6).

Illustration slide: Ghana No. 114/1961.

Type locality: Southwest Ghana. Fresh water (a small river west of the town Takoradi, Loc. No. 6).

Similar to *C. subalpina* Hust. var. *natalensis* Cholnoky (CHOLNOKY 1957 a, p. 48, fig. 44–52), but XX: 5 has somewhat denser striae, and an axial area wider than this.

— *theronii* Cholnoky. CHOLNOKY 1954 a, p. 122, figs. 6–8. 1963 a, p. 166, fig. 21.

Loc. Nos. 6, 8, 9, 12, 17–19, 26, 34, 49, 58, 59.

Previously known from South Africa and New Guinea (CHOLNOKY 1954 a, p. 122. 1963 a, p. 166).

Plate XX, fig. 6:  $16.0 \times 5.0 \mu$ . 12 striae in  $10 \mu$ . (Sample No. 166, Loc. No. 19).

— *turgida* (Greg.) Cleve. HUSTEDT 1930, p. 358, fig. 660.

Loc. Nos. 1–9, 11–22, 24–40, 42, 44, 46–49, 53, 54, 58–66.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 116), but very common in Sierra Leone (MÖLDER 1962, p. 42).

— — var. *pseudogracilis* Cholnoky. CHOLNOKY 1958 a, p. 112, figs. 49, 50.

Loc. Nos. 33, 34.

Previously known from South Africa (CHOLNOKY 1958 a, p. 112).

— *ventricosa* Kütz. HUSTEDT 1930, p. 359, fig. 661.

Loc. Nos. 1, 2, 6, 8, 9, 11–14, 17, 18–20, 25, 26, 29, 32–41, 43–48, 50, 54, 57, 58, 60–62, 64, 65.

Widely distributed and in many localities rather common in the Congo territory (HUSTEDT 1949 a, p. 116). Very common in Sierra Leone (MÖLDER 1962, p. 42).

### Gomphocymbella O. Müller.

*Gomphocymbella ruttneri* Hust. A. SCHMIDT Atlas 294: 29–32.

Loc. Nos. 6, 19, 22, 32, 40, 42, 48, 58–60, 65.

Plate XX, fig. 7:  $28.7 \times 7.0 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 299, Loc. No. 60).

### Gomphonema Agardh.

*Gomphonema acuminatum* Ehr. var. *turris* (Ehr.) Cleve. HUSTEDT 1930, p. 372, fig. 687.

Loc. Nos. 1–3, 31, 34, 47, 48, 50, 58, 59, 66.

— *africanum* G. S. West. HUSTEDT 1949 a, p. 121, 10: 1–5.

Loc. Nos. 1, 34, 35, 41, 47–49, 54, 58, 62.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 121).

Plate XXI, fig. 6:  $130 \times 16 \mu$ . 9 striae in  $10 \mu$ . (Sample No. 221, Loc. No. 34).

Somewhat similar to *G. subapicatum* Fritsch et Rich 1929, fig. 6 B.

— *angustatum* (Kütz.) Rabenh. HUSTEDT 1930, p. 373, fig. 690.

Loc. Nos. 2, 3, 8, 9, 12–14, 18, 23, 25, 26, 28–30, 37, 39, 42, 46, 48–50, 61.

Not rare in Sierra Leone (MÖLDER 1962, p. 42).

— var. *producta* Grun. Ibid. p. 373, fig. 693.

Loc. Nos. 2, 3, 8, 12, 14, 18, 22, 23, 26, 29, 30, 46, 50.

Rather common in Sierra Leone (MÖLDER 1962, p. 42).

— *brasiliense* Grun. O. MÜLLER 1903, 1: 9.

Loc. Nos. 6–9, 11–14, 17–23, 27–32, 58, 62–66.

Previously reported from the Tropics in Africa (O. MÜLLER 1903).

Plate XXI, fig. 4:  $20.6 \times 4.7 \mu$ . 10–11 striae in  $10 \mu$ . (Sample No. 203, Loc. No. 29).

Plate XXI, fig. 5:  $29.3 \times 4.7 \mu$ . 11 striae in  $10 \mu$ . (Sample No. 305, Loc. No. 64).

Somewhat similar to *G. rautenbachia* Cholnoky (CHOLNOKY 1959, p. 29).

— *clevei* Fricke. HUSTEDT 1949 a, p. 122. A. SCHMIDT Atlas 234: 44–46. GUERMEUR 1954, p. 71, 18: 4. FOGED 1959, p. 76, 12: 6.

Loc. Nos. 8, 12, 17.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 122) and rather common in Sierra Leone (MÖLDER 1962, p. 42).

— var. *javanica* Hust. CHOLNOKY 1956, fig. 70. A. SCHMIDT Atlas 266: 35.

Loc. Nos. 8, 11, 13, 14, 17, 58, 60.

— *farakulumense* Foged. FOGED 1959, p. 76, 11: 8.

Loc. Nos. 2, 62, 67.

Previously reported from Afghanistan (FOGED 1959, p. 76).

Plate XXI, fig. 10:  $14.7 \times 4.0 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 70, Loc. No. 2).

— forma.

Loc. No. 67.

Plate XXI, fig. 11:  $17.6 \times 3.6 \mu$ . 20–22 striae in  $10 \mu$ . (Sample No. 78, Loc. No. 67).

— *gracile* Ehr. HUSTEDT 1930, p. 376, fig. 702.

Loc. Nos. 1–4, 7, 8, 11–13, 15, 16, 18–23, 26–33, 35–42, 44–50, 53–56, 58, 59, 61, 62, 64–67.

Widely distributed and in many localities common in lakes in East Africa (HUSTEDT 1949 a, p. 122). Very common in Sierra Leone (MÖLDER 1962, p. 42).

— var. *lanceolata* (Kütz.) Cleve. Ibid. p. 376, fig. 703.

Loc. No. 58.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 43).



*Gomphonema intricatum* Kütz. Ibid. p. 375, fig. 697.

Loc. Nos. 12, 26.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 121) and in Sierra Leone (MÖLDER 1962, p. 43).

— — var. *vibrio* (Ehr.) Cleve. Ibid. p. 376, fig. 698.

Loc. No. 66.

— *lanceolatum* Ehr. Ibid. p. 376, fig. 700.

Loc. Nos. 3, 6, 8, 11, 13, 14, 17–19, 22, 24, 26, 31, 32, 44, 49, 56, 57, 61, 62, 64, 65.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 122). Not rare in Sierra Leone (MÖLDER 1962, p. 43).

— — var. *insignis* (Greg.) Cleve. Ibid. p. 376, fig. 702.

Loc. Nos. 14, 25, 26, 38, 39, 44, 60, 63, 67.

Not common in lakes in East Africa (HUSTEDT 1949 a, p. 122). Not rare in Sierra Leone (MÖLDER 1962, p. 43).

— *lingulatum* Hust. HUSTEDT 1927, p. 166, fig. 5.

Loc. Nos. 34, 58, 61.

Previously reported from Japan (HUSTEDT 1927, p. 166).

Plate XXI, fig. 3:  $23.5 \times 6.7 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 295, Loc. No. 58).

— *longiceps* Ehr. var. *subclavata* Grun. HUSTEDT 1930, p. 375, fig. 705.

Loc. Nos. 58, 59, 61, 64.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 119). Fairly rare in Sierra Leone (MÖLDER 1962, p. 43).

— — fo. *gracilis* Hust. Ibid. p. 375, fig. 706.

Loc. Nos. 30, 45.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 43).

— *parvulum* (Kütz.) Grun. Ibid. p. 372, fig. 713 a.

Loc. Nos. 1, 2, 4, 6, 8, 11, 12, 15, 17–20, 23, 24, 26–35, 38, 39, 41, 43, 44, 46–49, 54, 56, 58–63, 65, 67.

Widely distributed and in some places very common in the Congo territory (HUSTEDT 1949 a, p. 119). Very common in Sierra Leone (MÖLDER 1962, p. 43).

— — var. *lagenula* (Kütz.?). Grun.) Hust. Ibid. p. 373.

Loc. Nos. 1–4, 8, 12, 13, 16–19, 22, 23, 26–28, 30–32, 34, 35, 38–41, 43, 44, 46, 48–50, 52, 54, 56–63, 65, 67.

Occurs together with the species in the Congo territory (HUSTEDT 1949 a, p. 119).

— — var. *micropus* (Kütz.) Cleve. Ibid. p. 373, fig. 713 c.

Loc. Nos. 2, 8, 12–14, 19, 28, 32, 35, 37–39, 44, 49, 53, 55, 56, 58, 61, 63, 64.

— — var. *subelliptica* Cleve. Ibid. p. 373, fig. 695.

Loc. No. 25.

Not rare in Sierra Leone (MÖLDER 1962, p. 43).

— *sphaerophorum* Ehr. Ibid. p. 372, fig. 695.

Loc. Nos. 2, 4, 6, 8, 9, 11–14, 16–19, 22, 23, 26–28, 52, 58, 61, 63, 65, 67.

Not rare in Sierra Leone (MÖLDER 1962, p. 43).

— *suhmii* nov. spec. Plate XXI, fig. 1.

Valves cuneate, with a broad head pole and rather greatly tapering towards the foot pole.  $45\text{--}55 \mu$  long,  $6\text{--}8 \mu$  broad. Slight transapical expansion between the middle of the valve and the head pole. Axial area broad, about one third of the breadth of the valve, slightly lengthily expanded in the middle of the valve. Transapical striae radial, 15 in  $10 \mu$ , with 1–2 distinct, hyaline longitudinal stripes.

Loc. Nos. 58, 62.

Plate XXI, fig. 1:  $49.5 \times 6.8 \mu$ . 15 striae in  $10 \mu$ . (Sample No. 294, Loc. No. 58).

Illustration slide: Ghana No. 294/1961.

Type locality: East Ghana. Fresh water (the Volta river at Kete Krachi, Loc. No. 58).  
Named after H. von Suhm, a Danish Governor in Guinea 1724–27. He established the Ada Lodge at the Volta river.

Plate XXI, fig. 2:  $35.3 \times 6.7 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 295, Loc. No. 58).

*Gomphonema wulsiense* nov. spec. Plate XXI, fig. 7.

Valves clavate, with a more obtuse head pole and a somewhat narrower foot pole, evenly tapering from the middle.  $15\text{--}20 \mu$  long,  $4.7 \mu$  broad. Axial area very narrow, central area rounded, about half of the breadth of the valve. Transapical striae radial, about 20 in  $10 \mu$ , with 3–4 hyaline longitudinal stripes.

Loc. Nos. 2, 56.

Plate XXI, fig. 7:  $16.7 \times 4.7 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 287, Loc. No. 56).

Illustration slide: Ghana No. 287/1961.

Type locality: East Ghana. Fresh water (a pool near the village Wulasi, Loc. No. 56).

— — var. *nunguaensis* nov. var. Plate XXI, fig. 9.

Differs from the species by the valves being ovally clavate. Transapical striae denser, 22–24 in  $10 \mu$ , than in the species.

Loc. Nos. 1–3, 29, 62.

Plate XXI, fig. 9:  $16.0 \times 5.9 \mu$ . 22–24 striae in  $10 \mu$ . (Sample No. 33, Loc. No. 1).

Illustration slide: Ghana No. 33/1961.

Type locality: South Ghana. Fresh water (a cattle pool at Nungua Farm, Loc. No. 1).

— — var. *vollaensis* nov. var. Plate XXI, fig. 8.

Deviates from the species by having broadly cuneate valves, which near the head pole as well as the foot pole are cuneately acuminate.

Loc. Nos. 2, 58.

Plate XXI, fig. 8:  $15.3 \times 4.0 \mu$ . 20 striae in  $10 \mu$ . (Sample No. 293, Loc. No. 58).

Illustration slide: Ghana No. 293/1961.

Type locality: East Ghana. Fresh water (the Volta river near Kete Krachi, Loc. No. 58).

#### IV. Epithemiaceae

##### Denticula Kütz.

*Denticula tenuis* Kütz. HUSTEDT 1930, p. 381, fig. 723.

Loc. No. 11.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 123), and in Sierra Leone (MÖLDER 1962, p. 43).

##### Epithemia Bréb.

*Epithemia sorex* Kütz. HUSTEDT 1930, p. 388, fig. 736.

Loc. Nos. 11, 38.

Not common in the Congo territory (HUSTEDT 1949 a, p. 124).

— *zebra* (Ehr.) Kütz. Ibid. p. 384, fig. 729.

Loc. Nos. 31, 33.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 122).

— — var. *porcellus* (Kütz.) Grun. Ibid. p. 385, fig. 731.

Loc. No. 35.

More common than the species in lakes in East Africa (HUSTEDT 1949 a, p. 123).

— — var. *saxonica* (Kütz.) Grun. Ibid. p. 385, fig. 730.

Loc. No. 47.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 123).

**Rhopalodia** O. Müller.

- Rhopalodia gibba* (Ehr.) O. Müller. HUSTEDT 1930, p. 390, fig. 740.  
 Loc. Nos. 2, 3, 19, 34, 40, 44, 47, 49, 58, 59.  
 Widely distributed and often common in the Congo territory (HUSTEDT 1949 a, p. 124).  
 — var. *ventricosa* (Ehr.) Grun. Ibid. p. 391, fig. 741.  
 Loc. No. 49.  
 Very common in Sierra Leone (MÖLDER 1962, p. 44).  
 — *gibberula* (Ehr.) O. Müller. Ibid. p. 391, fig. 742.  
 Loc. No. 6.  
 Widely distributed and in many places common in the Congo territory (HUSTEDT 1949 a, p. 125).  
 Mesohalobous.  
 — *musculus* (Ehr.) O. Müller. Ibid. p. 391, fig. 742.  
 Loc. Nos. 2, 4, 6–8, 11–13, 16, 20, 23, 26, 27, 47, 58, 62, 66.  
 Mesohalobous.

**V. Nitzschiaceae****Hantzschia** Grun.

- Hantzschia amphioxys* (Ehr.) Grun. HUSTEDT 1930, p. 394, fig. 747. GUERMEUR 1954, p. 74, 19: 1.  
 Loc. Nos. 3, 6, 8, 11–13, 19, 26, 34, 35, 37, 38, 40, 41, 43, 44, 46, 49, 56, 58, 59.  
 Widely distributed but most frequently singly in the Congo territory (HUSTEDT 1949 a, p. 129). Fairly rare in Sierra Leone (MÖLDER 1962, p. 44).  
 — fo. *capitata* O. Müller. HUSTEDT 1930, p. 394, fig. 748.  
 Loc. No. 3.  
 Very rare in Sierra Leone (MÖLDER 1962, p. 44).  
 — var. *africana* O. Müller. O. MÜLLER 1921, p. 167, 1: 25.  
 Loc. Nos. 37–39, 44, 46, 53.  
 Previously reported from tropical Africa (O. MÜLLER 1921, p. 167).  
 Plate XXI, fig. 14:  $60 \times 7.2 \mu$ . 8–9 carinate dots and 19–20 striae in  $10 \mu$ . (Sample No. 249, Loc. No. 44).  
 — var. *maior* Grun. HUSTEDT 1930, p. 394, fig. 749.  
 Loc. Nos. 38, 39, 41, 43, 44, 58, 59.  
 — var. *vivax* (Hantzsch) Grun. Ibid. p. 394, fig. 750.  
 Loc. Nos. 2, 33, 34, 36, 38, 44, 45, 54, 58.  
 — *distincte-punctata* Hust. HUSTEDT 1922, p. 167. A. SCHMIDT Atlas 329: 21, 22. CHOLNOKY 1957 c, p. 66, fig. 63.  
 Loc. Nos. 6, 8, 11, 12, 18, 19, 21, 22, 27, 28, 55.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 129).  
 Plate XXII, fig. 3:  $50 \times 7.3 \mu$ . 5–6 carinate dots and 12 striae in  $10 \mu$ . (Sample No. 171, Loc. No. 21).  
 — *virgata* (Rop.) Grun. HUSTEDT 1930, p. 395, fig. 752.  
 Loc. No. 2.  
 Mesohalobous.  
 — var. *capitellata* Hust. Ibid. p. 395, fig. 753.  
 Loc. No. 1.  
 Mesohalobous.

**Bacillaria** Gmelin

*Bacillaria paradoxa* Gmelin. HUSTEDT 1930, p. 396, fig. 755.

Loc. Nos. 1, 3-6, 8, 11-14, 17-19, 21, 22, 61, 62, 67.

Mesohalobous.

**Nitzschia** Hassalla. **Tryblionellae** (W. Smith. Grun.) Hust.

*Nitzschia angustata* (W. Smith) Grun. HUSTEDT 1930, p. 402, fig. 767.

Loc. Nos. 22, 58.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 130), and in Sierra Leone (MÖLDER 1962, p. 44).

— *apiculata* (Greg.) Grun. Ibid. p. 401, fig. 765.

Loc. Nos. 4, 5, 19, 26, 32, 47, 58, 67.

Mesohalobous.

— *debilis* (Arnott) A. Mayer. Ibid. p. 400, fig. 759.

Syn.: *N. tryblionella* Hantz. var. *debilis* (Arnott) A. Mayer.

Loc. Nos. 2-6, 8, 9, 11, 12, 15, 16, 22, 26, 28, 33, 47, 61, 62.

— *hungarica* Grun. Ibid. p. 401, fig. 766.

Loc. Nos. 2, 8, 26, 31, 57.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 130).

Halophilous-mesohalobous.

— *levidensis* (W. Smith) Grun. Ibid. p. 399, fig. 760.

Syn.: *N. tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.

Loc. Nos. 1, 2, 8, 12-14, 17-19, 27, 28, 30, 47, 60, 64, 65.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 129).

Halophilous.

— *perversa* Grun. CLEVE ET GRUN. 1880, p. 70. A. SCHMIDT Atlas 35: 9. HENDEY 1957-58, p. 77, 3: 9. 5: 7.

Loc. Nos. 8, 13, 18, 22.

Polyhalobous.

— *punctata* (W. Smith) Grun. var. *coarctata* Grun. HUSTEDT 1930, p. 401.

Loc. Nos. 4-6, 8, 11-14, 17-22, 24, 25, 28, 31, 32, 34, 61, 62, 67.

Halophilous-mesohalobous.

— *subpunctata* Cholnoky. CHOLNOKY 1960 a, p. 104, fig. 314.

Loc. No. 6.

Previously reported from South Africa (CHOLNOKY 1960 a, p. 104).

— *tryblionella* Hantzsch var. *victoriae* Grun. HUSTEDT 1930, p. 399, fig. 758.

Loc. Nos. 1-6, 8, 9, 11, 12, 14, 17-25, 27, 28, 30-34, 36, 40, 41, 47, 50, 58, 61, 62, 65, 67.

Halophilous.

b. **Dubiae** Grun.

*Nitzschia amisaensis* nov. spec. Plate XXI, fig. 15.

Valves broadly linear with almost parallel sides and shortly protracted apices. 30-35  $\mu$  long, 5-6  $\mu$  broad. Carina highly eccentric. Carinate dots 11-12 in 10  $\mu$  with greater distance between the two midmost ones. Transapical striae 24 in 10  $\mu$ , finely punctate.

Loc. No. 5.

Plate XXI, fig. 15: 30.6  $\times$  5.4  $\mu$ . 11-12 carinate dots and 24 striae in 10  $\mu$ . (Sample No. 111, Loc. No. 5).

Illustration slide: Ghana No. 111/1961.

Type locality: Southwest Ghana. Fresh water (the Amisa river near the village Mankesim, Loc. No. 5).

Somewhat similar to *N. plicatula* Hust. (HUSTEDT 1953, p. 151, figs. 1, 2).

*Nitzschia commutata* Grun. HUSTEDT 1930, p. 405, fig. 774.

Loc. Nos. 38, 45.

Halophilous-mesohalobous.

— *dubia* W. Smith. Ibid. p. 403, fig. 770.

Loc. Nos. 44, 56.

Halophilous.

— *mankesimensis* nov. spec. Plate XXI, fig. 17.

Valves broadly linear with parallel sides and shortly protracted, pointedly rounded apices. 40–45  $\mu$  long, 8  $\mu$  broad. Carina highly eccentric. Carinate dots 8–9 in 10  $\mu$ . Transapical striae 15 in 10  $\mu$ .

Loc. Nos. 4, 6, 44.

Plate XXI, fig. 17: 43.4  $\times$  8.0  $\mu$ . 8–9 carinate dots and 15 striae in 10  $\mu$ . (Sample No. 112, Loc. No. 4).

Illustration slide: Ghana No. 112/1961.

Type locality: Southwest Ghana. Fresh water (a pond near the Amisa river near the village Mankesim, Loc. No. 4).

— *nunguaensis* nov. spec. Plate XXI, fig. 16.

Valves broadly linear with parallel sides and shortly protracted capitate apices, 30–35  $\mu$  long, 7–8  $\mu$  broad. Carina highly eccentric. Carinate dots 6–8 in 10  $\mu$ . Transapical striae 18–19 in 10  $\mu$ .

Loc. Nos. 1, 46.

Plate XXI, fig. 16: 34.5  $\times$  7.3  $\mu$ . 6–8 carinate dots and 18–19 striae in 10  $\mu$ . (Sample No. 33, Loc. No. 1).

Illustration slide: Ghana No. 33/1961.

Type locality: South Ghana. Fresh water (a cattle pool at the university farm Nungua, Loc. No. 1).

Somewhat similar to *N. stagnorum* Rabenh. (HUSTEDT 1930, p. 405, fig. 773).

— *plicatula* Hust. HUSTEDT 1953, p. 150, figs. 1, 2. CHOLNOKY 1959, p. 58, figs. 295, 296. Loc. Nos. 1, 5, 8, 22, 28, 31, 46, 47, 49, 58, 62, 67.

Plate XXIII, fig. 3: 44.6  $\times$  8.0  $\mu$ . 6–8 carinate dots and 18–19 striae in 10  $\mu$ . (Sample No. 210, Loc. No. 31).

Similar to *N. commutata* Grun.

Halophilous-mesohalobous.

— *thermalis* Kütz. HUSTEDT 1930, p. 403, fig. 771.

Loc. Nos. 32, 35, 67.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 130). Fairly rare in Sierra Leone (MÖLDER 1962, p. 49).

### c. *Bilobatae* Grun.

*Nitzschia syrachii* nov. spec. Plate XXII, fig. 12.

Valves lanceolate, slightly retracted on the dorsal side, and with slightly protracted apices. 30–40  $\mu$  long, 5–6  $\mu$  broad. Carina eccentric. Carinate dots rounded, rather prominent, 12 in 10  $\mu$ ; greater distance between the two midmost ones. Transapical striae not visible.

Loc. Nos. 6, 56.

Plate XXII, fig. 12: 40  $\times$  5.5  $\mu$ . 12 carinate dots in 10  $\mu$ , and striae very dense. (Sample No. 114, Loc. No. 6).

Illustration slide: Ghana No. 114/1961.

Type locality: South Ghana. Fresh water (a river to the west of Takoradi, Loc. No. 6).  
Dedicated to C. SYRACH LARSEN, Dr. agro. & Dr. phil.

d. **Lineares** (Grun.) Hust.

*Nitzschia akelechiensis* nov. spec. Plate XXII, fig. 2.

Valves elliptical-lanceolate with broadly protracted, evenly severed apices. 45–50  $\mu$  long, 7–8  $\mu$  broad. Carina eccentric. Carinate dots linear, prominent, 5–6 in 10  $\mu$ . Transapical striae 30–34 in 10  $\mu$  with undulate longitudinal stripes.

Loc. No. 11.

Plate XXII, fig. 2: 45.5  $\times$  7.3  $\mu$ . 5–6 carinate dots and 30–34 striae in 10  $\mu$ . (Sample No. 136, Loc. No. 11).

Illustration slide: Ghana No. 136/1961.

Type locality: Southwest Ghana. Fresh water (a river in the rain forest near the village Akitech, Loc. No. 11).

— *bansoensis* nov. spec. Plate XXII, fig. 4.

Valves lanceolate with somewhat protracted, slightly capitate apices. 40–45  $\mu$  long, 4  $\mu$  broad. Carina narrow, eccentric. Carinate dots 11 in 10  $\mu$ , rather small, rounded. Transapical striae 15 in 10  $\mu$ .

Loc. Nos. 8, 9, 11, 12, 18, 22, 30.

Plate XXII, fig. 4: 40.4  $\times$  4.0  $\mu$ . 11 carinate dots and 15 striae in 10  $\mu$ . (Sample No. 144, Loc. No. 12).

Illustration slide: Ghana No. 144/1961.

Type locality: Southwest Ghana. Fresh water (a small stream in a bamboo thicket between the villages Agona and Nsuaem, Loc. No. 12).

— *lawsonii* nov. spec. Plate XXII, fig. 13.

Valves linear with slightly concave carinate side and non-protracted, obtusely rounded apices. 90–100  $\mu$  long, 8  $\mu$  broad. Carina eccentric. Carinate dots 6 in 10  $\mu$ , prominent. Transapical striae 28–30 in 10  $\mu$ .

Loc. Nos. 1, 2, 4, 5.

Plate XXII, fig. 13: 96.5  $\times$  8.0  $\mu$ . 6 carinate dots and 28–30 striae in 10  $\mu$ . (Sample No. 112, Loc. No. 4).

Illustration slide: Ghana No. 112/1961.

Type locality: Southwest Ghana. Fresh water (a pond east of Mankesim, Loc. No. 4).  
Dedicated to Dr. G. W. LAWSON, University of Ghana.

— *linearis* W. Smith. HUSTEDT 1930, p. 409, fig. 784.

Loc. Nos. 3, 7, 11, 13, 14, 18, 21, 22, 24–32, 34, 46, 47, 49, 62.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 131), not rare in Sierra Leone (MÖLDER 1962, p. 44).

— *nagbogensis* nov. spec. Plate XXII, fig. 6.

Valves linear, with parallel sides and capitate apices, 40–45  $\mu$  long, 4–5  $\mu$  broad. Carina eccentric. Carinate dots 9–10 in 10  $\mu$ , linear. Transapical striae not visible.

Loc. Nos. 25, 53.

Plate XXII, fig. 6: 43.3  $\times$  4.2  $\mu$ . 9–10 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 279, Loc. No. 53).

Illustration slide: Ghana No. 279/1961.

Type locality: Northeast Ghana. Fresh water (a river near the village Nagbog, Loc. No. 53).

— *pretoriensis* Cholnoky. CHOLNOKY 1957 c, p. 77, fig. 110.

Loc. No. 11.

Previously reported from South Africa (CHOLNOKY 1957 c, p. 77).



- Plate XXII, fig. 1:  $56 \times 6 \mu$ . 6 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 136, Loc. No. 11).  
 The size of XXII: 1 is considerably greater than the dimensions of the species given by CHOLNOKY 1957 c, p. 77.
- Nitzschia recta* Hantzsch. HUSTEDT 1930, p. 411, fig. 785.  
 Loc. Nos. 2, 3, 26, 67.  
 Rare in lakes in East Africa (HUSTEDT 1949 a, p. 132).
- *ruttneri* Manguin. E. MANGUIN 1942, 4: 79.  
 Loc. No. 59.  
 Previously reported from the Azores (E. MANGUIN 1942).
- *tonoensis* nov. spec. Plate XXIII, fig. 5.  
 Valves linear-lanceolate, with rather far protracted capitate apices.  $90\text{--}95 \mu$  long,  $8\text{--}9 \mu$  broad. Carina eccentric. Carinate dots 7–8 in  $10 \mu$ ; greater distance between the two midmost ones. Transapical striae 18 in  $10 \mu$ .  
 Loc. Nos. 2, 4, 33–36, 44, 45, 67.  
 Plate XXIII, fig. 5:  $90.6 \times 8.3 \mu$ . 7–8 carinate dots in  $10 \mu$ . 18 striae in  $10 \mu$ . (Sample No. 252, Loc. No. 45).  
 Illustration slide: Ghana No. 252/1961.  
 Type locality: North Ghana. Freshwater (pond No. 26 at Tono agricultural station near the town Navrongo; Loc. No. 45).
- *vedelii* nov. spec. Plate XXII, fig. 5.  
 Valves lanceolate, with long and narrowly protracted capitate apices.  $40\text{--}45 \mu$  long,  $4\text{--}5 \mu$  broad. Carina narrow, eccentric. Carinate dots 11–12 in  $10 \mu$ , small, rounded. Transapical striae 12–13 in  $10 \mu$ .  
 Loc. No. 11.  
 Plate XXII, fig. 5:  $44 \times 4.3 \mu$ . 11–12 carinate dots and 12–13 striae in  $10 \mu$ . (Sample No. 135, Loc. No. 11).  
 Illustration slide: Ghana No. 135/1961.  
 Type locality: Southwest Ghana. Fresh water (a small river in the rain forest west of Takoradi; Loc. No. 11).  
 Dedicated to the Danish Vice-Admiral A.H. VEDEL, Ph. D. h. c.
- *vitrea* Norman. HUSTEDT 1930, p. 411, fig. 787.  
 Loc. Nos. 14, 16.  
 Very rare in hot springs in East Africa (HUSTEDT 1949 a, p. 132).

#### e. *Dissipatae* Grun.

- Nitzschia acuta* Hantzsch. HUSTEDT 1930, p. 412, fig. 790.  
 Loc. Nos. 12, 17, 18.  
 Not rare in Sierra Leone (MÖLDER 1962, p. 44).
- *dissipata* (Kütz.) Grun. Ibid. p. 412, fig. 789.  
 Loc. Nos. 1, 6, 8, 9, 12–14, 18, 19, 21, 22, 27–29, 31, 47, 61, 62, 65.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 132), and in Sierra Leone (MÖLDER 1962, p. 44).
- *socialis* Greg. CLEVE et GRUNOW 1880, p. 85. H. et M. PERAGALLO 1897–1908, p. 280, 72: 7, 8.  
 Loc. Nos. 4, 8, 12, 14.

#### f. *Lanceolatae* Grun.

- Nitzschia abonuensis* nov. spec. Plate XXII, fig. 8.  
 Valves linear, with parallel sides, tapering a little towards the obtusely rounded apices.  $25\text{--}30 \mu$  long,  $2.5\text{--}3.0 \mu$  broad. Carina eccentric. Carinate dots 9–10 in  $10 \mu$ , rather small. Transapical striae not visible.

Loc. No. 26.

Plate XXII, fig. 8:  $26.6 \times 2.7 \mu$ . 9–10 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 194, Loc. No. 26).

Illustration slide: Ghana No. 194/1961.

Type locality: West Ghana. Fresh water (a pond near the shore of Bosumtwi Lake near the village Abonu; Loc. No. 26).

*Nitzschia amphibia* Grun. HUSTEDT 1930, p. 414, fig. 793.

Loc. Nos. 2–4, 6, 7, 11, 13, 17–19, 22, 23, 26, 28, 29, 31, 32, 34, 35, 43, 44, 46, 47, 49, 57–59, 61, 62, 66, 67.

Widely distributed and rather common in the Congo territory (HUSTEDT 1949 a, p. 140).

Rather rare in Sierra Leone (MÖLDER 1962, p. 44).

— *ankobraensis* nov. spec. Plate XXI, fig. 13.

Valves broadly linear, with parallel sides and capitate apices. 20–25  $\mu$  long, 5–6  $\mu$  broad. Carina highly eccentric. Carinate dots 8–9 in  $10 \mu$ . Transapical striae prominent, 24–26 in  $10 \mu$ , finely punctate.

Loc. Nos. 33, 35.

Plate XXI, fig. 13:  $22.7 \times 5.7 \mu$ . 8–9 carinate dots and 24–26 striae in  $10 \mu$ . (Sample No. 205, Loc. No. 33).

Illustration slide: Ghana No. 205/1961.

Type locality: West Ghana. Fresh water (a small river near the village Dwinyana; Loc. No. 33).

Similar to *N. legleri* Hust. (HUSTEDT 1959 b, p. 437, figs. 18–20).

— *apropongensis* nov. spec. Plate XXIV, fig. 13.

Valves broadly linear, with parallel sides and protracted apices. 20–25  $\mu$  long, 5–6  $\mu$  broad. Carina broad, eccentric. Carinate dots 6 in  $10 \mu$ , irregular, rounded. Transapical striae 28–30 in  $10 \mu$ .

Loc. No. 29.

Plate XXIV, fig. 13:  $23.3 \times 5.3 \mu$ . 6 carinate dots and 28–30 striae in  $10 \mu$ . (Sample No. 203, Loc. No. 29).

Illustration slide: Ghana No. 203/1961.

Type locality: West Ghana. Fresh water (the Apropong river, Loc. No. 29).

— *bosumtwiensis* nov. spec. Plate XXIII, fig. 13.

Valves linear, with parallel sides and evenly rounded apices. 40–45  $\mu$  long, 3–4  $\mu$  broad. Carina eccentric. Carinate dots 11 in  $10 \mu$ , rather prominent. Transapical striae not visible.

Loc. No. 26.

Plate XXIII, fig. 13:  $43.4 \times 3.4 \mu$ . 11 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 189, Loc. No. 26).

Illustration slide: Ghana No. 189/1961.

Type locality: West Ghana. Fresh water (Bosumtwi Lake, Loc. No. 26).

— *capitellata* Rabenh. HUSTEDT 1930, p. 417, fig. 798.

Loc. Nos. 28, 35, 40, 43, 44, 49, 58.

Rare in lakes in East Africa (HUSTEDT 1949 a, p. 139), and in Sierra Leone (MÖLDER 1962, p. 44).

Halophilous.

— *chuchiligaensis* nov. spec. Plate XXIV, fig. 8.

Valves linear, with almost parallel sides (slightly concave), protracted and obtusely rounded apices. 25–30  $\mu$  long, 4  $\mu$  broad. Carina eccentric. Carinate dots 7–8 in  $10 \mu$ , prominent, greater distance between the two midmost ones. Transapical striae not visible.

Loc. Nos. 43, 44, 46.

Plate XXIV, fig. 8:  $28.6 \times 4.0 \mu$ . 7–8 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 254, Loc. No. 46).

Illustration slide: Ghana No. 254/1961.

Type locality: North Ghana. Fresh water (a cattle-pool near the village Chuchiliga southwest of Navrongo; Loc. No. 46).

*Nitzschia congolensis* HUST. HUSTEDT 1949 a, p. 134, 12: 15, 16.

Loc. No. 46.

Previously reported from Lake Edward, East Africa, only (HUSTEDT 1949 a, p. 134).

— *dadwinensis* nov. spec. Plate XXIII, fig. 10.

Valves linear, with parallel sides and evenly, broadly tapering apices.  $45\text{--}50 \mu$  long,  $3\text{--}4 \mu$  broad. Carina eccentric. Carinate dots 7 in  $10 \mu$ , of different size and with diverse distances. Transapical striae not visible.

Loc. No. 13.

Plate XXIII, fig. 10:  $46.6 \times 3.5 \mu$ . 7 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 149, Loc. No. 13).

Illustration slide: Ghana No. 149/1961.

Type locality: Southwest Ghana. Fresh water (a small river near the village Dadwin, Loc. No. 13).

— *densuensis* nov. spec. Plate XXIV, fig. 9.

Valves lanceolate, with shortly protracted apices,  $26 \mu$  long,  $4\text{--}5 \mu$  broad. Carina eccentric. Carinate dots very prominent, 9 in  $10 \mu$ . Transapical striae  $30\text{--}34$  in  $10 \mu$ , finely, but distinctly punctate.

Loc. Nos. 3, 8.

Plate XXIV, fig. 9:  $26.0 \times 4.5 \mu$ . 9 carinate dots and  $30\text{--}34$  striae in  $10 \mu$ . (Sample No. 73, Loc. No. 3).

Illustration slide: Ghana No. 73/1961.

Type locality: South Ghana. Fresh water (the Densu river, west of Accra; Loc. No. 3).

— *fonticola* Grun. HUSTEDT 1930, p. 415, fig. 800.

Loc. Nos. 13, 18, 33, 43, 66.

Common in lakes in East Africa (HUSTEDT 1949 a, p. 142). Not rare in Sierra Leone (MÖLDER 1962, p. 44).

— *frustulum* (Kütz.) Grun. HUSTEDT 1930, p. 414, fig. 795.

Loc. Nos. 2, 6, 8, 9, 11–14, 17–19, 21, 22, 26–29, 31, 32, 34, 38, 43, 46, 47, 49, 57–62, 65, 67. Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 145).

— var. *perpusilla* (Rabenh.) Grun. Ibid. p. 415.

Loc. Nos. 6, 26, 29, 58, 60.

— *gracilis* Hantzsch. Ibid. p. 416, fig. 784.

Loc. No. 46.

Rare in Sierra Leone (MÖLDER 1962, p. 44).

— *hantzschiana* Rabenh. Ibid. p. 415, fig. 797.

Loc. No. 26.

Rare in Sierra Leone (MÖLDER 1962, p. 44).

— *heustleriana* Grun. Ibid. p. 414, fig. 805.

Loc. Nos. 37, 47, 62.

— *huniensis* nov. spec. Plate XXIV, fig. 17.

Valves linear, with almost parallel sides and broadly protracted, obtusely rounded apices.  $12\text{--}15 \mu$  long,  $2.0\text{--}2.5 \mu$  broad. Carina eccentric. Carinate dots 9 in  $10 \mu$ , prominent, greater distance between the two midmost ones. Transapical striae not visible.

Loc. No. 17.

- Plate XXIV, fig. 17:  $14.0 \times 2.1 \mu$ . 9 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 157, Loc. No. 17).  
 Illustration slide: Ghana No. 157/1961.  
 Type locality: Southwest Ghana. Fresh water (the Huni river north of the town Tarkwa; Loc. No. 17).
- Nitzschia intermedia* Hantzsch. HUSTEDT 1937–39, p. 477, 41: 4–7. 1949 a, p. 136, 12: 21–23. Loc. Nos. 43, 46.  
 Rare in lakes in East Africa (HUSTEDT 1949 a, p. 136).
- *krachiensis* nov. spec. Plate XXIV, fig. 1.  
 Valves narrowly lanceolate, with tapering, pointed apices.  $35\text{--}40 \mu$  long,  $2.5\text{--}3.0 \mu$  broad. Carina narrow, eccentric. Carinate dots 11 in  $10 \mu$ , small. Transapical striae 22 in  $10 \mu$ .  
 Loc. Nos. 18, 58, 65.  
 Plate XXIV, fig. 1:  $37.3 \times 2.7 \mu$ . 11 carinate dots and 22 striae in  $10 \mu$ . (Sample No. 293, Loc. No. 58).  
 Illustration slide: Ghana No. 293/1961.  
 Type locality: East Ghana. Fresh water (the Volta river at the town Kete Krachi; Loc. No. 58).  
 Very similar to *N. subrostrata* Hust. (HUSTEDT 1942, p. 137, figs. 313–319), which taxon differs by its denser striae.
- *kützingiana* Hilse. HUSTEDT 1930, p. 416, fig. 802.  
 Loc. Nos. 1, 4–6, 13, 18, 19, 24–26, 28, 34, 44, 49, 57, 60, 65.  
 Very rare in Sierra Leone (MÖLLER 1962, p. 44).
- *lancetula* O. Müller. A. SCHMIDT Atlas 348: 52, 53. HUSTEDT 1949 a, p. 141, 13: 39–47. Loc. No. 34.  
 One of the commonest diatom species in the Congo territory, an “Endemismus des tropischen Afrika” (HUSTEDT 1949 a, p. 141).
- *mamataensis* nov. spec. Plate XXII, fig. 10.  
 Valves narrowly linear with parallel sides and evenly, obtusely rounded apices.  $50\text{--}55 \mu$  long,  $3\text{--}4 \mu$  broad. Carina eccentric. Carinate dots  $11\text{--}12$  in  $10 \mu$ , rather small. Transapical striae not visible.  
 Loc. Nos. 4, 57.  
 Plate XXII, fig. 10:  $53.3 \times 3.4 \mu$ .  $11\text{--}12$  carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 291, Loc. No. 57).  
 Illustration slide: Ghana No. 291/1961.  
 Type locality: East Ghana. Fresh water (a small river, the Volta river system, near the village Mamata, Loc. No. 57).
- *obsidialis* Hust. HUSTEDT 1949 a, p. 148, 13: 25. CHOLNOKY 1960 a, figs. 300–302. Loc. Nos. 6, 61.  
 Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 148).  
 Plate XXIII, fig. 9:  $30.0 \times 4.0 \mu$ . 8 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 92, Loc. No. 61).
- *ofinensis* nov. spec. Plate XXIV, fig. 12.  
 Valves broadly lanceolate, with pointed apices.  $15\text{--}16 \mu$  long,  $4 \mu$  broad. Carina narrow, eccentric. Carinate dots 12 in  $10 \mu$ . Greater distance between the two midmost ones. Transapical striae 24 in  $10 \mu$ .  
 Loc. No. 25.  
 Plate XXIV, fig. 12:  $15.3 \times 4.0 \mu$ . 12 carinate dots and 24 striae in  $10 \mu$ . (Sample No. 186, Loc. No. 25).  
 Illustration slide: Ghana No. 186/1961.

- Type locality: West Ghana. Fresh water (the Ofin river at the Adiembra bridge; Loc. No. 25). Presumably related to *N. pseudoamphioxys* Hust. (HUSTEDT 1942, p. 135, figs. 301–308), which taxon, however, has considerably fewer carinate dots in 10  $\mu$  than XXIV: 12.
- Nitzschia ovalis* Arnott. VAN HEURCK 1880–85, 69: 36. CHOLNOKY 1962 b, p. 57, figs. 86–88. Loc. Nos. 22, 62.  
Plate XXI, fig. 12: 17.3  $\times$  6.6  $\mu$ . 7–8 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 173, Loc. No. 22).
- *palea* (Kütz.) W. Smith. HUSTEDT 1930, p. 416, fig. 801.  
Loc. Nos. 1, 3, 5, 8, 11, 13–16, 18, 19, 21–24, 28–31, 34, 35, 37–39, 41, 43, 46, 49, 50, 53, 56, 58–61, 64, 66, 67.  
Widely distributed but mainly singly in lakes in East Africa (HUSTEDT 1949 a, p. 147). Very common in Sierra Leone (MÖLDER 1962, p. 44).  
Plate XXIII, fig. 8: 26.0  $\times$  4.6  $\mu$ . 12 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 256, Loc. No. 46).
- *fo. dubia* Manguin. E. MANGUIN 1942, 4: 78.  
Loc. Nos. 8, 21, 22, 25, 43, 47, 53.  
Previously reported from tropical Africa (E. MANGUIN, 1942).  
Plate XXIII, fig. 11: 32.3  $\times$  5.3  $\mu$ . 10–12 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 186, Loc. No. 25).
- *var. tenuirostris* Grun. HUSTEDT 1930, p. 416.  
Loc. No. 46.
- *paleaceae* Grun. Ibid. p. 416, fig. 807.  
Loc. Nos. 3, 4, 20, 28, 35, 37, 45, 46, 61, 66.
- *paleaeformis* Hust. HUSTEDT 1946–50, p. 439, 39: 6–14.  
Loc. Nos. 3, 15, 43.  
Plate XXIII, fig. 12: 48  $\times$  4.0  $\mu$ . 9–10 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 73, Loc. No. 3).
- *perminuta* Hust. HUSTEDT 1949 a, p. 145.  
Syn.: *N. frustulum* (Kütz.) Grun. *var. perminuta* Grun. (HUSTEDT 1930, p. 415).  
Loc. No. 6.  
Fairly rare in the Congo territory (HUSTEDT 1949 a, p. 145).
- *philippinarum* Hust. HUSTEDT 1942, p. 137, figs. 322–330.  
Loc. Nos. 1, 2, 6, 8, 13, 26, 28, 29, 34, 37, 39, 44, 46, 53, 58, 59, 61, 63, 65–67.  
Previously reported from the Philippines (HUSTEDT 1942, p. 137).
- *pseudofonticola* Hust. HUSTEDT 1957, p. 353, figs. 83–90.  
Loc. Nos. 1, 2, 4, 5, 8, 9, 11, 12, 16, 18, 19, 21–23, 26–29, 38, 39, 42–44, 46, 50, 54, 57, 58, 60–63, 65, 66.
- *pumila* Hust. HUSTEDT 1954 c, p. 480, figs. 67–69.  
Loc. Nos. 39, 43.
- *sakaensis* nov. spec. Plate XXIV, fig. 16.  
Valves linear-lanceolate, with broadly rounded apices. 20–25  $\mu$  long, 4  $\mu$  broad. Carina narrow, eccentric. Carinate dots 7 in 10  $\mu$ . Transapical striae 20–21 in 10  $\mu$ .  
Loc. No. 49.  
Plate XXIV, fig. 16: 23.2  $\times$  4.0  $\mu$ . 7 carinate dots and 20–21 striae in 10  $\mu$ . (Sample No. 266, Loc. No. 49).  
Illustration slide: Ghana No. 266/1961.  
Type locality: Northeast Ghana. Fresh water (the White Volta river near the village Saka, Loc. No. 49).
- *salinicola* Aleem et Hust. A. A. ALEEM et HUSTEDT 1951, p. 19, fig. 6.  
Loc. Nos. 46, 52.

Previously reported from Southern England (A. A. ALEEM et HUSTEDT 1951, p. 19).  
Halophilous.

*Nitzschia sansomei* nov. spec. Plate XXIII, fig. 4.

Valves linear, with parallel sides, cuneately tapering towards the rounded apices. 50–55  $\mu$  long, 4–5  $\mu$  broad. Carina narrow, eccentric. Carinate dots 7–8 in 10  $\mu$ , rather prominent. Transapical striae 15–16 in 10  $\mu$ , punctate in longitudinal stripes.

Loc. Nos. 58, 67.

Plate XXIII, fig. 4: 53.3  $\times$  4.1  $\mu$ . 7–8 carinate dots and 15–16 striae in 10  $\mu$ . (Sample No. 295, Loc. No. 58).

Illustration slide: Ghana No. 295/1961.

Type locality: East Ghana. Fresh water (the Volta river at Kete Krachi, Loc. No. 58).  
Dedicated to Professor F. W. SANSOME, Ph. D., University of Ghana.

— *schjellerupii* nov. spec. Plate XXII, fig. 9.

Valves linear-lanceolate, rather evenly tapering from the middle towards the obtusely rounded apices. 35–40  $\mu$  long, 5–6  $\mu$  broad. Carina narrow, eccentric. Carinate dots 7 in 10  $\mu$ , rather prominent. Transapical striae 21–22 in 10  $\mu$ , greater distance between the two midmost ones.

Loc. Nos. 58, 59.

Plate XXII, fig. 9: 37.3  $\times$  5.3  $\mu$ . 7 carinate dots and 21–22 striae in 10  $\mu$ . (Sample No. 296, Loc. No. 58).

Illustration slide: Ghana No. 296/1961.

Type locality: East Ghana. Fresh water (the Volta river at Kete Krachi, Loc. No. 58).  
Named after S. SCHJELLERUP, Danish governor in Guinea 1735–36.

— *subrostrata* Hust. HUSTEDT 1942, p. 137, figs. 313–319.

Loc. Nos. 8, 38, 44, 49, 67.

Previously reported from Indonesia (HUSTEDT 1942, p. 137).

— *subvitrea* Hust. var. *capensis* Cholnoky. CHOLNOKY 1959, p. 59, fig. 318.

Loc. Nos. 2, 11–13, 21, 22, 43, 65, 66.

Previously reported from South Africa (CHOLNOKY 1959, p. 59).

Plate XXIII, fig. 2: 44  $\times$  5.3  $\mu$ . 8–9 carinate dots and 26 striae in 10  $\mu$ . (Sample No. 135, Loc. No. 11).

— *svedstrupii* nov. spec. Plate XXII, fig. 14.

Valves broadly linear with slightly concave sides and shortly protracted apices. 20–25  $\mu$  long, 4–5  $\mu$  broad. Carina eccentric. Carinate dots 7 in 10  $\mu$ , prominent. Transapical striae not visible.

Loc. Nos. 8, 18, 30.

Plate XXII, fig. 14: 23.6  $\times$  4.7  $\mu$ . 7 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 204, Loc. No. 30).

Illustration slide: Ghana No. 204/1961.

Type locality: West Ghana. Fresh water (a small river near the village Dwinyana, Loc. No. 30).

Named after C. W. SVEDSTRUP, a Danish lieutenant in Guinea 1844–46, father of the Danish author ALEXANDER SVEDSTRUP.

— *tainensis* nov. spec. Plate XXIII, fig. 14.

Valves linear with almost parallel sides, cuneately tapering towards the apices. 20–25  $\mu$  long, 3–4  $\mu$  broad. Carina eccentric. Carinate dots 7–8 in 10  $\mu$ , rather prominent. Transapical striae 14–15 in 10  $\mu$ , coarsely punctate.

Loc. No. 32.

Plate XXIII, fig. 14: 23.3  $\times$  3.4  $\mu$ . 7–8 carinate dots and 14–15 striae in 10  $\mu$ . (Sample No. 216, Loc. No. 32).



Illustration slide: Ghana No. 216/1961.

Type locality: West Ghana. Fresh water (the Tain river, the Black Volta river system, Loc. No. 32).

*Nitzschia tarda* Hust. HUSTEDT 1949 a, p. 138, 12: 24, 25.

Loc. Nos. 1, 8, 31, 43, 58, 59, 67.

Previously reported from Lake Edward, East Africa (HUSTEDT 1949 a, p. 138).

Plate XXIII, fig. 1:  $53.3 \times 5.6 \mu$ . 7–8 carinate dots and 24 striae in  $10 \mu$ . (Sample No. 210, Loc. No. 31).

This taxon is very similar to *N. goetzeana* O. Müller 1905, p. 176, 2: 20, reported from East Africa.

— *towulensis* Hust. HUSTEDT 1942, p. 139, figs. 338, 339.

Loc. Nos. 6, 8.

Previously reported from Celebes (HUSTEDT 1942, p. 139).

Plate XXIV, fig. 11:  $16.6 \times 4.7 \mu$ . 14–15 carinate dots and 30–32 striae in  $10 \mu$ . (Sample No. 114, Loc. No. 6).

— *tropica* Hust. HUSTEDT 1949 a, p. 147, 11: 34–38. CHOLNOKY 1958 a, p. 132, figs. 140–142. Loc. Nos. 8, 46.

Widely distributed and not rare in the Congo territory (HUSTEDT 1949 a, p. 147).

— *voltaensis* nov. spec. Plate XXII, fig. 11.

Valves narrow linear, with parallel sides and tapering, rounded apices. 35–40  $\mu$  long, 2.5–3.0  $\mu$  broad. Carina eccentric. Carinate dots 10–11 in  $10 \mu$ , prominent. Transapical striae not visible.

Loc. No. 58.

Plate XXII, fig. 11:  $39.3 \times 2.7 \mu$ . 10–11 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 293, Loc. No. 58).

Illustration slide: Ghana No. 293/1961.

Type locality: East Ghana. Fresh water (the Volta river at Kete Krachi, Loc. No. 58).

#### g. *Sigmoideae* (Grun.) Hust.

*Nitzschia abraensis* nov. spec. Plate XXII, fig. 7.

Valves linear, with parallel sides; towards the capitate apices very slightly sigmoid. 60–70  $\mu$  long, 6–7  $\mu$  broad. Carina eccentric. Carinate dots 8–9 in  $10 \mu$ , linear. Transapical striae not visible.

Loc. No. 8.

Plate XXII, fig. 7:  $65.4 \times 6.7 \mu$ . 8–9 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 123, Loc. No. 8).

Illustration slide: Ghana No. 123/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest near the village Abra, north of Takoradi, Loc. No. 8).

— *apowaensis* nov. spec. Plate XXIV, fig. 7.

Valves lanceolate, with rather far and pointedly protracted apices, slightly sigmoid. 70  $\mu$  long, 5–6  $\mu$  broad. Carina narrow, eccentric. Carinate dots 7–8 in  $10 \mu$ , rather prominent, rounded, with irregular intervals and with greater distance between the two midmost ones. Transapical striae not visible.

Loc. No. 6.

Plate: XXIV, fig. 7:  $70 \times 5.3 \mu$ . 7–8 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 114, Loc. No. 6).

Illustration slide: Ghana No. 114/1961.

Type locality: Southwest Ghana. Fresh water (a river in the rain forest west of Takoradi, near the village Apowa, Loc. No. 6).

*Nitzschia clausii* Hantzsch. HUSTEDT 1930, p. 421, fig. 814.

Loc. No. 30.

Halophilous-mesohalobous.

— *pseudosigma* Hust. HUSTEDT 1937–39, p. 486, 40: 13–15.

Loc. No. 6.

Very rare in Sierra Leone (MÖLDER 1962, p. 44).

— *sigma* (Kütz.) W. Smith. HUSTEDT 1930, p. 420, fig. 813.

Loc. Nos. 1, 4–6, 8, 9, 11–14, 17–23, 25, 28–32, 60–62, 65–67.

Singly in hot springs, East Africa (HUSTEDT 1949 a, p. 152). Rare in Sierra Leone (MÖLDER 1962, p. 44).

Mesohalobous.

— *sigmoidea* (Ehr.) W. Smith. Ibid. p. 419, fig. 810.

Loc. Nos. 17, 18.

Very rare in Lake Kiwu, East Africa (HUSTEDT 1949 a, p. 151). Not rare in Sierra Leone (MÖLDER 1962, p. 44).

— *vermicularis* (Kütz.) Grun. Ibid. p. 419, fig. 811.

Loc. Nos. 5, 8, 9, 13, 22, 60, 62.

#### h. **Obtusae** (Grun.) Hust.

*Nitzschia adiembraensis* nov. spec. Plate XXIV, fig. 2.

Valves linear-lanceolate, with broadly protracted, obtusely rounded apices, slightly sigmoid. 35–40  $\mu$  long, 4  $\mu$  broad. Carina narrow, eccentric. Carinate dots 11 in 10  $\mu$ , with a somewhat irregular mutual distance. Transapical striae not visible.

Loc. No. 25.

Plate XXIV, fig. 2: 36.6  $\times$  4.0  $\mu$ . 11 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 186, Loc. No. 25).

Illustration slide: Ghana No. 186/1961.

Type locality: West Ghana. Fresh water (the Ofin river at Adiembra bridge, Loc. No. 25).

— *filiformis* (W. Smith) Hust. HUSTEDT 1930, p. 422, fig. 818.

Loc. No. 27.

Very rare in Lake Kiwu, East Africa (HUSTEDT 1949 a, p. 151).

Halophilous-mesohalobous.

— *ghanaensis* nov. spec. Plate XXIV, fig. 15.

Valves broadly linear, with concave sides, a little sigmoid, and with obtusely protracted apices. 20–25  $\mu$  long, 4–5  $\mu$  broad. Carina narrow, eccentric. Carinate dots 10–11 in 10  $\mu$ , small, rounded, greater distance between the two midmost ones. Transapical striae dense.

Loc. No. 8.

Plate XXIV, fig. 15: 23.4  $\times$  4.2  $\mu$ . 10–11 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 123, Loc. No. 8).

Illustration slide: Ghana No. 123/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest between Takoradi and Axim, Loc. No. 8).

Somewhat similar to *N. parvula* Lewis.

— *ignorata* Krasske. HUSTEDT 1930, p. 422, fig. 819. GUERMEUR 1954, p. 83, 23: 5.

Loc. Nos. 6, 8, 11–17, 22, 23, 26, 27, 29, 30, 61, 62, 64.

Plate XXIV, fig. 5: 49.3  $\times$  4.0  $\mu$ . 10 carinate dots in 10  $\mu$ . Striae very dense. (Sample No. 203, Loc. No. 29).

Loc. No. 11.

— *irresoluta* Hust. fo. *minor* nov. fo. Plate XXIV, fig. 10.

Loc. No. 11.

Plate XXIV, fig. 10:  $30.6 \times 3.3 \mu$ . 11–12 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 136, Loc. No. 11).

Differs from the species only by its considerably smaller size of the valve. As to shape of the valve and carinate dots, which have a greater distance between the two midmost ones, and the very dense striae, this form seems to be very closely related to *N. irresoluta* Hust. from Celebes (HUSTEDT 1942, p. 142, figs. 349, 350).

*Nitzschia obtusa* W. Smith. HUSTEDT 1930, p. 422, fig. 817 a.

Loc. Nos. 1–5, 11, 17.

Rare in Sierra Leone (MÖLDER 1962, p. 44).

Mesohalobous.

— — var. *scalpelliformis* Grun. GUERMEUR 1954, p. 84, 23: 10.

Loc. Nos. 1, 3, 4, 6, 8, 20, 22, 26, 27, 29, 30, 61, 62, 64.

Plate XXIV, fig. 3:  $25.6 \times 4.7 \mu$ . 9 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 196, Loc. No. 27).

Plate XXIV, fig. 4:  $36 \times 4.5 \mu$ . 9 carinate dots in  $10 \mu$ . Striae 28 in  $10 \mu$  (Sample No. 73, Loc. No. 3).

Presumably closely related to *N. obtusa* fo. *parva* Hust. CHOLNOKY 1960 a, fig. 303. A. SCHMIDT Atlas 336: 25, 26.

Halophilous (?).

— *parvula* Lewis. HUSTEDT 1930, p. 421, fig. 816.

Loc. Nos. 1, 2, 11–14, 16, 19–21, 29, 45–47, 53, 62.

Rare in Sierra Leone (MÖLDER 1962, p. 44).

Mesohalobous.

#### i. *Nitzschiellae* (Rabenh.) Grun.

*Nitzschia acicularis* W. Smith. HUSTEDT 1930, p. 423, fig. 821.

Loc. Nos. 1, 4, 7, 44–47.

Very rare in Lake Edward, East Africa (HUSTEDT 1949 a, p. 150). Rare in Sierra Leone (MÖLDER 1962, p. 44).

— *closterium* (Ehr.) W. Smith. Ibid. p. 424, fig. 822.

Loc. Nos. 3–5, 8, 12, 13, 16, 21, 23, 58, 63.

Plate XXIV, fig. 14:  $82.5 \times 4.6 \mu$ . 12 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 181, Loc. No. 23).

Mesohalobous.

— *lorenziana* Grun. Ibid. p. 423. H. et M. PERAGALLO 1897–1908, p. 293, 24: 25.

Loc. Nos. 27, 31.

Mesohalobous.

— — var. *subtilis* Grun. HUSTEDT 1930, p. 423, fig. 820. 1937–39, p. 489, 41: 17.

Loc. Nos. 6, 8, 11–13, 18, 21, 22, 27–29, 62.

Plate XXIV, fig. 6:  $97 \times 3.3 \mu$ . 9 carinate dots and 17–18 striae in  $10 \mu$ . (Sample No. 145, Loc. No. 12).

Mesohalobous.

— *navrongensis* nov. spec. Plate XXIII, fig. 6.

Valves narrowly lanceolate, with much protracted, greatly tapering apices. 60–70  $\mu$  long, 2.5–3.0  $\mu$  broad. Carina eccentric. Carinate dots 12 in  $10 \mu$ . Transapical striae not visible.

Loc. Nos. 44, 62.

Plate XXIII, fig. 6:  $66 \times 2.7 \mu$ . 12 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 249, Loc. No. 44).

Illustration slide: Ghana No. 249/1961.

Type locality: North Ghana. Fresh water (the pond No. 14 at Tono agricultural station near Navrongo; Loc. No. 44).

*Nitzschia spiculoides* Hust. HUSTEDT 1949 a, p. 151, 13: 5, 6.

Loc. Nos. 1, 35, 48, 50, 55, 60, 62, 67.

Very rare in Lake Edward, East Africa (HUSTEDT 1949 a, p. 151).

Plate XXIII, fig. 7:  $60.7 \times 3.3 \mu$ . 11–12 carinate dots in  $10 \mu$ . Striae very dense. (Sample No. 223, Loc. No. 35).

## Surirellaceae

### Cymatopleura W. Smith.

*Cymatopleura solea* (Bréb.) W. Smith. HUSTEDT 1930, p. 425, fig. 823 a.

Loc. No. 25.

Singly in some lakes in East Africa (HUSTEDT 1949 a, p. 152).

— — var. *rugosa* O. Müller. A. SCHMIDT Atlas 245: 4.

Loc. No. 31.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 152).

### Stenopterobia Bréb.

*Stenopterobia intermedia* Lewis. HUSTEDT 1930, p. 830. 1937–39, p. 492.

Loc. Nos. 38, 41, 54.

Fairly rare in Sierra Leone (MÖLDER 1962, p. 45).

### Surirella Turpin.

*Surirella agonaensis* nov. spec. Plate XXV, fig. 3.

Apical axis heteropolar. Valves lengthily cuneate, with broadly rounded apices; head pole a little broader than foot pole.  $80 \mu$  long, 28–30  $\mu$  broad. Alae, 15–16 in  $100 \mu$ , prolonged into a narrow, linear central area and provided with small irregularly distributed spines. Alar canals much broader than alae. Striae indistinct.

Loc. Nos. 11, 12.

Plate XXV, fig. 3:  $80 \times 28.7 \mu$ . 15–16 alae in  $100 \mu$ . (Sample No. 141, Loc. No. 12).

Illustration slide: Ghana No. 141/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the bamboo thicket between the villages Agona and Nsuaem, Loc. No. 12).

Perhaps related to *S. tenera* Greg.

— *anassae* Cholnoky. CHOLNOKY 1957 a, fig. 84. 1959, p. 65, fig. 342.

Loc. Nos. 4, 31, 67.

Previously reported from South Africa (CHOLNOKY 1957 a, p. 84. 1959, p. 65).

— *angusta* Kütz. HUSTEDT 1930, p. 435, figs. 844, 845.

Loc. Nos. 31, 32, 35, 40, 49.

Very rare in Lake Kiwu, East Africa (HUSTEDT 1949 a, p. 156), but not rare in Sierra Leone (MÖLDER 1962, p. 45).

— *angustiformis* Hust. HUSTEDT 1942, p. 156, figs. 389, 390.

Loc. Nos. 8, 9, 11–13, 18, 22, 27, 28, 32, 64, 65.

Previously reported from Indonesia (HUSTEDT 1942, p. 156).

— *biseriata* Bréb. HUSTEDT 1930, p. 432, figs. 831, 832.

Loc. Nos. 18, 21, 22, 28, 29, 31, 32, 35, 37, 39, 42–44, 46, 47, 50, 54.

Rare in the Congo territory (HUSTEDT 1949 a, p. 152), and very rare in Sierra Leone (MÖLDER 1962, p. 45).

— — var. *bifrons* (Ehr.) Hust. Ibid. p. 433, fig. 833.

Loc. No. 46.

*Surirella bonsaensis* nov. spec. Plate XXV, fig. 1.

Apical axis isopolar. Valves broadly linear, with parallel sides and broadly rounded apices. 70  $\mu$  long, 25–26  $\mu$  broad. Alae, 22–24 in 100  $\mu$ , prolonged into a narrow, hyaline central area. The alae are of the same breadth as the intervals (“flügelkanäle”).

Loc. Nos. 12, 14, 19, 65.

Plate XXV, fig. 1: 70×25.2  $\mu$ . 22–24 alae in 100  $\mu$ . (Sample No. 151, Loc. No. 14).

Illustration slide: Ghana No. 151/1961.

Type locality: Southwest Ghana. Fresh water (the Bonsa river, a tributary to the Ankobra river; Loc. No. 14).

Presumably related to *S. didyma* Kütz.

— *capronii* Bréb. HUSTEDT 1930, p. 440, fig. 857.

Loc. Nos. 47, 61.

— *celebesiana* Hust. HUSTEDT 1942, p. 161, figs. 403–406.

Loc. Nos. 27, 44.

Previously reported from Celebes (HUSTEDT 1942, p. 161).

— *delicatissima* Lewis. HUSTEDT 1930, p. 436, figs. 846, 847.

Loc. Nos. 8, 12–18, 33, 38, 41, 44, 48, 50, 55, 64.

Rare in the Congo territory (HUSTEDT 1949 a, p. 155); not rare in Sierra Leone (MÖLDER 1962, p. 45).

— — var. *africana* Cholnoky. CHOLNOKY 1959, p. 65, fig. 345. 1960 a, p. 339.

Loc. Nos. 8, 12–14, 39, 51, 53, 64, 65.

Previously reported from South Africa (CHOLNOKY 1959, p. 65. 1960 a, p. 339).

— — var. *ghanaensis* nov. var. Plate XXV, fig. 9.

Differs from the species and from var. *africana* Cholnoky, especially by its small size and rather dense alae.

Loc. No. 30.

Plate XXV, fig. 9: 25.3×4.9  $\mu$ . 68 alae in 100  $\mu$ . (Sample No. 204, Loc. No. 30).

Illustration slide: Ghana No. 204/1961.

Type locality: West Ghana. Fresh water (a small river north of the village Dwinyana; Loc. No. 30).

— — fo. *tenuissima* Manguin. E. MANGUIN 1942, 4: 85.

Loc. No. 41.

Previously reported from the Azores (E. MANGUIN 1942).

— *didyma* Kütz. HUSTEDT 1930, p. 437, figs. 848, 849.

Loc. Nos. 6, 8, 9, 13, 17, 18, 33, 36, 65.

Very rare in Sierra Leone (MÖLDER 1962, p. 45).

Mesohalobous.

— *dodowaensis* nov. spec. Plate XXV, fig. 6.

Apical axis heteropolar. Valves ovals elliptical, with broadly rounded head pole and a somewhat more pointed foot pole. 35–40  $\mu$  long, 12–15  $\mu$  broad. Alae, 18–20 in 100  $\mu$ , lengthened almost to the middle of the valve. Alar canals broader than the alae. Area narrow, linear. Striae indistinct.

Loc. No. 62.

Plate XXV, fig. 6: 36×14  $\mu$ . 18–20 alae in 100  $\mu$ . (Sample No. 106, Loc. No. 62).

Illustration slide: Ghana No. 106/1961.

Type locality: Southeast Ghana. Fresh water (a river near the village Dodowa, Loc. No. 62).

— *engleri* O. Müller. HUSTEDT 1949 a, p. 153, 15: 1–6.

Loc. Nos. 8, 29.

Widely distributed in lakes in East Africa (HUSTEDT 1949 a, p. 153). Rare in Sierra Leone (MÖLDER 1962, p. 45).

*Surirella esamangensis* nov. spec. Plate XXV, fig. 2.

Apical axis slightly heteropolar. Valves lengthily elliptical, with evenly rounded apices. 60  $\mu$  long, 24  $\mu$  broad. Alae, 24 in 100  $\mu$ , lengthened on to the surface of the valve, into a rather narrow, hyaline central area. Alar canals much broader than alae. Striae indistinct. Loc. Nos. 12, 18, 34.

Plate XXV, fig. 2: 60  $\times$  24  $\mu$ . 24 alae in 100  $\mu$ . (Sample No. 144, Loc. No. 12).

Illustration slide: Ghana No. 144/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest near the village Esamang, Loc. No. 12).

- *fimbriata* Hust. HUSTEDT 1942, p. 164, figs. 409, 410. CHOLNOKY 1957 a, p. 85, figs. 282–284. Loc. Nos. 4, 5, 22, 24, 28.
- *linearis* W. Smith. HUSTEDT 1930, p. 434, figs. 837, 838. Loc. Nos. 2, 8, 17, 18, 40, 43–45, 47, 55, 62. Rare in Sierra Leone (MÖLDER 1962, p. 45).
- var. *constricta* (Ehr.) Grun. Ibid. p. 434, fig. 839. Loc. Nos. 2, 17, 32–34, 36, 40, 48, 49, 58. Rare in Sierra Leone (MÖLDER 1962, p. 45).
- *minima* Ross et Abdin. Ross et ABDIN 1949, p. 226, 1: 2. FOGED 1958, p. 141, 16: 24. Loc. Nos. 6, 8, 12, 14, 35, 60, 64.
- *nagbogensis* nov. spec. Plate XXV, fig. 7. Apical axis heteropolar. Valves lengthily elliptical with broadly rounded head pole and somewhat narrower foot pole. 40  $\mu$  long, 13–15  $\mu$  broad. Alae, 35 in 100  $\mu$ , narrow, lengthened almost to the middle of the valve. Alar canals broader than alae. Area narrow, linear. Striae indistinct. Loc. Nos. 2, 12, 14, 23, 27, 35, 44, 46, 53, 54. Plate XXV, fig. 7: 40  $\times$  13.3  $\mu$ . 35 alae in 100  $\mu$ . (Sample No. 279, Loc. No. 53). Illustration slide: Ghana No. 279/1961. Type locality: Northeast Ghana. Fresh water (a small river near the village Nagbog, Loc. No. 53).
- *ovata* Kütz. HUSTEDT 1930, p. 442, figs. 863, 864. Loc. No. 12. Rare in Sierra Leone (MÖLDER 1962, p. 45).
- var. *africana* Cholnoky. CHOLNOKY 1955 a, p. 21, fig. 46. Loc. No. 6. Very rare in Sierra Leone (MÖLDER 1962, p. 45).
- var. *pinnata* W. Smith. HUSTEDT 1930, p. 422, fig. 865. Loc. Nos. 1, 22, 25, 35, 43, 46, 48, 50, 54. Fairly rare in Sierra Leone (MÖLDER 1962, p. 45).
- *pseudovalis* Hust. HUSTEDT 1942, p. 166, figs. 412–415. Loc. No. 62. Previously reported from Indonesia (HUSTEDT 1942, p. 166).
- *robusta* Ehr. HUSTEDT 1930, p. 437, fig. 850. Loc. Nos. 1, 2, 4, 6, 8, 11, 27, 31, 34, 37, 44, 50, 54, 59, 64, 65. Common in Sierra Leone (MÖLDER 1962, p. 45).
- *sorriensis* nov. spec. Plate XXV, fig. 8. Apical axis heteropolar. Valves egg-shaped, with a broadly rounded head pole and a somewhat narrower foot pole. 35–40  $\mu$  long, 18  $\mu$  broad. Alae, 30–35 in 100  $\mu$ , reach a hyaline area which includes about one fourth of the breadth of the valve. Alar canals very narrow. Striae indistinct. Loc. Nos. 34, 35.



Plate XXV, fig. 8:  $36 \times 18 \mu$ . 30–35 alae in  $100 \mu$ . (Sample No. 223, Loc. No. 35).

Illustration slide: Ghana No. 223/1961.

Type locality: North Ghana. Fresh water (the Sorri river, the White Volta river system, Loc. No. 35).

*Surirella takoradiensis* nov. spec. Plate XXV, fig. 4.

Apical axis heteropolar. Valves ovally elliptical with a broadly rounded head pole and a somewhat narrower foot pole. 20–25  $\mu$  long, 7–8  $\mu$  broad. Alae, 60–65 in  $100 \mu$ , very short and somewhat narrower than the alar canals. The surface of the valve with a very broad, hyaline central area, about two thirds of the breadth of the valve. Striae very fine. Loc. Nos. 8, 9, 13, 14, 18, 19, 24, 64.

Plate XXV, fig. 4:  $22.7 \times 7.5 \mu$ . 60–65 alae in  $100 \mu$ . (Sample No. 119, Loc. No. 8).

Illustration slide: Ghana No. 119/1961.

Type locality: Southwest Ghana. Fresh water (a small river in the rain forest west of Takoradi; Loc. No. 8).

— — var. *suhinensis* nov. var. Plate XXV, fig. 5.

Differs from the species by only having about 40 alae in  $100 \mu$ .

Loc. Nos. 19, 33, 65.

Plate XXV, fig. 5:  $25.3 \times 8.7 \mu$ . 40 alae in  $100 \mu$ . (Sample No. 218, Loc. No. 33).

Illustration slide: Ghana No. 218/1961.

Type locality: West Ghana. Fresh water (the Suhin river, the Black Volta river system; Loc. No. 33).

— *tenera* Greg. HUSTEDT 1930, p. 438, fig. 853.

Loc. Nos. 1, 13, 14, 18–23, 27, 30, 34, 37, 39, 43–45, 47, 50, 54, 61, 62, 64, 65.

Very rare in lakes in East Africa (HUSTEDT 1949 a, p. 156). Rare in Sierra Leone (MÖLDER 1962, p. 45).

— — var. *nervosa* A. Schmidt. Ibid. p. 439, figs. 854, 855.

Loc. Nos. 1, 5, 6, 8, 9, 12, 13, 17–19, 21–23, 27, 28, 30, 32, 35, 44, 47, 54, 62, 64, 65.

Rare in Sierra Leone (MÖLDER 1962, p. 45).

— *tenuis* Cholnoky. CHOLNOKY 1960 a, 120, fig. 346.

Loc. Nos. 9, 11–13.

— *ventricosa* Hust. HUSTEDT 1942, p. 168, fig. 421–424.

Loc. Nos. 11, 13, 17, 20, 22, 34, 35, 53, 55, 65.

Previously reported from Celebes (HUSTEDT 1942, p. 168).

— *welshii* Cholnoky. CHOLNOKY 1962 d, p. 337, fig. 45.

Loc. Nos. 8, 9, 11–14, 18, 22, 27, 33, 64, 65.

Previously reported from South Africa (CHOLNOKY 1962 d, p. 337).

9 of the 43 genera demonstrated (*Bacillaria*, *Biddulphia*, *Coscinodiscus*, *Licmophora*, *Pleurosigma*, *Scoliopleura*, *Terpsinoë*, *Thalassiosira*, and *Tropidoneis*) exclusively comprise mesohalobous and polyhalobous species. Of these the polyhalobous *Coscinodiscus* sp. and the mesohalobous *Bacillaria paradoxa* and *Thalassiosira fluviatilis* are the most frequent, whereas species of the other six genera are less common. It might be expected that the species of these nine genera were more frequent in the localities near the coast and rarer farther into the country, as has generally been the case in other areas investigated. In the localities south of a line from Bamboi to Kete Krachi it is not, however, possible to establish a sure difference in the frequency of the occurrence of the haline forms, while the density north of this line is considerably slighter.

In a number of localities no mesohalobous and (or) polyhalobous species have been found. As to the density of halophilous (oligohalobous) species, it is not possible in the material investigated to point out differences from one province to the other. The genera *Eunotia*, *Cymbella*, *Neidium*, and *Stauroneis* occur with rather large numbers of species. In other regions of the earth these genera are especially conspicuous in circumneutral, oligotrophic localities, and presumably many of the Ghanaese localities in a considerable part of the year are of the same character.

The two genera richest in species in the material, *Navicula* and *Nitzschia*, of which 182 and 93 forms, respectively, have been found, both have a very wide ecological range. Especially, some *Nitzschia* species are eurytopical as regards the contents of salt and the pH of the environment, just as many of them have a great tolerance to pollution and slight contents of oxygen in the biotope.

The causes of this peculiar composition of the diatomaceous flora, characterized by rather a frequent occurrence of more or less haline forms, and the mixture of oligotrophic and eutrophic forms in the great majority of localities, are no doubt to be sought in the very great fluctuations in the quantity of water characteristic of the great majority of water localities in Ghana. Even in the area of the Rain Forest (B) in the southwesternmost part of the country several months are generally almost without rain every year. The result must be great fluctuations in the contents of salt and the pH of the water. In many localities, especially with stagnant water, there will during the dry season also be a great concentration of products formed by the decomposition of organic substances in connexion with the pollution due to the fact that animals as well as human beings use the places as drinking-, bathing-, and washing-places. Near towns and villages, furthermore, it was seen in many localities that ponds and streams were highly polluted by the dumping of refuse into them. Freshwater diatoms with a narrow ecological range will only have negligible possibilities of existence and survival under such circumstances, and indeed they seem to be missing completely.

The difference which in many other places can be established between the types of diatomaceous flora in running water and stagnant water, is little conspicuous in Ghana. Rheophilous species such as *Meridion circulare* and *Ceratoneis arcus* play quite a subordinate part in all the localities examined.

It is also remarkable that the three centric genera *Cyclotella*, *Melosira*, and *Stephanodiscus*, which in other places are commonly represented by a number of plankton forms in lakes and ponds, have been found here equally frequently in stagnant and running water, distributed all over the country, but everywhere constituting rather a subordinate element in the diatomaceous flora.

## NEW SPECIES, LATIN DIAGNOSES

*Eunotia bonsaensis* nov. spec. Pl. III, fig. 7.

Valvae margine ventrali recto, dorsali convexo; a medio versus apices obtuse rotundatos multum attenuatae, longae  $32\ \mu$ , latae  $8-9\ \mu$ . Rhaphae brevissimae proxime a margine ventrali decurrentes paulum modo in superficiem valvae ascendentes. 12 striae transapicales in  $10\ \mu$  in medio valvae, versus apices paulo densius congestae. Pseudorhaphae in margine ventrali decurrens a superficie valvae non visibilis.

Holotypus: Ghana No. 151/1961.

*Eunotia lawsonii* nov. spec. Pl. III, fig. 12.

Valvae margine ventrali paene recto, dorsali paululum convexo, lateribus fere parallelis, et valvae versus apices non attenuatae, longae  $20-23\ \mu$ , latae  $4\ \mu$ . Rhaphae prope apices proxime a margine ventrali valvae; paulum modo in superficiem ascendentes. 12 striae transapicales in  $10\ \mu$ , paulum modo versus apices densius congestae. Pseudorhaphae a superficie valvae non visibilis.

Holotypus: Ghana No. 165/1961.

*Eunotia mansiensis* nov. spec. Pl. II, fig. 4.

Valvae margine ventrali tenuiter concavo, dorsali convexo; latitudo valvae a medio versus apices obtuse rotundatos valde attenuata,  $45-50\ \mu$  longae, latae  $8-9\ \mu$ . Rhaphae admodum longae a margine ventrali paululum in superficiem valvae ascendentes. 12 striae transapicales in  $10\ \mu$ , paulum modo versus apices densius congestae. Pseudorhaphae proxime a margine ventrali posita, zonam angustissimam hic efficiens.

Holotypus: Ghana No. 166/1961.

*Eunotia sorriensis* nov. spec. Pl. III, fig. 8.

Valvae margine ventrali levissime concavo, dorsali convexo; a medio valvae versus apices obtuse rotundatos sensim attenuatae, longae  $30\ \mu$ , latae  $4-5\ \mu$ . Rhaphae breves prope apices a margine ventrali paulum in latus valvae decurrentes. Striae transapicales  $15-16$  in  $10\ \mu$  in medio valvae, paulum modo versus apices densius congestae. Pseudorhaphae a superficie valvae non visibilis.

Holotypus: Ghana No. 223/1961.

*Eunotia tanosoensis* nov. spec. Pl. II, fig. 9.

Valvae margine ventrali concavo, dorsali convexo; apices versus latus dorsale reflexi; longae 33–38  $\mu$ , latae 7–8  $\mu$ . Rhaphae brevissimae prope apices positae paulum modo in superficiem valvae ascendentes. 8–10 striae transapicales in 10  $\mu$  in medio valvae, versus apices densius congestae. Pseudorhaphae proxime a margine ventrali. Holotypus: Ghana No. 216(1)/1961.

*Eunotia tarkwaensis* nov. spec. Pl. II, fig. 6.

Valvae margine ventrali recto vel paululum convexo, dorsali valde convexo; sensim a medio valvae versus apices obtuse rotundatos attenuatae, longae 15–26  $\mu$ , latae 9–10  $\mu$ . Rhaphae admodum prope apices in latere ventrali positae, paulum modo in superficiem valvae prolongatae. 9 striae transapicales in 10  $\mu$  in medio valvae, versus apices usque ad 15–20 crescentes. Pseudorhaphae in margine ventrali posita a superficie valvae non visibilis.

Holotypus: Ghana No. 296/1961.

*Cocconeis ankobraensis* nov. spec. Pl. IV, fig. 8 a, b.

Valvae ellipticae, longae 20–25  $\mu$ , latae 8–10  $\mu$ . Valva sine rhapsae striis transapicalibus radiantibus, robustis, crasse punctatis, 14–15 in 10  $\mu$ . Pseudorhaphae admodum angusta. Valva rhapsae striis transapicalibus radiantibus robustus crasse punctatis, 15 in 10  $\mu$ . Area axiliaris admodum lata, a medio valvae aream centralem decisam non habentis versus apices sensim convergens. Rhaphae rectae tenues appendices in medio valvae vel versus apices non habentes.

Holotypus: Ghana No. 168/1961.

*Cocconeis schörderii* nov. spec. Pl. IV, fig. 7 a, b.

Valvae ellipticae, longae 15–20  $\mu$ , latae 10–12  $\mu$ . Valva sine rhapsae striis transapicalibus fortissimis radiantibus crasse punctatis, 12 in 10  $\mu$ . Pseudorhaphae angustissima. Valva rhapsae striis transapicalibus radiantibus tenuissime punctatis, 18 in 10  $\mu$ . Area axiliaris angustissima in medio valvae paululum dilatata. Rhaphae rectae tenues.

Holotypus: Ghana No. 171/1961.

*Achnanthes mansiensis* nov. spec. Pl. IV, fig. 3 a, b.

Valvae linear-ellipticae apicibus obtuse protractis rotundatis, longae 18  $\mu$ , latae 6–7  $\mu$ . Valva sine rhapsae pseudorhaphae angusta, aream centralem decisam non habens. Striae transapicales radiantibus subtiliter punctatae, ca. 24 in 10  $\mu$ . Valva rhapsae filiformi recta, area axiliari aream centralem decisam non habens. Striae transapicales radiantibus subtiliter punctatae, ca. 24 in 10  $\mu$ , versus apices paulo densius congestae.

Holotypus: Ghana No. 166/1961.

*Frustulia weinholdi* Hust. fo. *ghanaensis* nov. fo. Pl. V, fig. 1.

Maiore inter strias spatio (ca. 24 in 10  $\mu$ ) a forma *weinholdi* differt.

Holotypus: Ghana No. 136/1961.

*Caloneis bosumtwiensis* nov. spec. Pl. XVII, fig. 4.

Valvae linear-lanceolatae lateribus parallelis vel leviter convexis, apicibus protractis, late obtuseque rotundatis, longae 24  $\mu$ , latae 4–5  $\mu$ . Rhaphe filiformis, recta fissuris centralibus et apicalibus in idem latus deflexis. Area axiliaris latissima,  $\frac{1}{2}$ – $\frac{3}{4}$  latitudinis valvae, in medio valvae in aream centralem ad marginem valvae pertinentem dilatata. Striae transapicales radiantibus, 15–16 in 10  $\mu$ .

Holotypus: Ghana no. 194/1961.

*Caloneis sansomei* nov. spec. Pl. V, fig. 9.

Valvae lineares marginibus parallelis apicibus late rotundatis, longae 55–60  $\mu$ , latae 9–10  $\mu$ . Rhaphe recta, fissuris centralibus in idem latus leviter deflexis. Area axiliaris lanceolata, admodum lata, brevi spatio ab apicibus subito contracta. Area centralis fascia transversalis ad latera valvarum dilatata. Striae transapicales radiantibus, versus apices convergentes, 18 in 10  $\mu$ , linea longitudinali prope marginem valvae divisae.

Holotypus: Ghana no. 260/1961.

*Caloneis voltaensis* nov. spec. Pl. V, fig. 4.

Valvae lineares lateribus parallelis apicibus cuneate convergentibus et late rotundatis, longae 25–30  $\mu$ , latae 6  $\mu$ . Rhaphe recta leviter in idem latus deflexis fissuris centralibus. Area centralis late lanceolata, ca.  $\frac{1}{2}$  latitudinis valvae, versus apices subito attenuata. Area centralis fascia transversalis ad latera valvae pertinens. Omnes striae radiantibus, 18 in 10  $\mu$ , manifesto punctatae, prope marginem valvae tenui fascia longitudinali decisae.

Holotypus: Ghana No. 92/1961.

*Caloneis voltaensis* var. *tarkwaensis* nov. var. Pl. V, fig. 5.

A var. *voltaensis* valvis linear-ellipticis, apicibus acutis differt. Area axiliaris lanceolata, ca.  $\frac{1}{3}$  latitudinis valvae.

Holotypus: Ghana No. 159/1961.

*Neidium affine* (Ehr.) Cleve. var. *bonsaensis* nov. var. Pl. VI, fig. 5.

Apicibus admodum angustis cuneate acutis a var. *affine* differt.

Holotypus: Ghana No. 151/1961.

*Neidium agonaense* nov. spec. Pl. VI, fig. 11.

Valvae ellipticae apicibus leviter protractis, longae 84  $\mu$ , latae 30  $\mu$ . Rhaphe recta poris centralibus in contrarium deflexis. Area axiliaris admodum angusta, versus

aream centralem et apices attenuata, in medio in aream centralem rotundatam dilatata. Striae transapicales in medio valvae leviter radiantes, versus apices fortius radiantes, admodum subtiliter punctatae, ca. 18 in  $10 \mu$ , secundum marginem valvae pluribus fasciis tenuissimis hyalinibus dense congestis.

Holotypus: Ghana No. 141/1961.

*Neidium dayiense* nov. spec. Pl. VI, fig. 7.

Valvae lineares apicibus obtuse rotundatis, longae 25–26  $\mu$ , latae 5,6  $\mu$ . Rhaphe filiformis, fissuris centralibus varie deflexis longis et rectis. Area axiliaris angusta. Area centralis oblique quadrata, ca.  $\frac{3}{4}$  latitudinis valvae. Striae transapicales obliquae, ca. 36 in  $10 \mu$ .

Holotypus: Ghana No. 309/1961.

*Neidium hercynicum* A. Mayer fo. *bogosoensis* nov. forma. Pl. VI, fig. 6.

Area centrali oblique ad  $\frac{1}{2}$  fere latitudinem valvae dilatata a *N. hercynicum* et a fo. *subrostratum* Reimer differt.

Holotypus: Ghana No. 163/1961.

*Neidium kumasiense* nov. spec. Pl. VI, fig. 8.

Valvae lineares vel leviter lanceolatae apicibus protractis late rotundatis, longae 23–26  $\mu$ , latae 8–9  $\mu$ . Rhaphe filiformis fissuris centralibus admodum longis diverse deflexis. Area axiliaris angustissima. Area centralis parva leviter obliqua. Striae transapicales diagonales, 24–26 in  $10 \mu$ , 6–9 manifestis striis hyalinibus.

Holotypus: Ghana No. 196/1961.

*Neidium nsuaemense* nov. spec. Pl. VI, fig. 12.

Valvae linear-ellipticae apicibus rotundatis, longae 28–30  $\mu$ , latae 6–7  $\mu$ . Rhaphe filiformis recta fissuris centralibus diverse deflexis longis. Area axiliaris admodum angusta, in medio in aream centralem ellipticam obliquiorem dilatata. Striae transapicales fortius diagonales, ad alterum latus rectis in rhaphen angulis vel leviter convergentes, ca. 24 in  $10 \mu$ , compluribus manifestis striis longitudinalibus.

Holotypus: Ghana No. 141/1961.

*Stauroneis akrosoensis* nov. spec. Pl. VII, fig. 2.

Valvae linear-ellipticae apicibus protractis obtuse rotundatis, longae 52  $\mu$ , latae 13–14  $\mu$ . Rhaphe filiformis recta. Area axiliaris angusta breviter ante medium in aream centralem dilatata, cuius media pars in fasciam transversalem angustissimam ad latera valvae dilatata extensa est. Striae transapicales 26–28 in  $10 \mu$  in medio valvae rectis fere in rhaphen angulis, versus apices sensim radiantes, manifesto punctatae.

Holotypus: Ghana No. 299/1961.



*Stauroneis navrongensis* nov. spec. Pl. VII, fig. 12.

Valvae lineares lateribus ter undatis apicibus late rostratis obtuse rotundatis, longae 20–25  $\mu$ , latae 4–5  $\mu$ . Pseudoseptae brevissimae. Rhapshe recta filiformis. Area axiliaris angusta, versus aream centralem fasciam transversam latissimam ad latera valvarum dilatata efficientem aliquantum dilatata. Striae transapicales omnes radiantes, 24–26 in 10  $\mu$ , manifesto punctatae.

Holotypus: Ghana No. 258/1961.

*Stauroneis slateri* nov. spec. Plate VII, fig. 3.

Valvae linear-ellipticae apicibus admodum angustis leviter protractis, longae 51–52  $\mu$ , latae 10  $\mu$ . Rhapshe recta longis in idem latus deflexis fissuris polaribus. Area axiliaris angusta versus mediam valvam versus aream centralem latam ad latera valvae dilatata leviter dilatata. Striae transapicales omnes valde radiantes, admodum crasse punctatae, 18 in 10  $\mu$ ; par medium in poros paucos prope rhapsen reductum.

Holotypus: Ghana No. 144/1961.

*Navicula halophila* fo. *nabogoensis* nov. fo. Pl. VIII, fig. 9.

Apicibus modo minime protractis et forma compacta a forma *halophila* differt.

Holotypus: Ghana No. 234/1961.

*Navicula ankobraensis* nov. spec. Pl. VIII, fig. 10.

Valvae lineares lateribus leviter concavis apicibus anguste protractis et capitatis, longae 16–20  $\mu$ , latae 4–5  $\mu$ . Rhapshe linearis filiformis. Area axiliaris linearis angusta aream centralem propriam non habens, sed in medio valvae striae transapicales alternis vicibus longiores vel breviores. Striae transapicales radiantes, 24–26 in 10  $\mu$ .

Holotypus: Ghana No. 172/1961.

*Navicula voltaensis* nov. spec. Plate VIII, fig. 16.

Valvae lineares lateribus fere parallelis vel paulum convexis, apicibus obtuse protractis, longae 22  $\mu$ , latae 5–6  $\mu$ . Rhapshe recta filiformis. Area axiliaris angustissima linearis aream centralem decisam non habens. Striae transapicales radiantes, ca. 36 in 10  $\mu$ .

Holotypus: Ghana No. 296/1961.

*Navicula aketechiensis* nov. spec. Plate X, fig. 33.

Valvae linear-ellipticae apicibus rotundatis, longae 30–35  $\mu$ , latae 10–12  $\mu$ . Rhapshe filiformis recta. Area axiliaris admodum lata, a polis versus medium valvae leviter in latitudinem crescens. Nulla area centralis decisa. Striae transapicales omnes radiantes, 21 in 10  $\mu$ , versus apices densiores congestae.

Holotypus: Ghana No. 136/1961.

*Navicula bosumtwiensis* nov. spec. Pl. IX, fig. 19.

Valvae linear-ellipticae, longae 20  $\mu$ , latae 5–6  $\mu$ . Rhaps linearis admodum longis in idem latus deflexis fissuris polaribus. Media superficies valvae structuram visibilem non habens. Striae transapicales brevissimae in partem modo fere quartam a margine valvae ad raphen ascendentes, 21–22 in 10  $\mu$ .

Holotypus: Ghana No. 192/1961.

*Navicula esamangensis* nov. spec. Pl. VIII, fig. 20.

Valvae linear-ellipticae apicibus late rotundatis, longae 18–20  $\mu$ , latae 6  $\mu$ . Rhaps linearis filiformis in idem latus deflexis brevibus fissuris polaribus. Area axiliaris linearis angusta in medio valvae in aream centralem parvam rotundatam dilatata. Striae transapicales radiantes, ca. 24 in 10  $\mu$ , in medio valvae singulae maiore inter se distantia.

Holotypus: Ghana No. 207/1961.

*Navicula langoraensis* nov. spec. Pl. X, fig. 32.

Valvae lineares lateribus parallelis apicibus plane rotundatis, longae 20  $\mu$ , latae 6–7  $\mu$ . Rhaps filiformis brevibus in idem latus deflexis fissuris polaribus. Area axiliaris angusta in medio valvae in aream centralem leviter dilatata. Striae transapicales rectis in raphen angulis, ca. 24 in 10  $\mu$ .

Holotypus: Ghana No. 220/1961.

*Navicula abuensis* nov. spec. Pl. XII, fig. 10.

Valvae rhomboides apicibus rotundatis, longae 26  $\mu$ , latae 8–9  $\mu$ . Rhaps filiformis recta. Area axiliaris rhomboides ab apicibus ad  $\frac{3}{4}$  fere latitudinis sensim latior in medio valvae. Striae transapicales breves, ca.  $\frac{1}{4}$  latitudinis valvae, radiantes, ca. 18 in 10  $\mu$ , manifesto punctatae.

Holotypus: Ghana No. 207/1961.

*Navicula ajenaensis* nov. spec. Pl. IX, fig. 1.

Valvae linear-ellipticae, longae 25–40  $\mu$ , latae 5–8  $\mu$ . Rhaps filiformis recta. Area axiliaris angusta linearis, in medio valvae in aream centralem rotundatam paulum enormem dilatata. Striae transapicales radiantes, 20–21 in 10  $\mu$ , in medio valvae nonnullae abbreviatae.

Holotypus: Ghana No. 294/1961.

*Navicula bamboiensis* nov. spec. Pl. X, fig. 29.

Valvae rhombo-ellipticae apicibus obtuse rotundatis, longae 10  $\mu$ , latae 5–6  $\mu$ . Rhaps filiformis recta. Area axiliaris linearis angusta, in medio valvae in aream centralem rotundatam dilatata. Striae transapicales omnes radiantes, ca. 20 in 10  $\mu$ , versus apices densius congestae.

Holotypus: Ghana No. 220/1961.

*Navicula bawdiaensis* nov. spec. Pl. X, fig. 26.

Valvae linear-ellipticae apicibus rotundatis, longae  $16 \mu$ , latae  $6 \mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis in medio valvae in aream centralem oblique dilatata dilatata. Striae transapicales tenuiter radiantes, 24–25 in  $10 \mu$ .

Holotypus: Ghana No. 165/1961.

*Navicula butreensis* nov. spec. Pl. IX, fig. 11.

Valvae linear-ellipticae apicibus protractis obtuse rotundatis, longae  $12 \mu$ , latae  $5 \mu$ . Rhaphe filiformis recta. Area axiliaris angusta linearis, nulla area centrali decisa. Striae transapicales radiantes, 24 in  $10 \mu$ .

Holotypus: Ghana No. 116 b/1961.

*Navicula dugaensis* nov. spec. Pl. X, fig. 25.

Valvae linear-ellipticae apicibus rotundatis, longae  $20\text{--}22 \mu$ , latae  $6 \mu$ . Rhaphe filiformis in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis in medio valvae in aream centralem ad latera valvae dilatata expansa, singulis striis enormiter distributis. Striae transapicales radiantes, ca. 22 in  $10 \mu$ , versus apices densius congestae.

Holotypus: Ghana No. 305/1961.

*Navicula huniensis* nov. spec. Pl. X, fig. 1.

Valvae lineares lateribus parallelis apicibus breviter protractis et obtuse rotundatis, longae  $18 \mu$ , late  $6 \mu$ . Rhaphe filiformis recta. Area axiliaris angusta linearis nulla area centrali decisa. Striae transapicales in medio valvae rectis in raphen angulis versus apices tenuiter radiantes, 30–32 in  $10 \mu$ .

Holotypus: Ghana No. 157/1961.

*Navicula kolugoensis* nov. spec. Pl. XII, fig. 9.

Valvae late ellipticae apicibus late rotundatis, longae  $17\text{--}18 \mu$ , latae  $8\text{--}9 \mu$ . Rhaphe filiformis recta. Area axiliaris lanceolata, in medio valvae ad ca.  $\frac{1}{3}$  latitudinis valvae. Striae transapicales radiantes, 12–15 in  $10 \mu$ , crasse punctatae.

Holotypus: Ghana No. 244/1961.

*Navicula lawsonii* nov. spec. Pl. X, fig. 6.

Valvae lineares in medio valvae leviter convexae dilatatae apicibus late rotundatis, longae  $16 \mu$ , latae  $3\text{--}4 \mu$ . Rhaphe filiformis recta. Area axiliaris angusta, in medio in aream centralem parvam rotundatam dilatata. Striae transapicales ca. 24 in  $10 \mu$ , in medio valvae tenuiter radiantes, versus apices admodum convergentes.

Holotypus: Ghana No. 192/1961.

*Navicula nunguaensis* nov. spec. Pl. X, fig. 5.

Valvae late ellipticae apicibus anguste protractis, longae 18–20  $\mu$ , latae 5–6  $\mu$ . Rhaps linearis filiformis. Area axiliaris linearis angusta, nulla area centrali decisa. Striae transapicales rectis in raphen angulis, 18–20 in 10  $\mu$ .

Holotypus: Ghana No. 33/1961.

*Navicula sansomei* nov. spec. Pl. IX, fig. 12.

Valvae ellipticae apicibus admodum acute protractis, longae 14  $\mu$ , latae 5–6  $\mu$ . Rhaps filiformis recta. Area axiliaris admodum angusta linearis, nulla area centrali decisa. Striae transapicales rectis in raphen angulis vel leviter radiantes, 18 in 10  $\mu$ .

Holotypus: Ghana No. 95/1961.

*Navicula sorriensis* nov. spec. Pl. XII, fig. 12.

Valvae late ellipticae apicibus late protractis obtuse rotundatis, longae 22  $\mu$ , latae 8  $\mu$ . Rhaps filiformis recta brevibus in idem latus deflexis fissuris polaribus. Area axiliaris admodum angusta recta, in medio valvae in aream centralem angustam cum striis transapicalibus enormiter abbreviatis. Striae transapicales 18 in 10  $\mu$ , quattuor striis longitudinalibus hyalinis secantibus.

Holotypus: Ghana No. 227/1961.

*Navicula abelioensis* nov. spec. Pl. XI, fig. 22.

Valvae lineares lateribus leviter convexis apicibus late protractis obtuse rotundatis, longae 16  $\mu$ , latae 4–5  $\mu$ . Rhaps filiformis recta. Area axiliaris angustissima. Area centralis admodum lata fascia ad latera valvae dilatata. Striae transapicales radiantes, ca. 24 in 10  $\mu$ , manifesto punctatae.

Holotypus: Ghana No. 254/1961.

*Navicula abonuenensis* nov. spec. Pl. XI, fig. 4.

Valvae linear-ellipticae, longae 20–25  $\mu$ , latae 6–7  $\mu$ . Rhaps filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris admodum lata linearis, in medio valvae in aream centralem transversam expansam dilatata. Striae transapicales radiantes, ca. 20 in 10  $\mu$ , manifesto punctatae, in medio valvae enormiter abbreviatae.

Holotypus: Ghana No. 194/1961.

*Navicula adampeensis* nov. spec. Pl. XIII, fig. 4.

Valvae ellipticae apicibus brevissime protractis late rotundatis, longae 32  $\mu$ , latae 17–18  $\mu$ . Rhaps filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta, in medio valvae in aream centralem parvam rotundatam dilatata. Striae transapicales radiantes, 12 in 10  $\mu$ , admodum crasse punctatae, versus apices paulo densius congestae.

Holotypus: Ghana No. 102/1961.

*Navicula akimensis* nov. spec. Pl. XIII, fig. 2.

Valvae ellipticae apicibus obtuse rostratis, longae 40  $\mu$ , latae 15–16  $\mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis. Area centralis rotundata, enormiter definita, in uno latere duobus stigmatibus separatis. Striae transapicales radiantes, 12 in 10  $\mu$ , in medio valvae striis brevioribus interiectis, versus apices paulo densius congestae admodum crasse punctatae.

Holotypus: Ghana No. 218/1961.

*Navicula ashantiensis* nov. spec. Pl. XIII, fig. 5.

Valvae elliptico-lanceolatae apicibus breviter protractis obtuse rotundatis, longae 35–40  $\mu$ , latae 15–16  $\mu$ . Rhaphe filiformis recta, in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis, in medio valvae in aream centralem enormem ad ca.  $\frac{1}{4}$  ad  $\frac{1}{3}$  latitudinis valvae dilatata. Striae transapicales radiantes, 12–13 in 10  $\mu$ , nonnullae breviores in medium valvae insertae, versus apices paulo densius congestae, manifesto punctatae.

Holotypus: Ghana No. 220/1961.

*Navicula bertelsenii* nov. spec. Pl. XI, fig. 23.

Valvae ellipticae apicibus late protractis obtuse rotundatis, longae 20–25  $\mu$ , latae 6–7  $\mu$ . Rhaphe filiformis recta. Area axiliaris angusta linearis, in medio in aream centralem rotundatam ad  $\frac{1}{3}$ – $\frac{1}{2}$  latitudinis valvae dilatata. Striae transapicales radiantes, 18 in 10  $\mu$ , in medio valvae paulo distantius crassiusque quam ad apices punctatae.

Holotypus: Ghana No. 207/1961.

*Navicula chadwickii* nov. spec. Pl. XII, fig. 8.

Valvae lanceolatae apicibus leviter protractis, longae 24–26  $\mu$ , latae 6–7  $\mu$ . Rhaphe filiformis recta in idem latus deflexis brevibus fissuris polaribus. Area axiliaris angustissima linearis, in medio valvae non dilatata. Striae transapicales omnes radiantes, 22–24 in 10  $\mu$ , subtilissime punctatae.

Holotypus: Ghana No. 205/1961.

*Navicula damongensis* nov. spec. Pl. XI, fig. 14.

Valvae linear-ellipticae apicibus rotundatis, longae 18–20  $\mu$ , latae 5–6  $\mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris admodum lata cum area centrali fasciam ad latera valvae dilatatam admodum latam efficienti. Striae transapicales radiantes duobus hyalinibus lineis longitudinalibus, 20–21 in 10  $\mu$ .

Holotypus: Ghana No. 223/1961.

*Navicula densuensis* nov. spec. Pl. XII, fig. 7.

Valvae linear-ellipticae apicibus longe protractis, longae 30–35  $\mu$ , latae 7  $\mu$ . Rhaphe filiformis recta, in idem latus deflexis fissuris polaribus. Area axiliaris angustissima,

linearis, in medio valvae non dilatata. Striae transapicales rectis in raphen angulis, 16 in  $10 \mu$ , in medio valvae crasse punctatae, versus apices subtilius punctatae. Holotypus: Ghana No. 73/1961.

*Navicula fawumangensis* nov. spec. Pl. XI, fig. 17.

Valvae late ellipticae apicibus late protractis obtuse rotundatis, longae 16–18  $\mu$ , latae 5–6  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angustissima, linearis, una stria brevissima ad latera valvae dilatata area centrali. Striae transapicales radiantes, 16 in  $10 \mu$ , in medio valvae radiantes, versus apices rectis in raphen angulis, crasse punctatae. Holotypus: Ghana No. 204/1961.

*Navicula grundtvigii* nov. spec. Pl. XIII, fig. 6.

Valvae elliptico-lanceolatae apicibus protractis obtuse rotundatis, longae 34–38  $\mu$ , latae 15–16  $\mu$ . Rhapshe filiformis recta. Area axiliaris angusta linearis, in medio valvae in aream centralem parvam rotundatam ad ca.  $1/4$ – $1/5$  latitudinis valvae dilatata. Striae transapicales radiantes 13 in  $10 \mu$ , in medio valvae una in utroque latere paulum abbreviata stria, versus apices paulo densius congestae, manifesto punctatae. Holotypus: Ghana No. 299/1961.

*Navicula ingoldii* nov. spec. Pl. XII, fig. 3.

Valvae ellipticae apicibus leviter protractis obtuse rotundatis, longae 25–30  $\mu$ , latae 10–11  $\mu$ . Rhapshe filiformis recta. Area axiliaris anguste lanceolata, ab apicibus ad ca.  $1/5$  latitudinis valvae in medio sensim in latitudinem accrescens. Striae transapicales radiantes, 15 in  $10 \mu$ , manifesto punctatae. Holotypus: Ghana No. 157/1961.

*Navicula isertii* nov. spec. Pl. XII, fig. 16.

Valvae ellipticae apicibus late rostratis ad polos plane rotundatis, longae 30–32  $\mu$ , latae 12–13  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis. Area centralis parva rotundata. Striae transapicales radiantes, ca. 11 in  $10 \mu$ , crasse punctatae, versus apices rectis in raphen angulis densiusque congestae. In medio valvae singulae striae abbreviatae. Holotypus: Ghana No. 205/1961.

*Navicula kpongensis* nov. spec. Pl. XII, fig. 14.

Valvae lanceolatae apicibus longe protractis, longae 30–35  $\mu$ , latae 7–8  $\mu$ . Rhapshe filiformis recta in idem latus deflexis brevibus fissuris polaribus. Area axiliaris angusta linearis, in medio valvae in aream centralem rotundatam in  $1/3$ – $1/2$  latitudinis valvae dilatata. Striae transapicales radiantes, 17–18 in  $10 \mu$ , manifesto punctatae, versus apices densius congestae. Holotypus: Ghana No. 101/1961.



*Navicula laingii* nov. spec. Pl. XII, fig. 1.

Valvae late lineares lateribus leviter convexus apicibus late rotundatis, longae 40  $\mu$ , latae 12  $\mu$ . Rhaphe filiformis recta. Area axiliaris admodum lata et in medio in aream centralem in longitudinem rotundatam ca.  $\frac{1}{3}$  latitudinis valvae dilatata. Striae transapicales radiantes, 18 in 10  $\mu$ , in medio valvae modo breviores, modo longiores, prope apices rectis in raphen angulis et densius congestae; omnes striae crasse punctatae.

Holotypus: Ghana No. 220/1961.

*Navicula mansiensis* nov. spec. Pl. XI, fig. 3.

Valvae late ellipticae apicibus protractis obtuse rotundatis, longae 18–20  $\mu$ , latae 6–7  $\mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angustissima linearis nulla area centrali decisa. Striae transapicales in medio valvae radiantes versus apices rectis in raphen angulis, ca. 22 in 10  $\mu$ ; in medio valvae singulae striae breviores interiectae.

Holotypus: Ghana No. 166/1961.

*Navicula navrongensis* nov. spec. Pl. XI, fig. 11.

Valvae linear-ellipticae apicibus obtuse rotundatis, longae 14–25  $\mu$ , latae 4–6  $\mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris angusta linearis, in medio valvae in aream centralem transversam vel in medium vel  $\frac{3}{4}$  ad latus valvae pertinentem dilatata. Striae transapicales radiantes compluribus lineis hyalinibus longitudinalibus secantibus, 20–24 in 10  $\mu$ .

Holotypus: Ghana No. 254/1961.

*Navicula nsutaensis* nov. spec. Pl. XI, fig. 18.

Valvae ellipticae apicibus admodum anguste protractis rotundatis, longae 18–20  $\mu$ , latae 6  $\mu$ . Rhaphe filiformis recta. Area axiliaris angusta linearis area centrali enormi in transversum dilatata. Striae transapicales radiantes 17–18 in 10  $\mu$ , in medio valvae enormiter longae punctatae.

Holotypus: Ghana No. 207/1961.

*Navicula subinsoensis* nov. spec. Pl. XII, fig. 13.

Valvae late ellipticae apicibus admodum protractis, longae 24–25  $\mu$ , latae 7–8  $\mu$ . Rhaphe filiformis recta. Area axiliaris angusta linearis, in medio valvae in aream centralem transversam ca.  $\frac{3}{4}$  latitudinis valvae dilatata. Striae transapicales radiantes, 22–23 in 10  $\mu$ , manifesto punctatae.

Holotypus: Ghana No. 218/1961.

*Navicula syrachii* nov. spec. Pl. XI, fig. 24.

Valvae late ellipticae apicibus obtuse rotundatis, longae 12–15  $\mu$ , latae 5–6  $\mu$ . Rhaphe filiformis recta. Area axiliaris angusta, in medio in aream centralem rotundatam

paulum irregularem  $\frac{1}{2}$  ad  $\frac{1}{3}$  latitudinis valvae dilatata. Striae transapicales radiantes, 24–26 in  $10 \mu$ , in medio valvae longitudine irregulari, punctatae.

Holotypus: Ghana No. 95/1961.

*Navicula monradii* nov. spec. Pl. XII, fig. 11.

Valvae linear-lanceolatae, longae  $26 \mu$ , latae  $6 \mu$ . Rhapshe filiformis recta. Area axiliaris admodum angusta recta, in medio valvae in aream centralem leviter in aream centralem oblongam ellipticam, ca.  $\frac{1}{3}$  latitudinis valvae dilatata. Striae transapicales radiantes, 24 in  $10 \mu$ , subtiliter punctatae.

Holotypus: Ghana No. 220/1961.

*Navicula abraensis* nov. spec. Pl. XV, fig. 12.

Valvae ellipticae, longae  $32 \mu$ , latae  $8-9 \mu$ . Rhapshe filiformis recta, in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis. Area centralis rotundata e transverso in ca.  $\frac{1}{2}$  latitudinis dilatata. Striae transapicales admodum radiantes, 10 in  $10 \mu$ , cum lineis longitudinalibus.

Holotypus: Ghana No. 124/1961.

*Navicula asanwinsoensis* nov. spec. Pl. XIV, fig. 15.

Valvae lineares lateribus leviter convexis et apicibus admodum protractis obtuse rotundatis, longae  $20-22 \mu$ , latae  $6-7 \mu$ . Rhapshe filiformis linearis. Area axiliaris linearis, admodum lata, in medio valvae in aream centralem ad ca.  $\frac{1}{2}$  latitudinis valvae dilatata. Striae transapicales rectis in raphen angulis vel leviter radiantes, 15 in  $10 \mu$ .

Holotypus: Ghana No. 173/1961.

*Navicula bansoensis* nov. spec. Pl. XIV, fig. 4.

Valvae late ellipticae apicibus rotundatis, longae  $20-25 \mu$ , latae  $10 \mu$ . Rhapshe filiformis recta. Area axiliaris admodum angusta linearis, in medio valvae non dilatata. Striae transapicales radiantes, 12 in  $10 \mu$ , in medio valvae modo breviores modo longiores versus apices densius congestae.

Holotypus: Ghana No. 122/1961.

*Navicula carloffii* nov. spec. Pl. XV, fig. 6.

Valvae linear-lanceolatae apicibus obtuse protractis rotundatis, longae  $15-20 \mu$ , latae  $3-4 \mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta recta. Striae transapicales in medio rectis in raphen angulis, versus apices leviter convergentes, 15 in  $10 \mu$ , versus apices densius congestae.

Holotypus: Ghana No. 204/1961.

*Navicula carstensenii* nov. spec. Pl. XIV, fig. 11.

Valvae lanceolatae attenuatae et rostratae ad capitatas versus apices protractae, longae  $33-35 \mu$ , latae  $8-9 \mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus.

Area axiliaris angusta linearis, in medio valvae in aream centralem rotundatam  $\frac{1}{3}$ – $\frac{1}{2}$  latitudinis valvae dilatata. Striae transapicales leviter radiantem, 12 in  $10 \mu$ , versus apices rectis in raphen angulis, crasse punctatae (lineis longitudinalibus).  
Holotypus: Ghana No. 188/1961.

*Navicula dodowaensis* nov. spec. Pl. XV, fig. 7.

Valvae linear-lanceolatae apicibus subito protractis admodum acute rotundatis, longae 25–30  $\mu$ , latae 8  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis minima rotundata in medio valvae dilatatione. Striae transapicales radiantem, 12 in  $10 \mu$ , manifesto lineatae.  
Holotypus: Ghana No. 106/1961.

*Navicula feuerborni* Hust. fo. *africana* nov. fo. Pl. XVI, fig. 2.

Apicibus acutis et non contractis a forma *feuerborni* differt.  
Holotypus: Ghana No. 119/1961.

*Navicula humjibreensis* nov. spec. Pl. XV, fig. 8.

Valvae lanceolatae versus apices protractae obtuse rotundatae, longae 20–25  $\mu$ , latae 6–7  $\mu$ . Rhapshe filiformis recta. Area axiliaris angusta linearis, in medio valvae paululum dilatata. Striae transapicales leviter radiantem vel rectis in raphen angulis, 14 in  $10 \mu$ , manifestis striis longitudinalibus.  
Holotypus: Ghana No. 171/1961.

*Navicula meyeri* nov. spec. Pl. XIV, fig. 12.

Valvae lineares lateribus leviter convexis apicibus late protractis lateque rotundatis, longae 34–38  $\mu$ , latae 12–14  $\mu$ . Rhapshe filiformis leviter curvata in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis. Area centralis minima rotundata. Striae transapicales radiantem, 9–10 in  $10 \mu$ , in medio valvae nonnullae breviores insertae, versus apices densius congestae, manifesto punctatae.  
Holotypus: Ghana No. 295/1961.

*Navicula moerckii* nov. spec. Pl. XV, fig. 5.

Valvae lineares lateribus leviter convexis, longae 16–17  $\mu$ , latae 4  $\mu$ . Rhapshe filiformis leviter curvata in idem latus deflexis fissuris polaribus. Area axiliaris lata, ca.  $\frac{1}{2}$  latitudinis valvae, in medio valvae haud ita dilatata. Striae transapicales leviter radiantem, 15 in  $10 \mu$ , tenuiter lineatae.  
Holotypus: Ghana No. 207/1961.

*Navicula nagbogensis* nov. spec. Pl. XV, fig. 1.

Valvae ellipticae apicibus late protractis obtuse rotundatis, longae 40–45  $\mu$ , latae 12–15  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Rhapshe

angustissima linearis, in medio valvae paene non dilatata. Striae transapicales leviter radiantes, 15 in  $10 \mu$ , manifesto punctatae, leviter convergentes et versus apices densius congestae.

Holotypus: Ghana No. 279/1961.

*Navicula sepasiensis* nov. spec. Pl. XV, fig. 4.

Valvae elliptico-lanceolatae apicibus late protractis, longae  $30 \mu$ , latae  $10-12 \mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris admodum angusta. Area centralis rotundata, ca.  $\frac{1}{3}-\frac{1}{2}$  latitudinis valvae. Striae transapicales admodum fortiter radiantes, 12 in  $10 \mu$ , in medio brevioribus striis interiectis, versus apices densius congestae, subtiliter secundum longitudinem striatae.

Holotypus: Ghana No. 196/1961.

*Navicula suhinensis* nov. spec. Pl. XIV, fig. 9.

Valvae linear-ellipticae apicibus protractis obtuse rotundatis, longae  $20-25 \mu$ , latae  $7-8 \mu$ . Rhaphe filiformis recta. Area axiliaris angustissima, in medio valvae in aream centralem transversam dilatata. Striae transapicales radiantes 22 in  $10 \mu$ , versus apices densius congestae.

Holotypus: Ghana No. 218/1961.

*Navicula tainensis* nov. spec. Pl. XV, fig. 9.

Valvae lineares lateribus leviter convexas, versus apices late protractae polis late rotundatis, longae  $40 \mu$ , latae  $6-7 \mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris angusta linearis. Area centralis paulula rotundata. Striae transapicales fortiter radiantes, 15 in  $10 \mu$ , manifestis lineis longitudinalibus.

Holotypus: Ghana No. 217/1961.

*Pinnularia nunguaensis* nov. spec. Pl. XVII, fig. 1.

Valvae late lineares, lateribus rectis vel leviter concavis, apicibus rotundatis, longae  $25-30 \mu$ , latae  $9-10 \mu$ . Rhaphe filiformis recta, in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris ab apicibus versus medium valvae in aream centralem latam expansa, quae in medio valvae fasciam transversam ad latera efficit. Striae transapicales rectis in raphen angulis, 10 in  $10 \mu$ , versus apices leviter convergentes.

Holotypus: Ghana No. 39/1961.

*Pinnularia suhinensis* nov. spec. Pl. XVII, fig. 5.

Valvae linear-lanceolatae, longae  $24-26 \mu$ , latae  $4-5 \mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris lata, ca.  $\frac{1}{2}$  latitudinis valvae. Area centralis latissima ad marginem valvae dilatata. Striae transapicales rectis in raphen angulis,  $11-12$  in  $10 \mu$ .

Holotypus: Ghana No. 218/1961.

*Pinnularia takoradiensis* nov. spec. Pl. XVI, fig. 13.

Valvae anguste lineares apicibus late rotundatis, longae 30–32  $\mu$ , latae 4–5  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris angusta. Area centralis latissima ad marginem valvae expansa. Striae transapicales omnes convergentes, 15 in 10  $\mu$ .

Holotypus: Ghana No. 122/1961.

*Pinnularia mankesimensis* nov. spec. Pl. XVIII, fig. 10.

Valvae lineares lateribus ter undulatis apicibus protractis, longae 30  $\mu$ , latae 4–5  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris lata,  $\frac{1}{2}$ – $\frac{2}{3}$  latitudinis valvae. Area centralis fascia transversalis latissima ad latera valvae pertinens. Striae transapicales breves rectis in raphen angulis, 12 in 10  $\mu$ .

Holotypus: Ghana No. 111/1961.

*Pinnularia bogosoensis* nov. spec. Pl. XIX, fig. 1.

Valvae linear-lanceolatae apicibus protractis admodum acutis, longae 60  $\mu$ , latae 8–9  $\mu$ . Rhapshe recta levissime in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris ad ca.  $\frac{1}{2}$  latitudinis valvae ab apicibus versus aream centralem latissimam ad latera valvarum dilatata crescens. Striae transapicales 10–11 in 10  $\mu$ , radiantes, versus apices convergentes.

Holotypus: Ghana No. 163/1961.

*Pinnularia mansiensis* nov. spec. Pl. XVIII, fig. 5.

Valvae linear-lanceolatae apicibus late protractis, longae 40  $\mu$ , latae 7–8  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris admodum lata ab apicibus versus medium in aream centralem admodum latam ad latera valvae expansam dilatata. Striae transapicales radiantes, 11 in 10  $\mu$  versus medium valvae, versus apices convergentes densiusque congestae.

Holotypus: Ghana No. 165/1961.

*Pinnularia nsuaemensis* nov. spec. Pl. XVI, fig. 14.

Valvae linear-lanceolatae, longae 25–28  $\mu$ , latae 4–5  $\mu$ . Rhapshe filiformis recta in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris angusta ab apicibus versus aream centralem latissimam ad marginem valvae pertinentem sensim latior. Striae transapicales 17–18 in 10  $\mu$ , propius medium valvae radiantes, versus apices convergentes.

Holotypus: Ghana No. 142/1961.

*Pinnularia otiensis* nov. spec. Pl. XVIII, fig. 4.

Valvae lineares lateribus leviter convexis apicibus latissime protractis et latissime rotundatis, longae 50–60  $\mu$ , latae 12–14  $\mu$ . Rhapshe recta in idem latus deflexis fissuris

polaribus. Area axiliaris admodum lata ab apicibus versus aream centram fasciam transversalem ad latera valvae pertinentem admodum latam efficientem sensim latior. Striae transapicales radiantes, 9 in 10  $\mu$ , versus apices tenuiter convergentes. Holotypus: Ghana No. 298/1961.

*Pinnularia tomentoensis* nov. spec. Pl. XIX, fig. 3.

Valvae elliptico-lanceolatae marginibus convexis apicibus obtuse protractis, longae 50–55  $\mu$ , latae 10  $\mu$ . Area axiliaris ca.  $\frac{1}{3}$  latitudinis valvae et in medio in aream centram ad marginem valvae expansam dilatata. Rhaphe ramis leviter curvatis longisque fissuris polaribus. Striae transapicales ca. 9 in 10  $\mu$ , in medio radiantes versus apices convergentes.

Holotypus: Ghana No. 133/1961.

*Pinnularia agogoensis* nov. spec. Pl. XVII, fig. 7.

Valvae lineares lateribus leviter convexis apicibus late rotundatis, longae 50–55  $\mu$ , latae 8–10  $\mu$ . Rhaphe recta in idem latus deflexis fissuris polaribus. Area axiliaris latissima, ca.  $\frac{3}{4}$  latitudinis valvae et area centralis fasciam transversalem latissimam ad latera valvae pertinentem efficiens. Striae transapicales brevissimae rectis in rhaphen angulis, 9 in 10  $\mu$ .

Holotypus: Ghana No. 185/1961.

*Pinnularia lawsonii* nov. spec. Pl. XVIII, fig. 3.

Valvae lineares lateribus leviter convexis et apicibus late capitatis, longae 45–60  $\mu$ , latae 10–12  $\mu$ . Rhaphe recta filiformis in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris lata, ca.  $\frac{1}{2}$  latitudinis valvae, recta, nulla vel exigua in medio valvae dilatatione. Striae transapicales rectis in rhaphen angulis, 12 in 10  $\mu$ .

Holotypus: Ghana No. 204/1961.

*Pinnularia odaensis* nov. spec. Pl. XVII, fig. 8.

Valvae lineares apicibus late rotundatis, longae 45–50  $\mu$ , latae 7–8  $\mu$ . Rhaphe filiformis in idem latus deflexis fissuris centralibus et polaribus. Area axiliaris latissima, ca.  $\frac{2}{3}$  latitudinis valvae. Area centralis fasciam transversalem latissimam ad marginem valvae pertinentem efficiens. Striae transapicales rectis in rhaphen angulis, 9 in 10  $\mu$ .

Holotypus: Ghana No. 198/1961.

*Pinnularia tafoensis* nov. spec. Pl. XVIII, fig. 11.

Valvae linear-ellipticae, longae 40–45  $\mu$ , latae 12  $\mu$ . Rhaphe filiformis recta in idem latus deflexis fissuris polaribus. Area axiliaris ab apicibus versus medium valvae ad ca.  $\frac{1}{2}$  latitudinis et in aream centram ad latera valvae expansam dilatata. Striae transapicales leviter radiantes, 10 in 10  $\mu$  versus apices rectis fere angulis in rhaphen. Holotypus: Ghana No. 6/1961.



*Amphora abuensis* nov. spec. Pl. XIX, fig. 6.

Valvae margine ventrali recto, dorsali convexo apicibus leviter protractis, longae 23–25  $\mu$ , latae 4–5  $\mu$ . Rhapshe recta prope marginem ventralem decurrens. Area axiliaris versus latus dorsale angustissima, nulla in medio valvae dilatatione, in latere ventrali usque ad marginem valvae latior. Striae transapicales in latere dorsali radiantibus, 15–16 in 10  $\mu$ , manifesto punctatae, in latere ventrali non visibiles.

Holotypus: Ghana No. 207/1961.

*Amphora ayensuensis* nov. spec. Pl. XIX, fig. 7.

Valvae margine ventrali recto, dorsali convexo et apicibus capitatis protractis, longae 25  $\mu$ , latae 4–5  $\mu$ . Rhapshe recta. Area axiliaris angustissima, in medio valvae non dilatata. Striae transapicales in latere dorsali fortes radiantibus, 14–15 in 10  $\mu$ . Nullae in latere ventrali visibiles striae.

Holotypus: Ghana No. 107/1961.

*Amphora crameri* nov. spec. Pl. XIX, fig. 8.

Valvae margine ventrali fere recto, dorsali valde convexo apicibus acute protractis, longae 25–30  $\mu$ , latae 7–8  $\mu$ . Rhapshe recta. Area axiliaris versus latus dorsale angustissima, in latere ventrali ad marginem valvae dilatata. Striae transapicales radiantibus, 22 in 10  $\mu$ , una in medio valvae abbreviata. Nullae in latere ventrali striae visibiles.

Holotypus: Ghana No. 207/1961.

*Amphora mansiensis* nov. spec. Pl. XX, fig. 1.

Valvae margine ventrali et dorsali convexo apicibus protractis et versus latus ventrale deflexis, longae 38–50  $\mu$ , latae 8–10  $\mu$  (in facie connectivali). Rhapshe in medio valvae decurrens aliquid curvata. Area axiliaris in latere dorsali angusta, in medio valvae leviter dilatata, in latere ventrali lata. Striae transapicales robustae, leviter radiantibus, in latere dorsali 12–14 in 10  $\mu$ , in latere ventrali non visibiles.

Holotypus: Ghana No. 168/1961.

*Cymbella ankobraensis* nov. spec. Pl. XIX, fig. 11.

Valvae incongruentes margine ventrali leviter convexo dorsali convexiore et apicibus obtuse rotundatis, longae 28–30  $\mu$ , latae 6  $\mu$ . Rhapshe in medio valvae fissuris polaribus versus latus ventrale deflexis et fissuris centralibus versus latus dorsale leviter deflexis. Area axiliaris admodum lata, in medio valvae non ita dilatata. Striae transapicales radiantibus, ca. 12 in 10  $\mu$ , duae mediae longiore inter se spatio; striae in latere ventrali versus apices leviter convergentes.

Holotypus: Ghana No. 166/1961.

*Cymbella dadwinensis* nov. spec. Pl. XX, fig. 3.

Valvae incongruentes lanceolatae margine ventrali convexo parva in medio valvae dilatatione, margine dorsali fortius convexo, longae 55–60  $\mu$ , latae 10–12  $\mu$ . Rhapshe

recta fissuris polaribus admodum longis versus latus ventrale deflexis, versus latus dorsale leviter deflexis fissuris centralibus. Area axiliaris anguste lanceolata nulla area centrali decisa. Striae transapicales radiantis, in latere dorsali 8, in ventrali 9 in  $10 \mu$ , manifesto lineatae.

Holotypus: Ghana No. 147/1961.

*Cymbella moragoensis* nov. spec. Pl. XX, fig. 9.

Valvae incongruentes margine ventrali leviter convexo, dorsali fortiter convexo et apicibus leviter protractis admodum acutis, longae  $25-30 \mu$ , latae  $9-10 \mu$ . Rhapshe leviter curvata prope ab margine ventrali, fissuris polaribus versus latus ventrale deflexis, centralibus versus latus dorsale leviter curvatis. Area axiliaris admodum angusta nulla area centrali decisa. Striae transapicales fortiter radiantis, ca. 9 in  $10 \mu$ , manifesto lineatae.

Holotypus: Ghana No. 268/1961.

*Cymbella tainensis* nov. spec. Pl. XX, fig. 4.

Valvae incongruenter lanceolatae naviculoides margine ventrali convexo, dorsali paulo fortius convexo, longae  $38-40 \mu$ , latae  $7-8 \mu$ . Rhapshe in medio fere valvae propius marginem ventralem, recta, brevibus versus marginem dorsalem deflexis fissuris polaribus. Area axiliaris angusta linearis, longa exigua in medio valvae dilatatione. Striae transapicales radiantis, 15 in  $10 \mu$ , manifesto punctatae (striis longitudinalibus). Holotypus: Ghana No. 215/1961.

*Cymbella takoradiensis* nov. spec. Pl. XX, fig. 5.

Valvae incongruentes lanceolatae, recto fere (leviter convexo) margine ventrali, convexo dorsali, longae  $40-45 \mu$ , latae  $5-7 \mu$ . Rhapshe fere recta in medio paene valvae posita fissuris polaribus brevibus versus latus dorsale deflexis. Area axiliaris anguste lanceolata nulla area centrali separatim dilatata. Striae transapicales radiantis, 15 in  $10 \mu$ , in latere ventrali versus apices leviter convergentes.

Holotypus: Ghana No. 114/1961.

*Gomphonema suhmii* nov. spec. Pl. XXI, fig. 1.

Valvae cuneiformes polo superiore lato, versus inferiorem admodum fortiter attenuatae, polo superiori cuneiformiter rotundato, longae  $45-55 \mu$ , latae  $6-8 \mu$ . Exigua inter medium valvae et polum superiorem dilatatio transapicalis. Area axiliaris lata, ca.  $\frac{1}{3}$  latitudinis valvae, leviter in medio valvae in longitudinem dilatata. Striae transapicales radiantis, 15 in  $10 \mu$ , 1-2 striis hyalinibus longitudinalibus manifestis.

Holotypus: Ghana No. 294/1961.

*Gomphonema wulasiense* nov. spec. Pl. XXI, fig. 7.

Valvae clavaformes polo superiori obtusiore inferiorem paulo angustiore a medio sensim attenuatae, longae  $15-20 \mu$ , latae  $4.7 \mu$ . Area axiliaris angustissima, centralis rotundata,

ca.  $\frac{1}{2}$  latitudinis valvae. Striae transapicales radiantes, ca. 20 in  $10 \mu$ , cum 3–4 striis hyalinibus longitudinalibus.

Holotypus: Ghana No. 287/1961.

*Gomphonema wulasiense* var. *nunguaensis* nov. var. Pl. XXI, fig. 9.

Valvis ovo-clavaformibus a var. *wulasiense* different. Striae transapicales 22–24 in  $10 \mu$ , densius quam apud var. *congestae*.

Holotypus: Ghana No. 33/1961.

*Gomphonema wulasiense* var. *voltaensis* nov. spec. Pl. XXI, fig. 8.

Valvis late cuneiformibus et prope polum superiorem et prope inferiorem cuneiformiter acutis a var. *wulasiense* differt.

Holotypus: Ghana No. 293/1961.

*Nitzschia amisaensis* nov. spec. Pl. XXI, fig. 15.

Valvae late lineares lateribus fere parallelis et apicibus breviter protractis, longae 30–35  $\mu$ , latae 5–6  $\mu$ . Carina fortiter excentrica. Puncta carinae 11–12 in  $10 \mu$  duabus mediis maiore inter se spatio. Striae transapicales 24 in  $10 \mu$ , subtiliter punctatae.

Holotypus: Ghana No. 111/1961.

*Nitzschia mankesimensis* nov. spec. Pl. XXI, fig. 17.

Valvae late lineares lateribus parallelis et apicibus breviter protractis acute rotundatis, longae 40–45  $\mu$ , latae 8  $\mu$ . Carina fortiter excentrica. Puncta carinae 8–9 in  $10 \mu$ . Striae transapicales 15 in  $10 \mu$ .

Holotypus: Ghana No. 112/1961.

*Nitzschia nunguaensis* nov. spec. Pl. XXI, fig. 16.

Valvae late lineares lateribus parallelis et apicibus capitatis breviter protractis, longae 30–35  $\mu$ , latae 7–8  $\mu$ . Carina fortiter excentrica. Puncta carinae 6–8 in  $10 \mu$ . Striae transapicales 18–19 in  $10 \mu$ .

Holotypus: Ghana No. 33/1961.

*Nitzschia syrachii* nov. spec. Pl. XXII, fig. 12.

Valvae lanceolatae, in medio lateris dorsalis aliquid contractae, apicibus leviter protractis, longae 30–40  $\mu$ , latae 5–6  $\mu$ . Carina excentrica. Puncta carinae rotundata admodum fortia, 12 in  $10 \mu$ , duobus mediis maiore inter se spatio. Striae transapicales non visibiles.

Holotypus: Ghana No. 114/1961.

*Nitzschia aketechiensis* nov. spec. Pl. XXII, fig. 2.

Valvae elliptico-lanceolatae apicibus late protractis et recte decisis, longae 45–50  $\mu$ , latae 7–8  $\mu$ . Carina excentrica. Puncta carinae lineata fortia, 5–6 in 10  $\mu$ . Striae transapicales 30–34 in 10  $\mu$  striis longitudinalibus undulatis.

Holotypus: Ghana No. 136/1961.

*Nitzschia bansoensis* nov. spec. Pl. XXII, fig. 4.

Valvae lanceolatae apicibus aliquid protractis leviter capitatis, longae 40–45  $\mu$ , latae 4  $\mu$ . Carina angusta excentrica. Puncta carinae 11 in 10  $\mu$ , admodum parva rotundata. Striae transapicales 15 in 10  $\mu$ .

Holotypus: Ghana No. 144/1961.

*Nitzschia lawsonii* nov. spec. Pl. XXII, fig. 13.

Valvae lineares latere carinae leviter concavo apicibus non protractis obtuse rotundatis, longae 90–100  $\mu$ , latae 8  $\mu$ . Carina excentrica. Puncta carinae 6 in 10  $\mu$ , fortia. Striae transapicales 28–30 in 10  $\mu$ .

Holotypus: Ghana No. 112/1961.

*Nitzschia nagbogensis* nov. spec. Pl. XXII, fig. 6.

Valvae lineares lateribus parallelis et apicibus capitatis, longae 40–45  $\mu$ , latae 4–5  $\mu$ . Carina excentrica, puncta carinae 9–10 in 10  $\mu$ , lineata. Striae transapicales non visibiles.

Holotypus: Ghana No. 279/1961.

*Nitzschia tonoensis* nov. spec. Pl. XXIII, fig. 5.

Valvae linear-lanceolatae apicibus capitatis admodum protractis, longae 90–95  $\mu$ , latae 8–9  $\mu$ . Carina excentrica. Puncta carinae 7–8 in 10  $\mu$ , duobus mediis maiore inter se spatio. Striae transapicales 18 in 10  $\mu$ , subtiliter punctatae.

Holotypus: Ghana No. 252/1961.

*Nitzschia vedelii* nov. spec. Pl. XXII, fig. 5.

Valvae lanceolatae apicibus capitatis longe et anguste protractis, longae 40–45  $\mu$ , latae 4–5  $\mu$ . Carina angusta excentrica. Puncta carinae 11–12 in 10  $\mu$ , parva rotundata. Striae transapicales 12–13 in 10  $\mu$ .

Holotypus: Ghana No. 135/1961.

*Nitzschia abonensis* nov. spec. Pl. XXII, fig. 8.

Valvae lineares lateribus parallelis versus apices paulum modo attenuatae et apicibus obtuse rotundatis, longae 25–30  $\mu$ , latae 2.5–3.0  $\mu$ . Carina excentrica. Puncta carinae 9–10 in 10  $\mu$  admodum parva. Striae transapicales non visibiles.

Holotypus: Ghana No. 194/1961.

*Nitzschia ankobraensis* nov. spec. Pl. XXI, fig. 13.

Valvae late lineares lateribus parallelis et apicibus capitatis, longae 20–25  $\mu$ , latae 5–6  $\mu$ . Carina valde excentrica. Puncta carinae 8–9 in 10  $\mu$ . Striae transapicales fortes, 24–26 in 10  $\mu$ , subtiliter punctatae.

Holotypus: Ghana No. 205/1961.

*Nitzschia apropongensis* nov. spec. Pl. XXIV, fig. 13.

Valvae late lineares lateribus parallelis et apicibus protractis, longae 20–25  $\mu$ , latae 5–6  $\mu$ . Carina lata excentrica. Puncta carinae 6 in 10  $\mu$ , irregularia rotundata. Striae transapicales 28–30 in 10  $\mu$ .

Holotypus: Ghana No. 203/1961.

*Nitzschia bosumtwiensis* nov. spec. Pl. XXIII, fig. 13.

Valvae lineares lateribus parallelis et apicibus sensim rotundatis, longae 40–45  $\mu$ , latae 3–4  $\mu$ . Carina excentrica. Puncta carinae 11 in 10  $\mu$ , admodum fortia. Striae transapicales non visibiles.

Holotypus: Ghana No. 189/1961.

*Nitzschia chuchiligaensis* nov. spec. Pl. XXIV, fig. 8.

Valvae lineares lateribus fere parallelis (leviter concavis), et apicibus protractis obtuse rotundatis, longae 25–30  $\mu$ , latae 4  $\mu$ . Carina excentrica. Puncta carinae 7–8 in 10  $\mu$ , fortia, maiore inter duo media spatio. Striae transapicales non visibiles.

Holotypus: Ghana No. 254/1961.

*Nitzschia dadwinensis* nov. spec. Pl. XXIII, fig. 10.

Valvae lineares lateribus parallelis et apicibus sensim late attenuatis, longae 45–50  $\mu$ , latae 3–4  $\mu$ . Carina excentrica. Puncta carinae 7 in 10  $\mu$  diversa magnitudine et vario spatio. Striae transapicales non visibiles.

Holotypus: Ghana No. 149/1961.

*Nitzschia densuensis* nov. spec. Pl. XXIV, fig. 9.

Valvae lanceolatae apicibus breviter productis, longae 26  $\mu$ , latae 4–5  $\mu$ . Carina excentrica. Puncta carinae fortissima, 9 in 10  $\mu$ . Striae transapicales 30–34 in 10  $\mu$ , subtiliter sed manifesto punctatae (lineatae).

Holotypus: Ghana No. 73/1961.

*Nitzschia huniensis* nov. spec. Pl. XXIV, fig. 17.

Valvae lineares lateribus fere parallelis et apicibus late productis obtuse rotundatis, longae 12–15  $\mu$ , latae 2.0–2.5  $\mu$ . Carina excentrica. Puncta carinae 9 in 10  $\mu$ , parva, irregulariter distantia. Striae transapicales non visibiles.

Holotypus: Ghana No. 157/1961.

*Nitzschia krachiensis* nov. spec. Pl. XXIV, fig. 1.

Valvae anguste lanceolatae apicibus acutis sensim attenuatis, longae 35–40  $\mu$ , latae 2.5–3.0  $\mu$ . Carina angusta excentrica. Puncta carinae 11 in 10  $\mu$ , parva. Striae transapicales 22 in 10  $\mu$ .

Holotypus: Ghana No. 293/1961.

*Nitzschia mamataensis* nov. spec. Pl. XXII, fig. 10.

Valvae anguste lineares lateribus parallelis et apicibus sensim obtuse rotundatis, longae 50–55  $\mu$ , latae 3–4  $\mu$ . Carina excentrica. Puncta carinae 11–12 in 10  $\mu$ , admodum parva. Striae transapicales non visibiles.

Holotypus: Ghana No. 291/1961.

*Nitzschia ofinensis* nov. spec. Pl. XXIV, fig. 12.

Valvae late lanceolatae apicibus acutis, longae 15–16  $\mu$ , latae 4  $\mu$ . Carina angusta excentrica. Puncta carinae 12 in 10  $\mu$ , maiore inter duo media spatio. Striae transapicales 24 in 10  $\mu$ .

Holotypus: Ghana No. 186/1961.

*Nitzschia sakaensis* nov. spec. Pl. XXIV, fig. 16.

Valvae linear-lanceolatae apicibus late rotundatis, longae 20–25  $\mu$ , latae 4  $\mu$ . Carina angusta excentrica. Puncta carinae 7 in 10  $\mu$ . Striae transapicales 20–21 in 10  $\mu$ .

Holotypus: Ghana No. 266/1961.

*Nitzschia sansomei* nov. spec. Pl. XXIII, fig. 4.

Valvae lineares lateribus parallelis, versus apices rotundatos cuneiformiter attenuatae, longae 50–55  $\mu$ , latae 4–5  $\mu$ . Carina angusta excentrica. Puncta carinae 7–8 in 10  $\mu$ , admodum fortia. Striae transapicales 15–16 in 10  $\mu$ , punctatae (striis longitudinalibus).

Holotypus: Ghana No. 295/1961.

*Nitzschia schiellerupii* nov. spec. Pl. XXII, fig. 9.

Valvae linear-lanceolatae a medio versus apices obtuse rotundatos sensim attenuatae, longae 35–40  $\mu$ , latae 5–6  $\mu$ . Carina angusta excentrica. Puncta carinae 7 in 10  $\mu$ , admodum fortia. Striae transapicales 21–22 in 10  $\mu$ .

Holotypus: Ghana No. 296/1961.

*Nitzschia svedstrupii* nov. spec. Pl. XXII, fig. 14.

Valvae late lineares lateribus leviter concavis et apicibus breviter protractis, longae 20–25  $\mu$ , latae 4–5  $\mu$ . Carina excentrica. Puncta carinae 7 in 10  $\mu$ , fortia. Striae transapicales non visibiles.

Holotypus: Ghana No. 204/1961.



*Nitzschia tainensis* nov. spec. Pl. XXIII, fig. 14.

Valvae lineares lateribus fere parallelis, versus apices cuneiformiter attenuatae, longae 20–25  $\mu$ , latae 3–4  $\mu$ . Carina excentrica. Puncta carinae 7–8 in 10  $\mu$ , admodum fortia. Striae transapicales 14–15 in 10  $\mu$ , crasse punctatae.

Holotypus: Ghana No. 216/1961.

*Nitzschia voltaensis* nov. spec. Pl. XXII, fig. 11.

Valvae anguste lineares lateribus parallelis et apicibus attenuatis rotundatis, longae 35–40  $\mu$ , latae 2.5–3.0  $\mu$ . Carina excentrica. Puncta carinae 10–11 in 10  $\mu$ , admodum fortia. Striae transapicales non visibiles.

Holotypus: Ghana No. 293/1961.

*Nitzschia abraensis* nov. spec. Pl. XXII, fig. 7.

Valvae lineares lateribus parallelis versus apices capitatos levissime sigmoidibus, longae 60–70  $\mu$ , latae 6–7  $\mu$ . Carina excentrica. Puncta carinae 8–9 in 10  $\mu$ , linearia. Striae transapicales non visibiles.

Holotypus: Ghana No. 123/1961.

*Nitzschia apowaensis* nov. spec. Pl. XXIV, fig. 7.

Valvae lanceolatae apicibus admodum longe et acute protractis, leviter sigmoides, longae 70  $\mu$ , latae 5–6  $\mu$ . Carina angusta excentrica. Puncta carinae 7–8 in 10  $\mu$ , admodum fortia rotundata spatiis irregularibus et maiore inter duo media distantia. Striae transapicales non visibiles.

Holotypus: Ghana No. 114/1961.

*Nitzschia adiembraensis* nov. spec. Pl. XXIV, fig. 2.

Valvae linear-lanceolatae apicibus late protractis obtuse rotundatis, leviter sigmoides, longae 35–40  $\mu$ , latae 4  $\mu$ . Carina angusta excentrica. Puncta carinae 11 in 10  $\mu$ , distantia admodum varia. Striae transapicales non visibiles.

Holotypus: Ghana No. 186/1961.

*Nitzschia ghanaensis* nov. spec. Pl. XXIV, fig. 15.

Valvae late lineares lateribus leviter concavis paulum sigmoides apicibus obtuse protractis, longae 20–25  $\mu$ , latae 4–5  $\mu$ . Carina angusta excentrica. Puncta carinae 10–11 in 10  $\mu$ , parva rotundata maiore inter duo media spatio. Striae transapicales subtilissimae.

Holotypus: Ghana No. 123/1961.

*Nitzschia irresoluta* Hust. fo. *minor* nov. fo. Pl. XXIV, fig. 10.

Magnitudine tantum valvae multo minore a forma *irresoluta* differt.

Holotypus: Ghana No. 136/1961.

*Nitzschia navrongensis* nov. spec. Pl. XXIII, fig. 6.

Valvae anguste lanceolatae apicibus longe protractis et fortiter attenuatis, longae 60–70  $\mu$ , latae 2.5–3.0  $\mu$ . Carina excentrica. Puncta carinae 12 in 10  $\mu$ . Striae transapicales non visibiles.

Holotypus: Ghana No. 249/1961.

*Surirella agonaensis* nov. spec. Pl. XXV, fig. 3.

Axis apicalis heteropolis. Valvae oblonge cuneiformes apicibus late rotundatis, polo superiore paulo latiore quam polo inferiore, longae 80  $\mu$ , latae 28–30  $\mu$ . Alae 15–16 in 100  $\mu$ , ad aream medialem angustam linearem prolongatae et parvis spinis enormiter distributis praeditae. Canales alarum multo latiores quam alae. Striae non manifestae.

Holotypus: Ghana No. 141/1961.

*Surirella bonsaensis* nov. spec. Pl. XXV, fig. 1.

Axis apicalis isopolis. Valvae late lineares lateribus parallelis et apicibus late rotundatis, longae 70  $\mu$ , latae 25–26  $\mu$ . Alae 22–24 in 100  $\mu$ , ad aream medialem angustam hyalinam prolongatae. Alae eadem latitudine qua canales alarum.

Holotypus: Ghana No. 151/1961.

*Surirella delicatissima* Lewis var. *ghanaensis* nov. var. Pl. XXV, fig. 9.

A. var. *delicatissima* et var. *africana* Cholnoky exiguitate et alis admodum dense congestis differt.

Holotypus: Ghana No. 204/1961.

*Surirella dodowaensis* nov. spec. Pl. XXV, fig. 6.

Axis apicalis heteropolis. Valvae ovaliter ellipticae polo superiore late rotundato, inferiore aliquid acutiore, longae 35–40  $\mu$ , latae 12–15  $\mu$ . Alae 18–20 in 100  $\mu$ , ad medium fere valvae prolongatae. Canales alarum latiores quam alae. Area angusta linearis. Striae non distinctae.

Holotypus: Ghana No. 106/1961.

*Surirella esamangensis* nov. spec. Pl. XXV, fig. 2.

Axis apicalis leviter heteropolis. Valvae lineares apicibus sensim rotundatis, longae 60  $\mu$ , latae 24  $\mu$ . Alae 24 in 100  $\mu$ , in superficiem valvae ad aream medialem admodum angustam hyalinam prolongatae. Canales alarum multo latiores quam alae. Striae non distinctae.

Holotypus: Ghana No. 144/1961.

*Surirella nagbogensis* nov. spec. Pl. XXV, fig. 7.

Axis apicalis heteropolis. Valvae oblonge ellipticae polo superiore late rotundato, inferiore aliquid angustiore, longae 40  $\mu$ , latae 13–15  $\mu$ . Alae 35 in 100  $\mu$ , angustae

ad medium fere superficiei valvae prolongatae. Canales alarum multo latiores quam alae. Area linearis angusta. Striae subtilissimae.

Holotypus: Ghana No. 279/1961.

*Surirella sorriensis* nov. spec. Pl. XXV, fig. 8.

Axis apicalis heteropolis. Valvae ovales polo superiore late rotundato, inferiore paulo angustiore, longae 35–40  $\mu$ , latae 18  $\mu$ . Alae 30–35 in 100  $\mu$ , ad aream hyalinam ca.  $\frac{1}{4}$  latitudinis valvae ascendentes. Canales alarum angustissimae. Striae non distinctae.

Holotypus: Ghana No. 223/1961.

*Surirella takoradiensis* nov. spec. Pl. XXV, fig. 4.

Axis apicalis heteropolis. Valvae ovaliter ellipticae polo superiore late rotundato, inferiore aliquid angustiores, longae 20–25  $\mu$ , latae 7–8  $\mu$ . Alae 60–65 in 100  $\mu$  brevissimae et aliquid angustiores quam canales alarum. Superficies valvae area mediali hyalina latissima, ca.  $\frac{2}{3}$  latitudinis valvae. Striae subtilissimae.

Holotypus: Ghana No. 119/1961.

*Surirella takoradiensis* var. *suhinensis* nov. var. Pl. XXV, fig. 5.

Ca. 40 alae in 100  $\mu$  a var. *takoradiensis* differt.

Holotypus: Ghana No. 218/1961.

Species novae praeparatae in collectione diatomearum NIELS FOGED, Odense, Danmark, exstant.

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Indleveret til Selskabet den 10. september 1964.  
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**PLATES**

PLATE I.

- Fig. 1. *Cyclotella stelligeroides* Hust.  
2. — *pseudostelligera* Hust.  
3. — *stelligera* Cleve & Grun.  
4, 8. — *meneghiniana* Kütz.  
5. *Melosira ikapöensis* O. Müller var. *minor* Chohnoky.  
6. — *herzogi* Lemmermann.  
7. *Cyclotella kützingiana* Thwaites fo. *minor* Hust.  
9. *Fragilaria pinnatoides* Chohnoky.  
10. — *leptostauron* (Ehr.) Hust. var. *dubia* Grun. forma.  
11. *Synedra montana* Krasske.  
12, 13. — *rumpens* Kütz. var. *fragilarioides* Grun.  
14. *Eunotia asymmetrica* Chohnoky.  
15. — *rabenhorsti* Cleve & Grun. fo. *monodon* Cleve & Grun.  
16, 17. — *rhomboidea* Hust.  
18, 19. — *tschirchiana* O. Müller.  
20. — *trigibba* Hust.

Scales 10  $\mu$ .

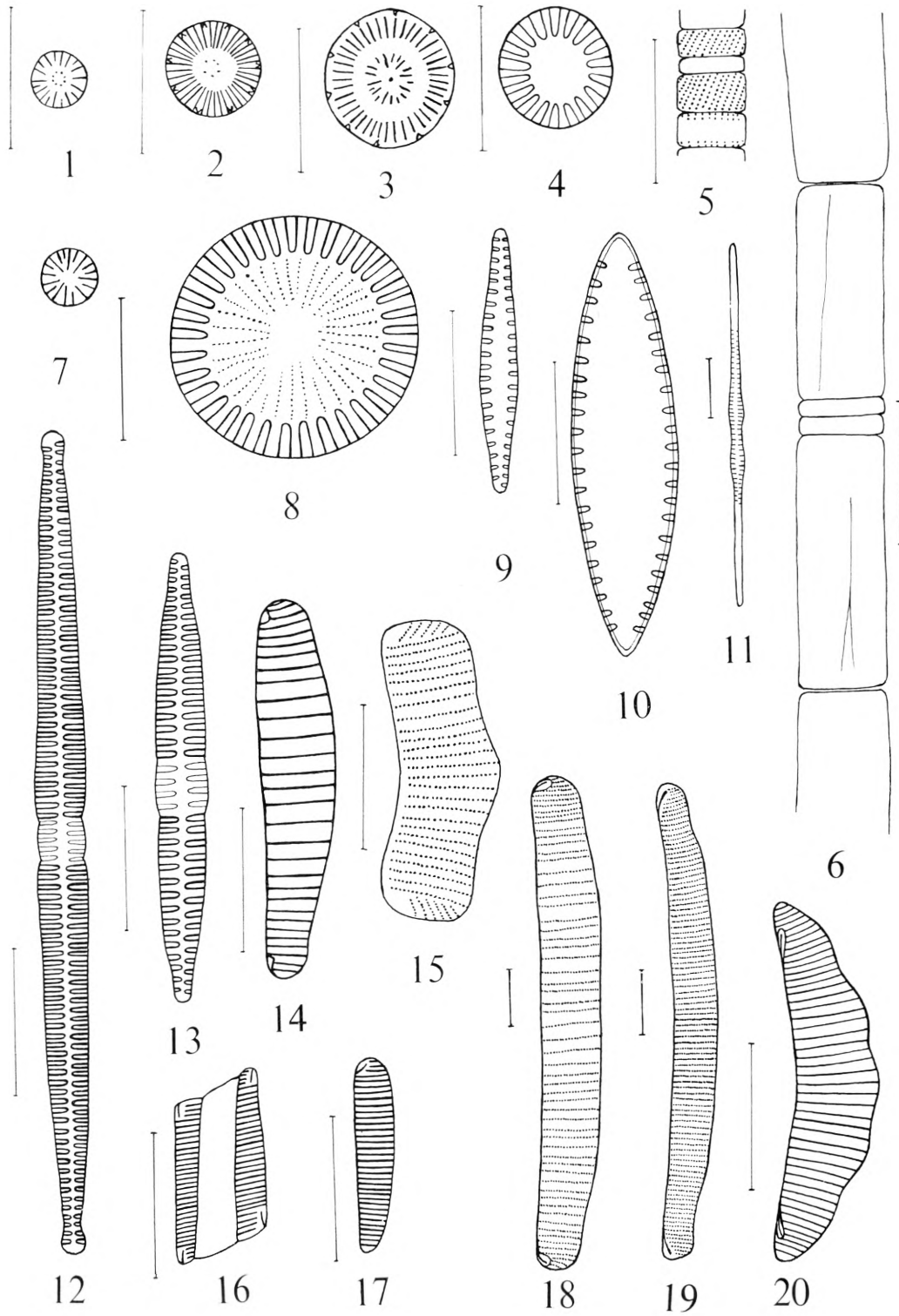


PLATE II.

- Fig. 1. *Eunotia monodon* Ehr. var. *bidens* (Greg.) W. Smith.  
2. — *didyma* Grun. fo. *genuina* Hust.  
3. — — var. *tuberosa* Hust.  
4. — *mansiensis* nov. spec.  
5, 6, 7. — *tarkwaensis* nov. spec.  
8. — *epithemioides* Hust.  
9. — *tanosoensis* nov. spec.

Scales 10  $\mu$ .

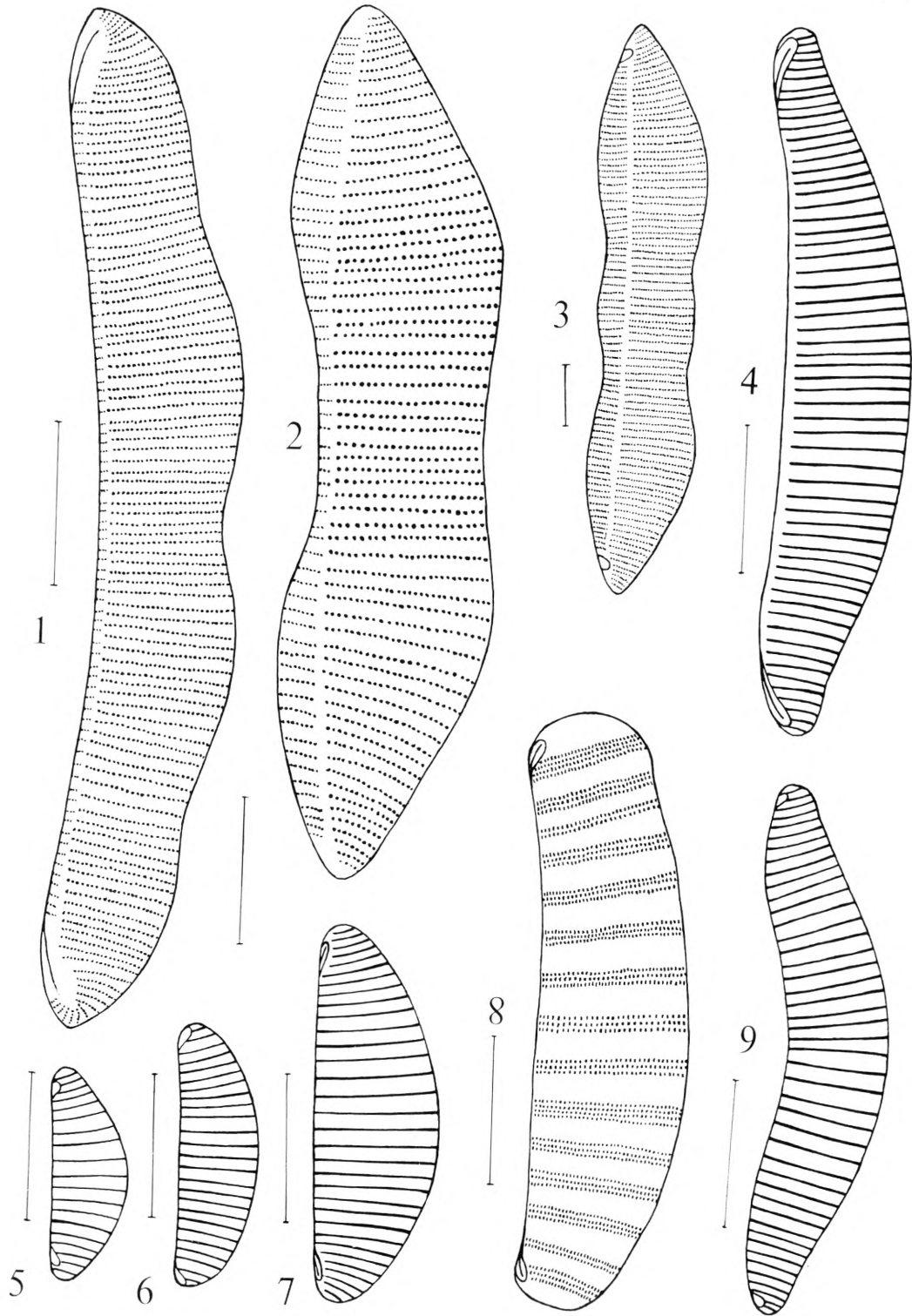


PLATE III.

- Fig. 1. *Eunotia gracilis* (Ehr.) Rabenh.  
2. — *flexuosa* (Bréb.) Kütz.  
3. — *lunaris* (Ehr.) Grun.  
4. — *garussica* Chohnoky.  
5. — *oliffii* Chohnoky.  
6. — *diodon* Ehr.  
7. — *bonsaensis* nov. spc.  
8. — *sorriensis* nov. spec.  
9. — *vumbae* Chohnoky.  
10. — *similis* Hust.  
11. — *hugenottarum* Chohnoky.  
12. — *lawsonii* nov. spec.  
13. — *asterionelloides* Hust.  
14 a, b. 15 a, b. *Achnanthes pinnata* Hust.

Scales 10  $\mu$ .



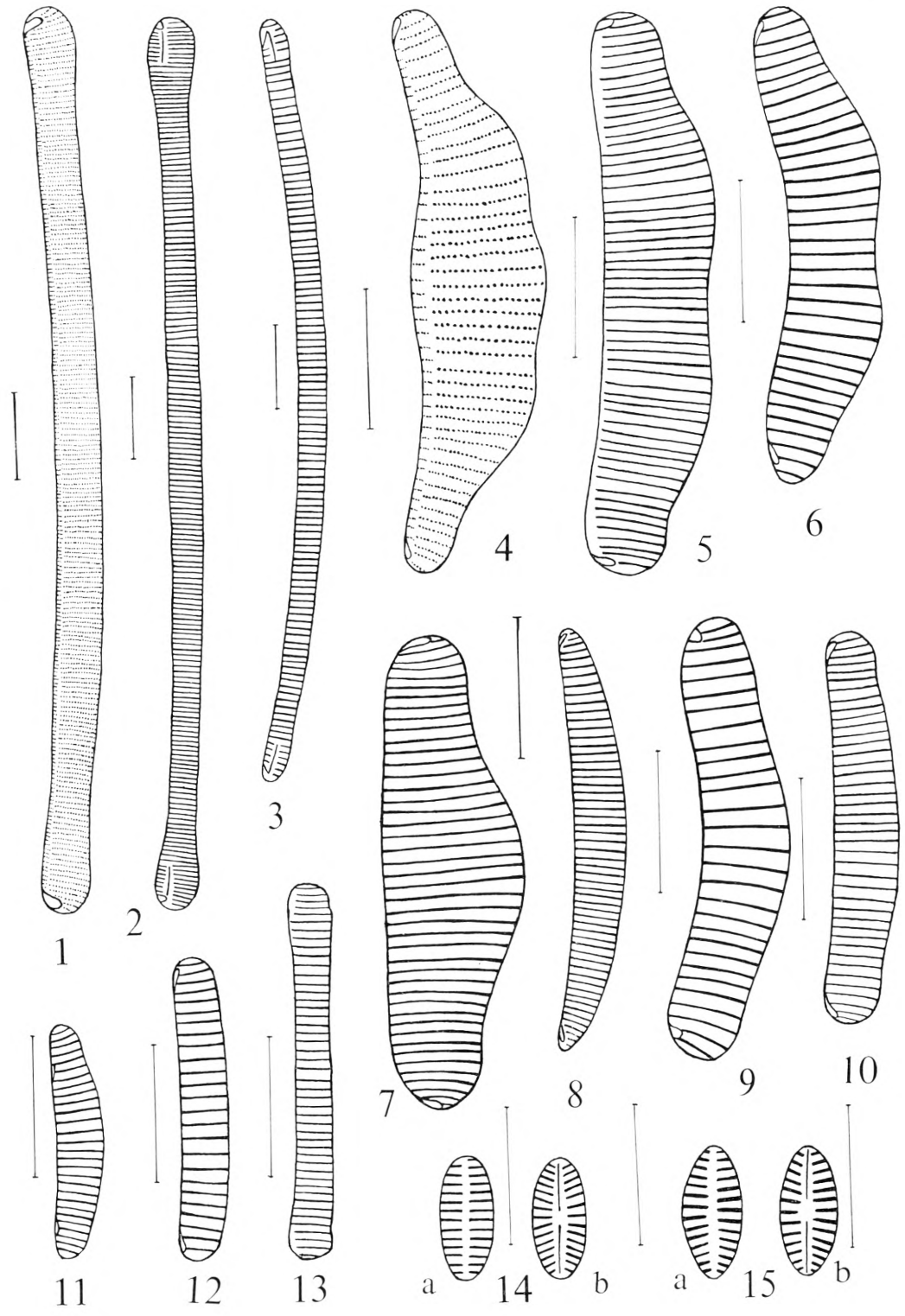


PLATE IV.

- Fig. 1 a, b. 2 a, b. *Achnanthes subhudsonis* Hust.  
3 a, b. — *mansiensis* nov. spec.  
4 a, b. *Cocconeis subdirupta* Cholnoky.  
5 a, b. 6 a, b. *Achnanthes kraeuselii* Cholnoky.  
7 a, b. *Cocconeis schröderii* nov. spec.  
8 a, b. — *ankobraensis* nov. spec.  
9. *Diploneis pseudovalis* Hust.  
10. — *subovalis* Cleve.  
11 a, b. *Cocconeis feuerborni* Hust.  
12. — sp. (rapheless valve).  
13. — sp. (rapheless valve).  
Scales 10  $\mu$ .

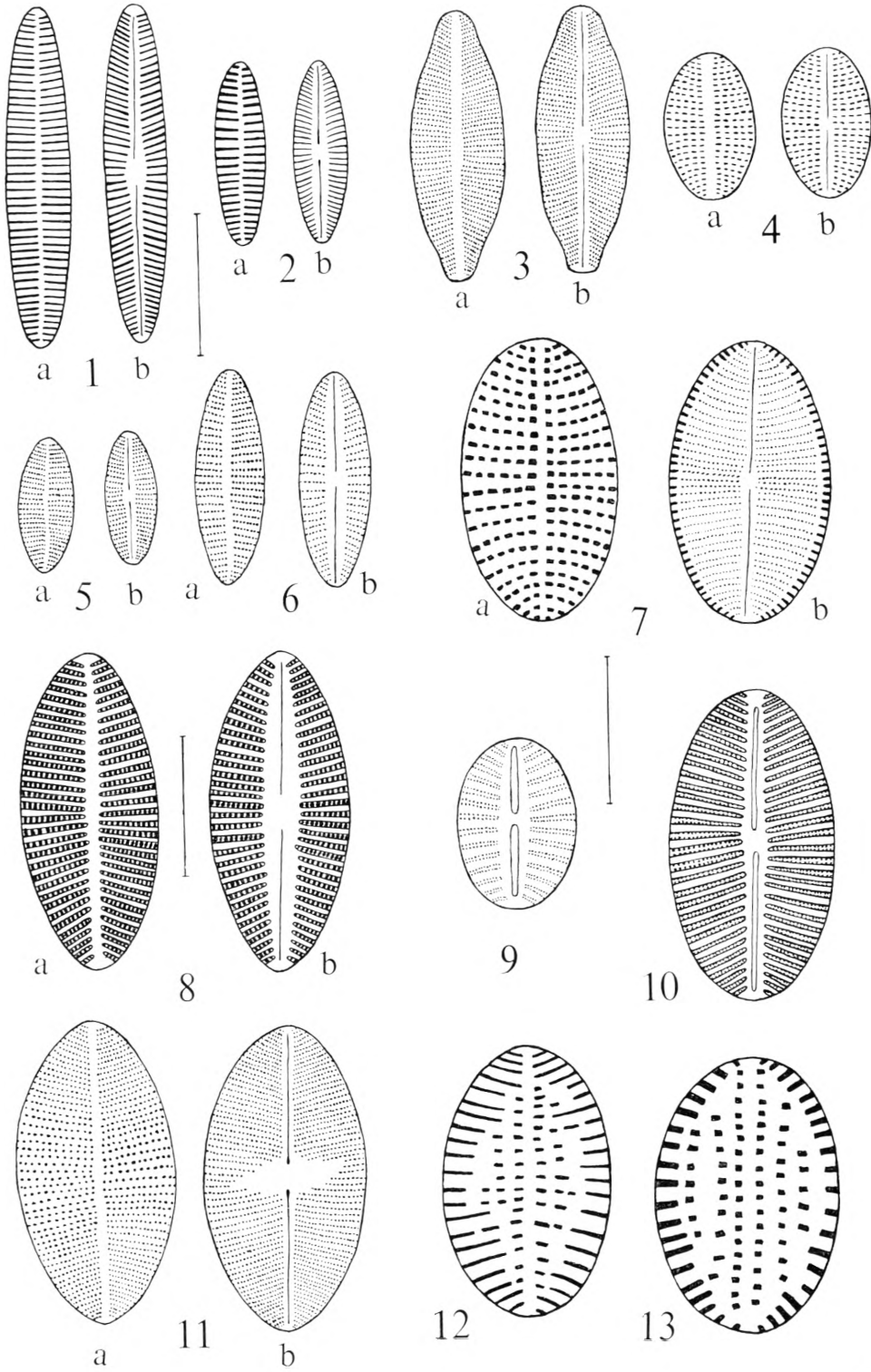


PLATE V.

- Fig. 1. *Frustulia weinholdi* Hust. fo. *ghanaensis* nov. f.  
2, 3, 6. *Caloneis incognita* Hust.  
4. — *voltaensis* nov. spec.  
5. — — var. *tarkwaensis* nov. var.  
7. — *fasciata* (Lagerst.) Cleve.  
8. — *aequatorialis* Hust.  
9. — *sansomei* nov. spec.  
10. — *desertorum* Hust.

Scale 10  $\mu$ .

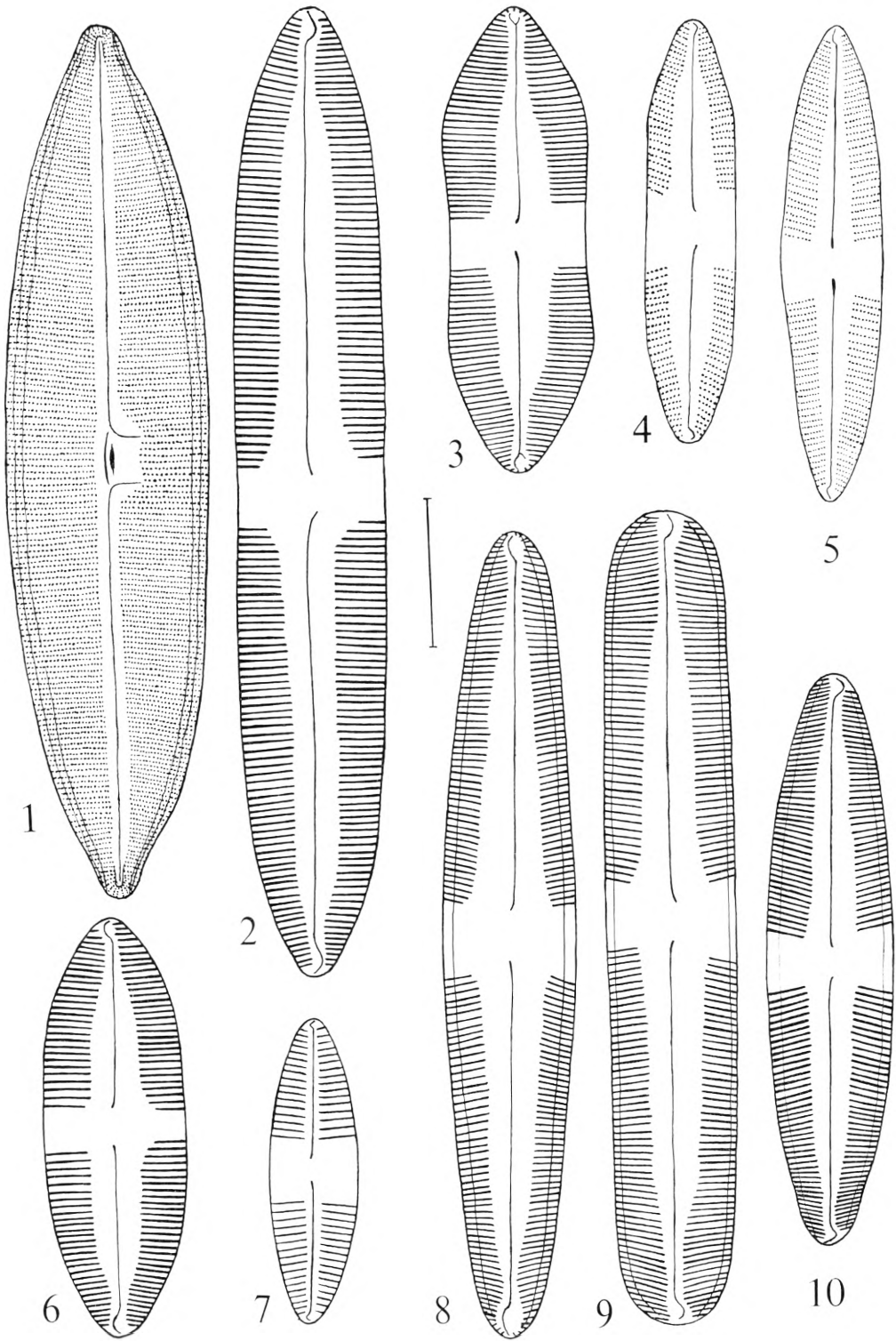


PLATE VI.

- Fig. 1. *Caloneis vehemens* Cholnoky.  
2. — *schroederi* Hust.  
3. — *macedonica* Hust.  
4. — *beccariana* (Grun.) Cleve.  
5. *Neidium affine* (Ehr.) Cleve var. *bonsaensis* nov. var.  
6. — *hercynicum* A. Mayer fo. *bogosoensis* nov. fo.  
7. — *dayiense* nov. spec.  
8. — *kumasiense* nov. spec.  
9. — *bisulcatum* (Lagerst.) Cleve var. *baicalensis* (Skvortzow & Meyer) Reimer.  
10. — *minutissimum* Krasske.  
11. — *agonaense* nov. spec.  
12. — *nsuaemense* nov. spec.  
13. — *alpinum* Hust.

Scales 10  $\mu$

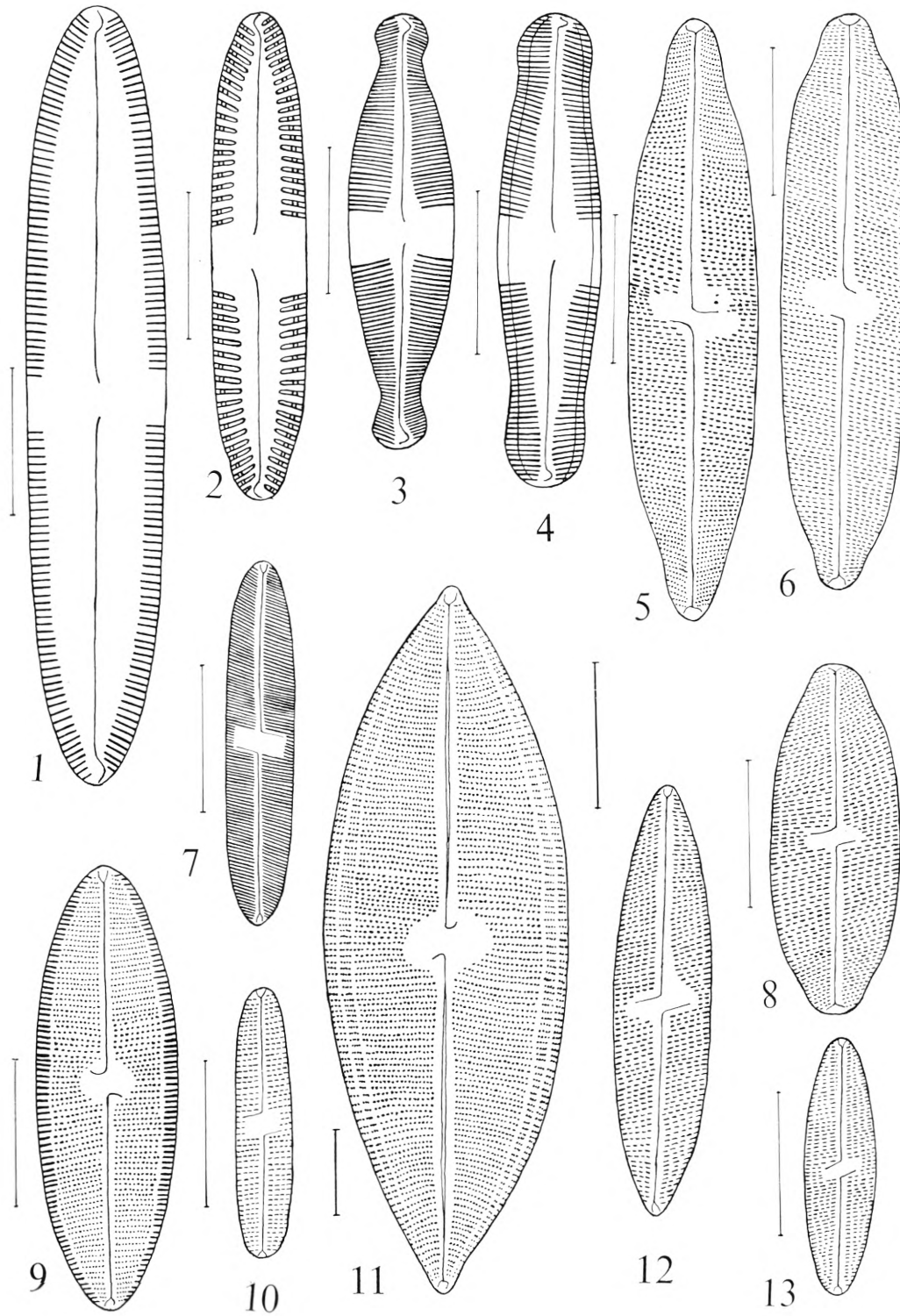




PLATE VII.

- Fig. 1. *Neidium gracile* Hust. fo. *aequalis* Hust.  
2. *Stauroneis akrosoensis* nov. spec.  
3. — *slateri* nov. spec.  
4, 5, 6, 7. — *crucicula* (Grun.) Cleve.  
8, 11. — *borrichii* (Petersen) Lund.  
9. — *subdahomensis* Guerneur.  
10. — *wislouchii* Poretzky & Anisimowa.  
12. — *navrongensis* nov. spec.  
13. — *obtusa* Lagerst.  
14. — *schinzii* (Brun) Cleve.  
15. — *kriegeri* Patrick.  
16. — *tropicalis* Guerneur var. *undulata* Guerneur.

Scales 10  $\mu$ .

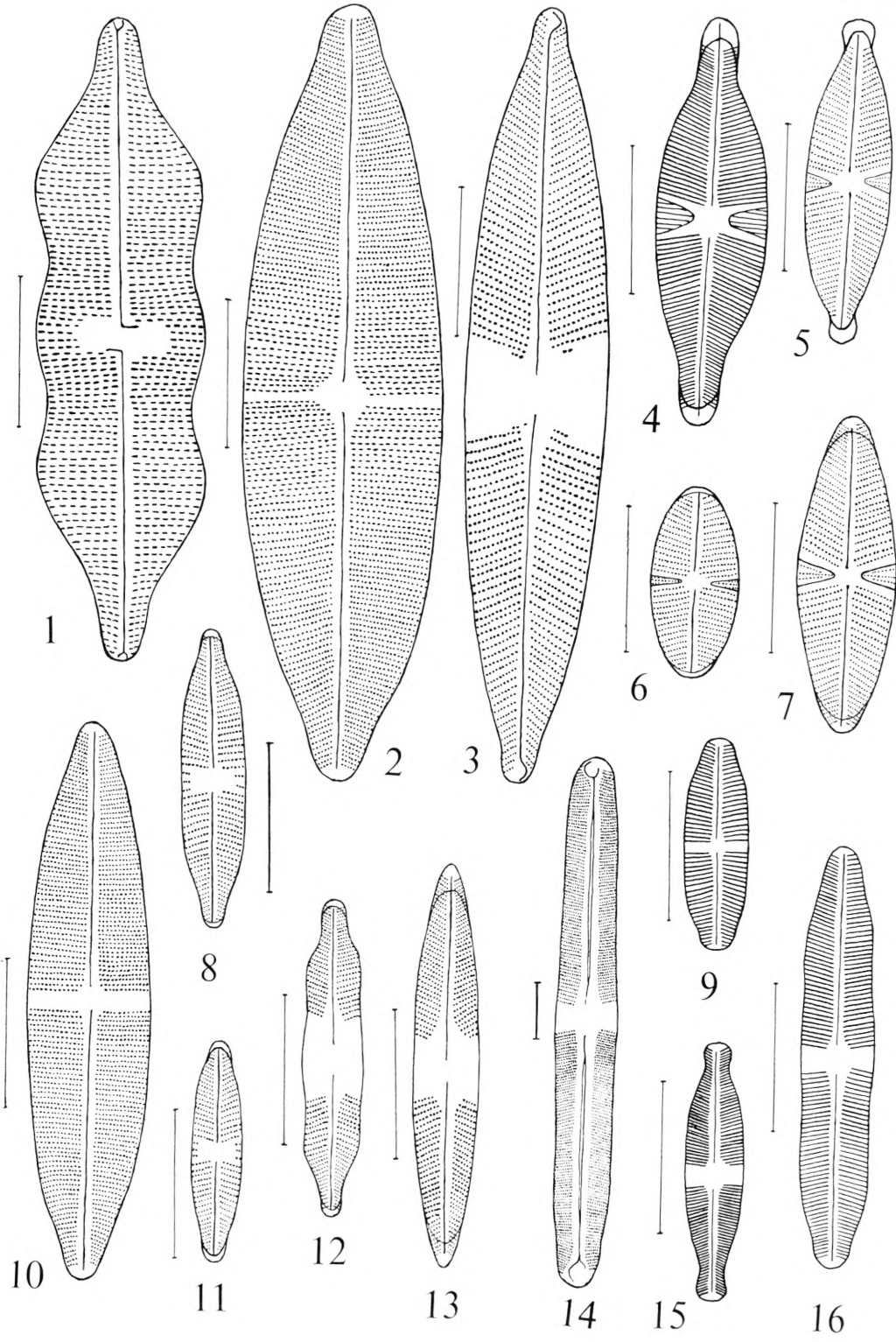


PLATE VIII.

- Fig. 1. *Stauroneis spicula* Hickie.  
2. *Anomoeoneis sphaerophora* (Kütz.) Pfitzer var. *güntheri* O. Müller.  
3. — — forma (ca. 1040 ×).  
4. *Navicula halophila* (Grun.) Cleve.  
5, 6. — — formae.  
7. — — fo. *tenuirostris* Hust.  
8. — — var. *subcapitata* Østrup.  
9. — — fo. *nabogoensis* nov. fo.  
10. — *ankobraensis* nov. spec.  
11. — *kwamkuji* Hust.  
12. — *standeri* Chohnoky.  
13. — *tridentula* Krasske.  
14. — *tridentulaeformis* Bourelly.  
15. — *contenta* Grun. fo. *biceps* Arnott.  
16. — *voltaensis* nov. spec.  
17. — *bella* Hust.?.  
18. — *perlucida* Hust.  
19. — *invicta* Hust.  
20. — *esamangensis* nov. spec.

Scale 10  $\mu$ .

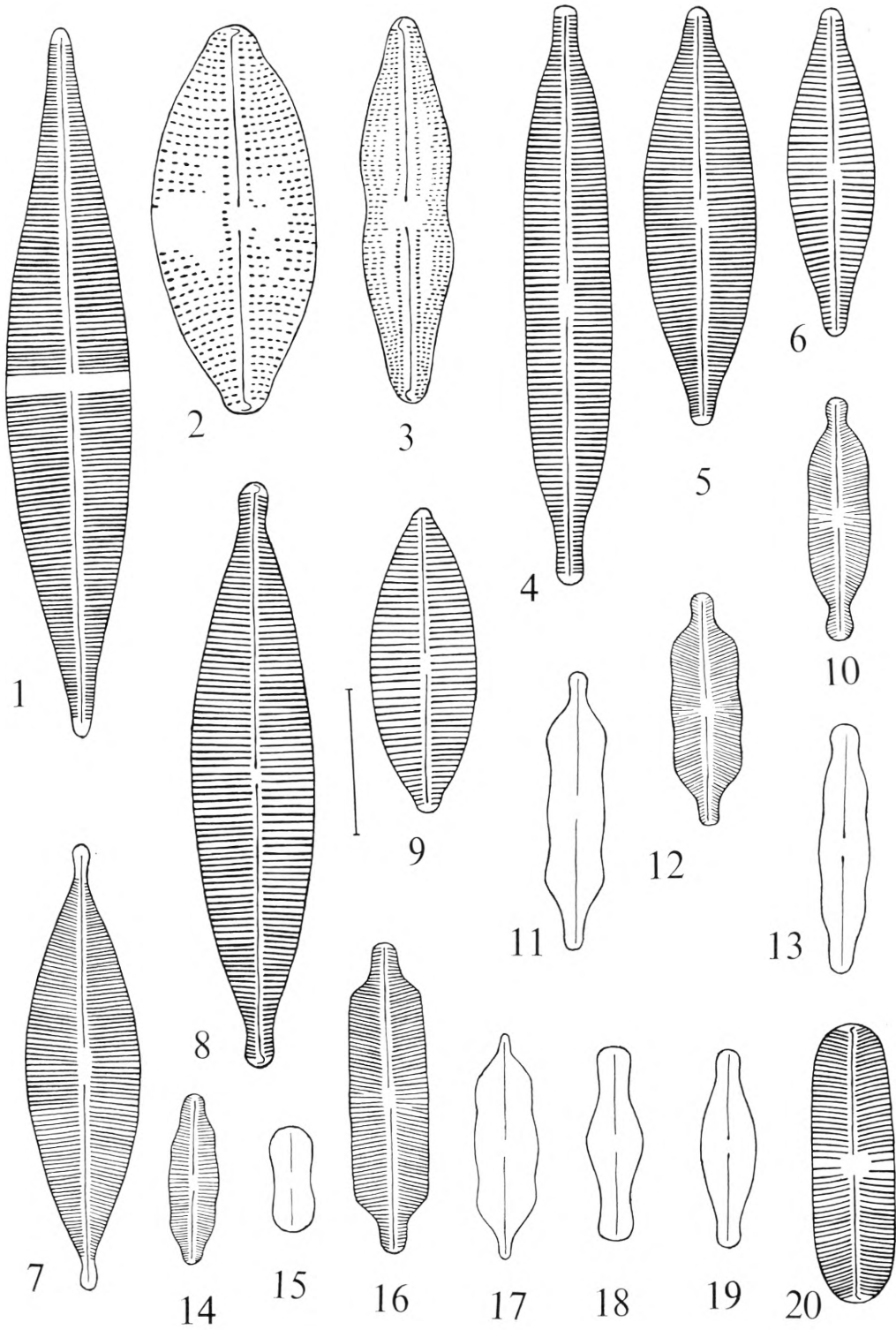


PLATE IX.

- Fig. 1, 2. *Navicula ajenaensis* nov. spec.  
3. — *helensis* Schulz.  
4. — *kriegeri* Krasske.  
5. — *demissa* Hust.  
6. — *omissa* Hust.  
7. — *modica* Hust.  
8. — *thienemanni* Hust.  
9. — *ventralis* Krasske.  
10. — *schadei* Krasske.  
11. — *butrensis* nov. spec.  
12. — *sansomei* nov. spec.  
13. — *vitabunda* Hust.  
14, 15. — *nyassensis* O. Müller.  
16, 17. — *platycephala* O. Müller.  
18. — — forma.  
19. — *bosumtwiensis* nov. spec.  
Scale 10  $\mu$ .

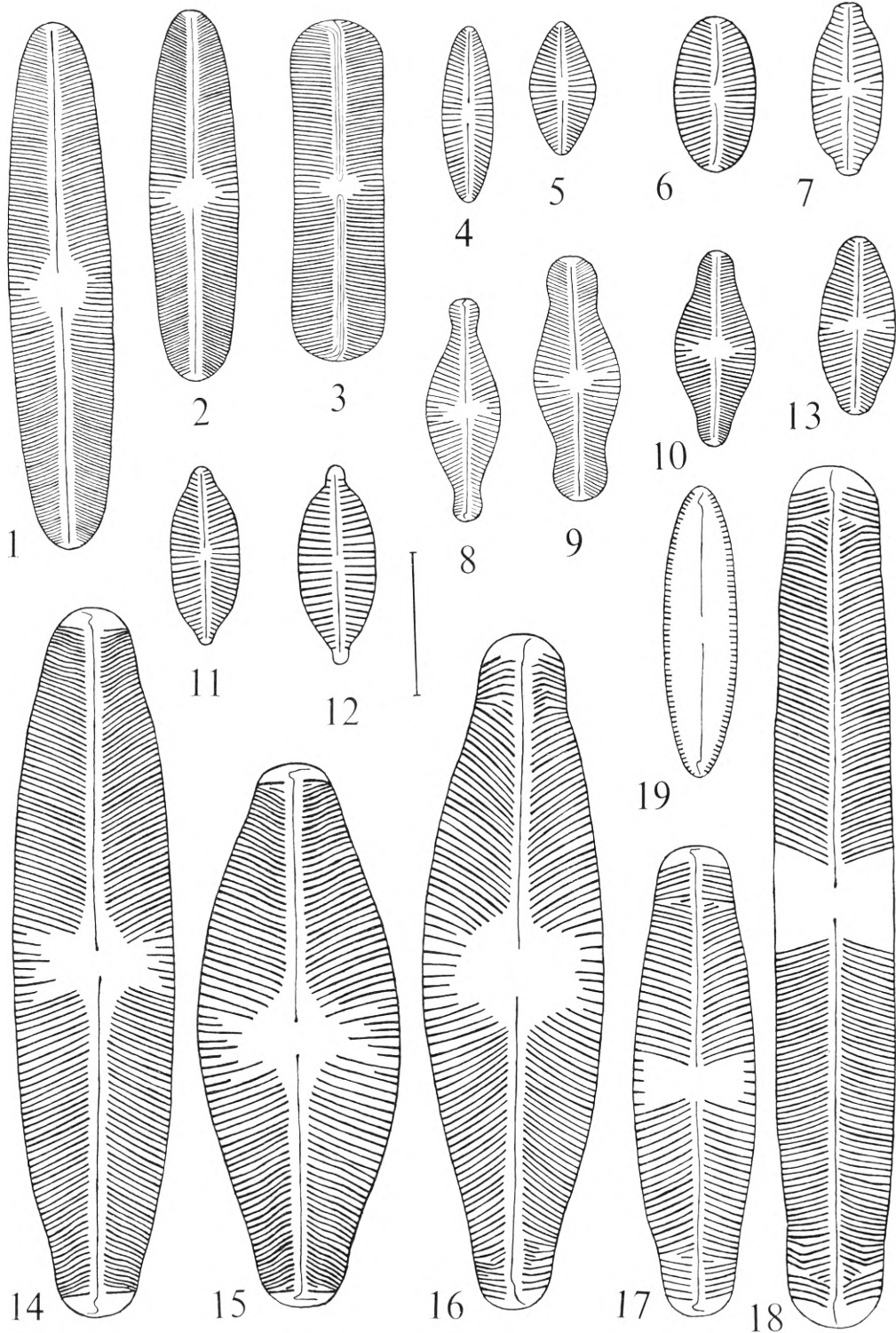


PLATE X.

- Fig. 1. *Navicula huniensis* nov. spec.  
2, 3. — *submolesta* Hust.?.  
4. — *submolesta* Hust.  
5. — *nunguaensis* nov. spec.  
6. — *lawsonii* nov. spec.  
7. — *consentanea* Hust.  
8, 9, 10. — *seminulum* Grun.  
11. — *tantula* Hust.(?).  
12, 13, 14. — *seminuloides* Hust.  
15. — sp.  
16. — *rotunda* Hust.  
17. — *seminuloides* Hust.  
18. — *pseudofaceta* Guermeur.  
19. — *tranciloba* Guermeur.  
20. — *vanidica* Chlcnoky.  
21. — *subminuscula* Manguin.  
22. — *minima* Grun.  
23. — *pseudagrestis* Lund.  
24. — *iniqua* Krasske.  
25. — *dugaensis* nov. spec.  
26. — *bawdiaensis* nov. spec.  
27. — *dugaensis* nov. spec. (?).  
28. — *pseudographa* Manguin  
29. — *bamboiensis* nov. spec.  
30. — *mutica* Kütz. var. *cohnii* (Hilse) Grun.  
31. — *auriculata* Hust.  
32. — *langoraensis* nov. spec.  
33. — *aketechiensis* nov. spec.

Scale 10  $\mu$ .



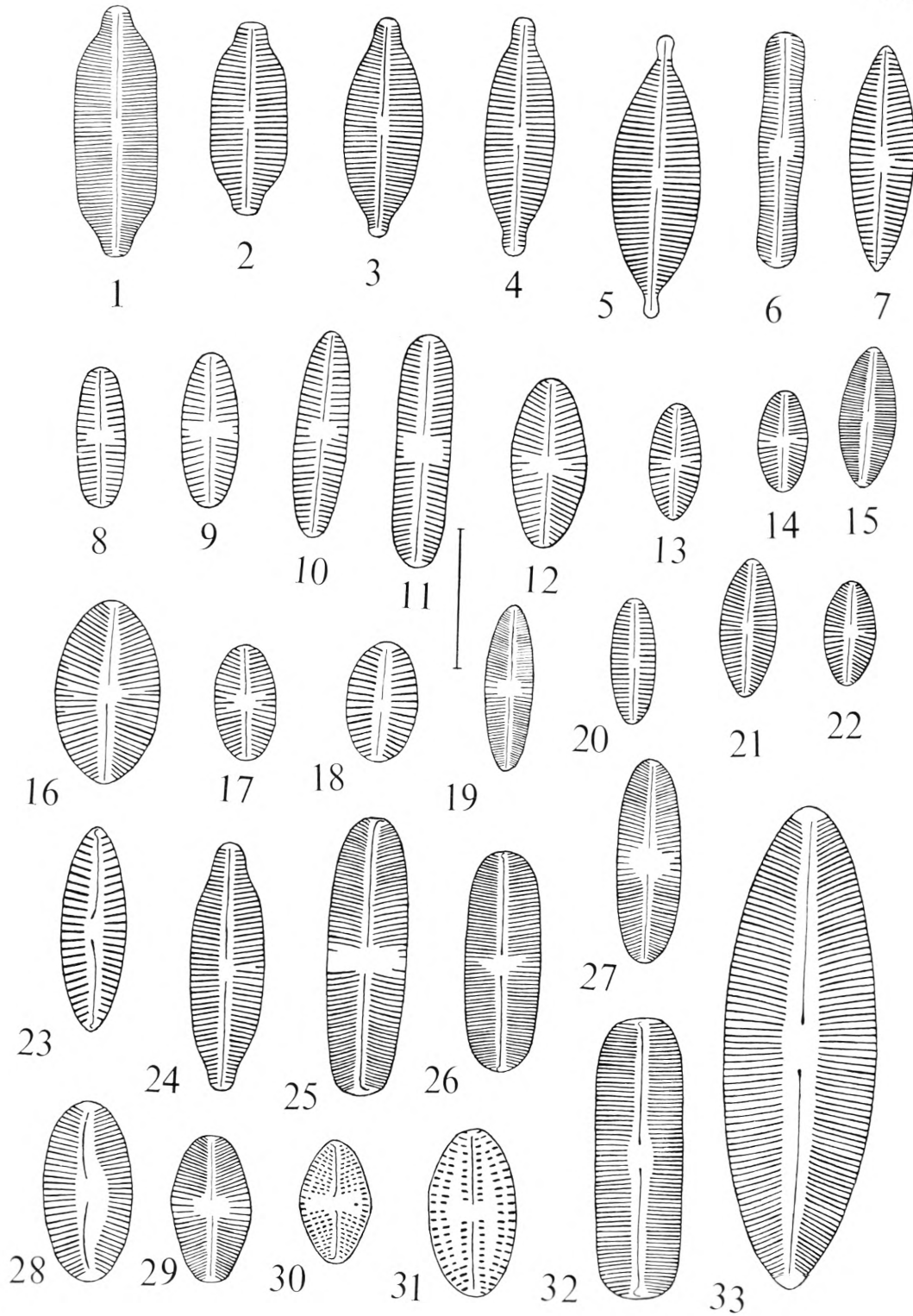


PLATE XI.

- Fig. 1. *Navicula auriculata* Hust.  
2. — *insociabilis* Krasske.  
3. — *mansiensis* nov. spec.  
4. — *abonuensis* nov. spec.  
5. — *obstinata* Krasske.  
6. — *schweickerdtii* Cholnoky.  
7. — *suecorum* Carlsson.  
8. — *lagerheimii* Cleve var. *intermedia* Hust.  
9. — *lagerheimii* Cleve.  
10, 11. — *navrongensis* nov. spec.  
12. — *pseudographa* Manguin.  
13. — *mutica* Kütz. var. *cohnii* (Hilse) Grun. forma.  
14. — *damongensis* nov. spec.  
15. — *grimmei* Krasske.  
16. — *ancisa* Hust.  
17. — *fawumangensis* nov. spec.  
18, 21. — *nsutaensis* nov. spec.  
19. — *mutica* Kütz. var. *cohnii* (Hilse) Grun. forma.  
20. — *inserata* Hust. var. *undulata* Hust.  
22. — *abelioensis* nov. spec.  
23. — *bertelsenii* nov. spec.  
24. — *syrachii* nov. spec.

Scale 10  $\mu$ .

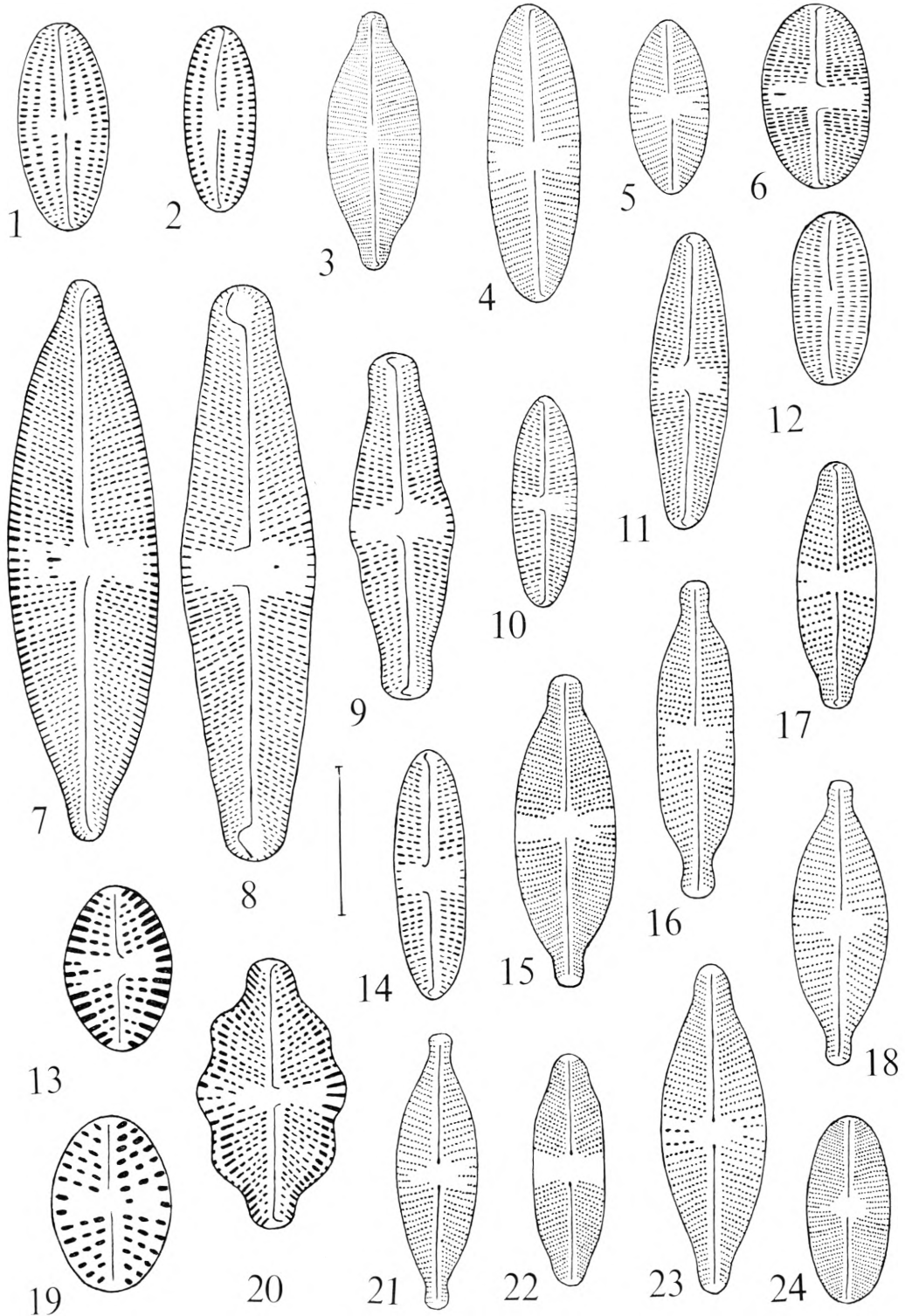


PLATE XII.

- Fig. 1. *Navicula laingii* nov. spec.  
2. — *finitima* Hust.  
3. — *ingoldii* nov. spec.  
4, 5. — *bannajensis* Boye Petersen.?.  
6. — *confervacea* (Kütz.) Grun.  
7. — *densuensis* nov. spec.  
8. — *chadwickii* nov. spec.  
9. — *kolugoensis* nov. spec.  
10. — *abuensis* nov. spec.  
11. — *monradii* nov. spec.  
12. — *sorriensis* nov. spec.  
13. — *subinsoensis* nov. spec.  
14. — *kpongensis* nov. spec.  
15. — *towutiensis* (Hust.) Chohnoky.  
16. — *isertii* nov. spec.

Scale 10  $\mu$ .

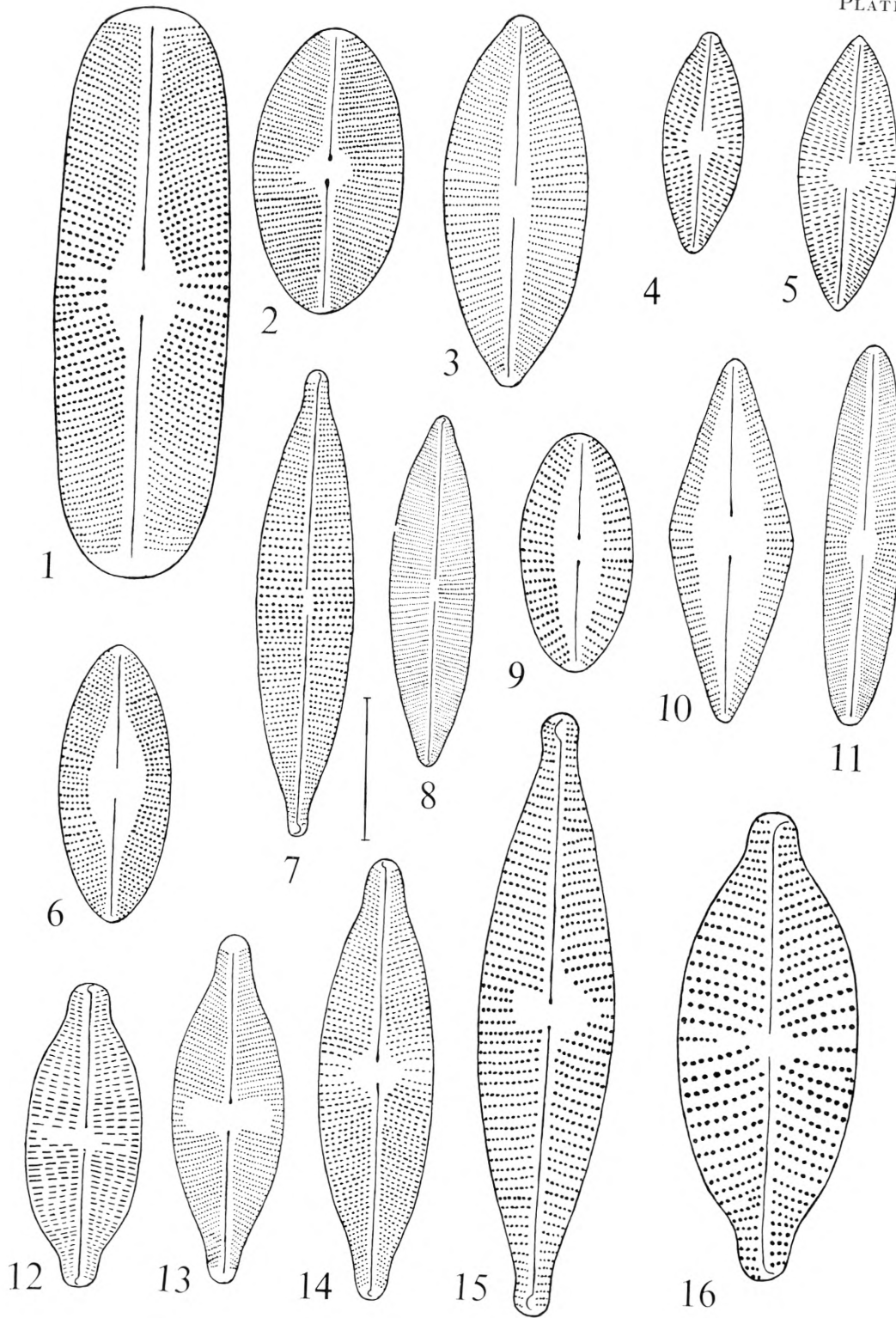


PLATE XIII.

- Fig. 1. *Navicula omegopsis* Hust.  
2. — *akimensis* nov. spec.  
3. — *densa* Hust.  
4. — *adampeensis* nov. spec.  
5. — *ashantiensis* nov. spec.  
6. — *grundtvigii* nov. spec.  
Scale 10  $\mu$ .

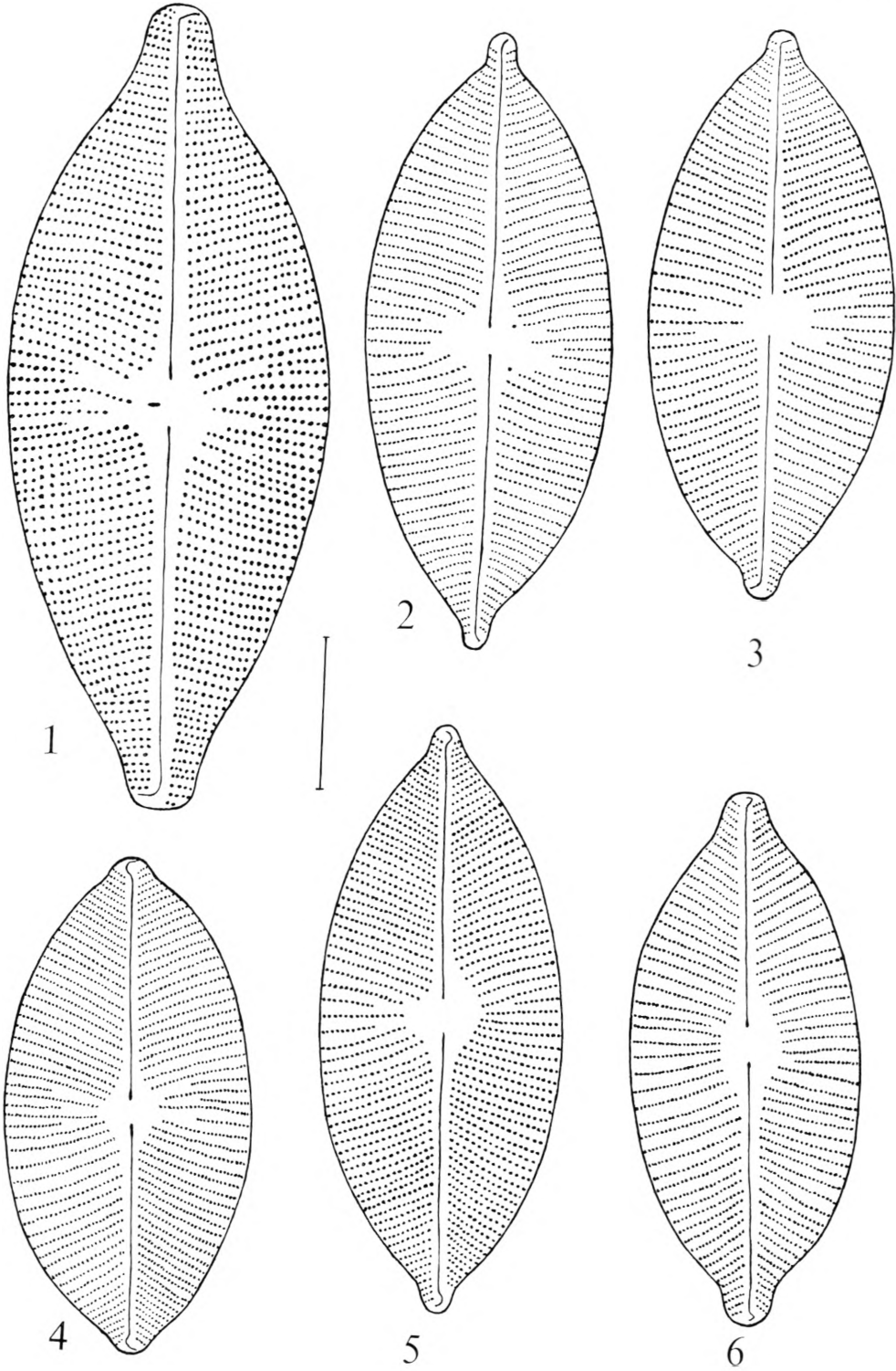




PLATE XIV.

- Fig. 1, 2, 3. *Navicula quadripartita* Hust.  
4. — *bansoensis* nov. spec.  
5. — *exiguiformis* Hust.?.  
6, 7, 8. — *constans* Hust. var. *symmetrica* Hust.  
9. — *suhinensis* nov. spec.  
10. — *exigua* (Greg.) O. Müller var. *signata* Hust.  
11. — *carstensenii* nov. spec.  
12. — *meyeri* nov. spec.  
13. — *exiguiformis* Hust.  
14. — *exiguiformis* Hust.?.  
15. — *asanwinsoensis* nov. spec.

Scale 10  $\mu$ .

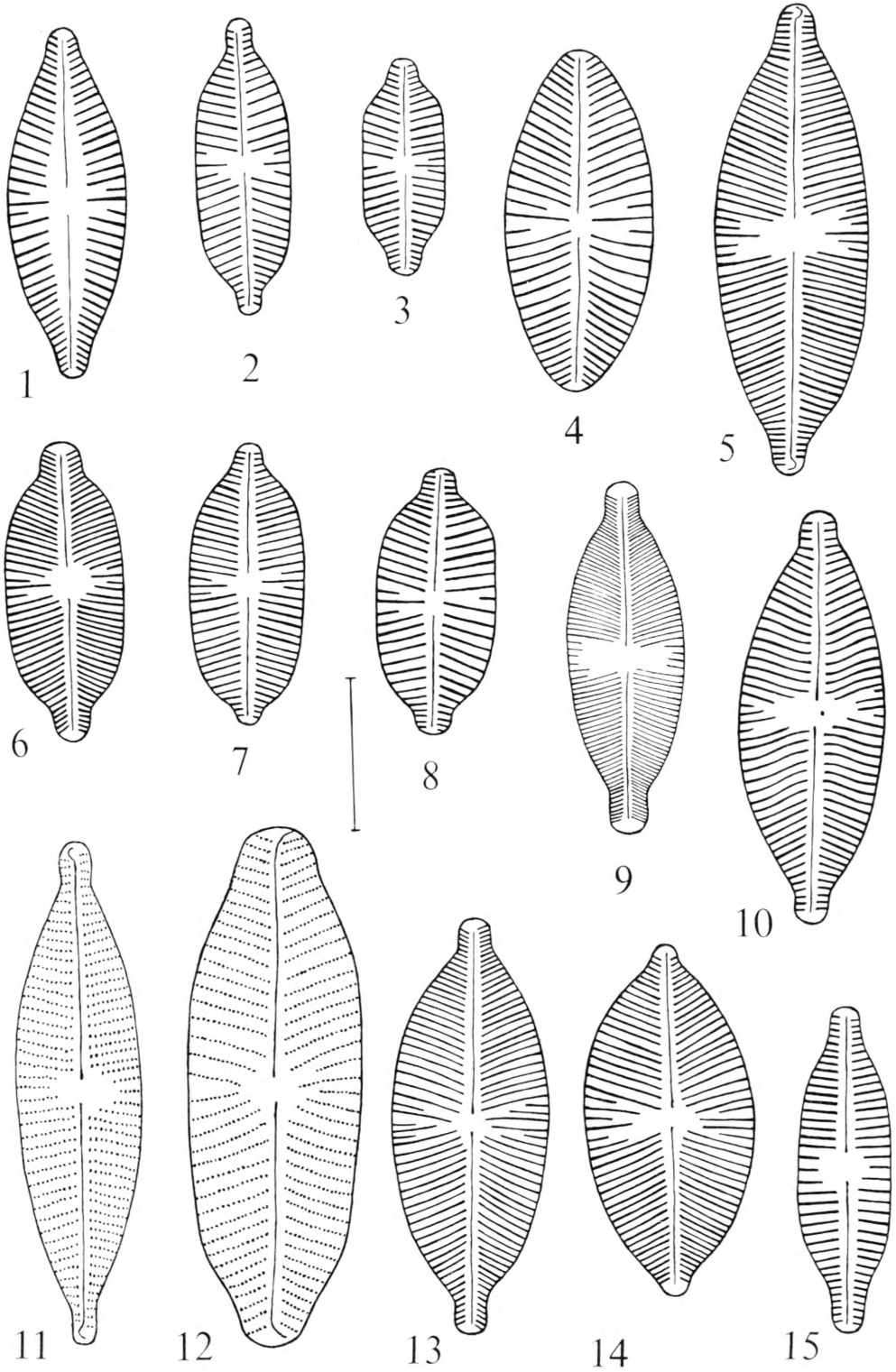


PLATE XV.

- Fig. 1. *Navicula nagbogensis* nov. spec.  
2. — *zanoni* Hust.  
3. — *manguini* Guermeur.  
4. — *sepasiensis* nov. spec.  
5. — *moerckii* nov. spec.  
6. — *carloffii* nov. spec.  
7. — *dodowaensis* nov. spec.  
8. — *humjibreensis* nov. spec.  
9. — *tainensis* nov. spec.  
10, 11. — *fauta* Hust.?.  
12. — *abraensis* nov. spec.  
13. — *ammophila* Grun.  
14. — *hungarica* Grun.  
15. — *costulata* Grun.

Scale 10  $\mu$ .

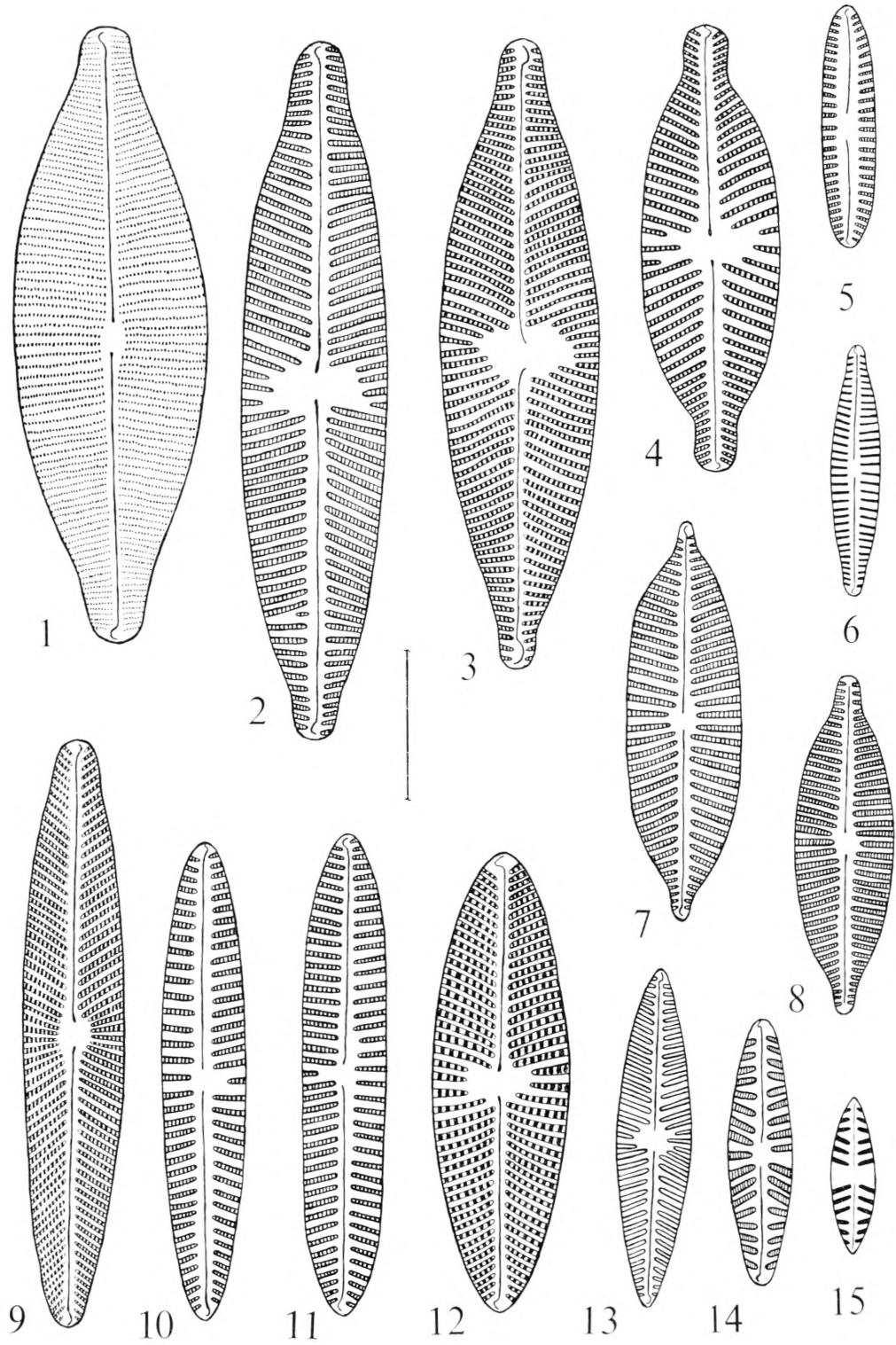


PLATE XVI.

- Fig. 1. *Navicula feuerborni* Hust.  
2, 3. — — *fo. africana* nov. fo.  
4. — *paludosa* Hust.  
5. — *decussis* Østrup.  
6. — *pseudolagerstedtii* Chohnoky.  
7. — *bicephala* Hust.  
8. — *longicephala* Hust.  
9. *Pinnularia molaris* Grun.  
10. — *interrupta* W. Smith var. *jaculata* Manguin.  
11, 15. — *braunii* (Grun.) Cleve.  
12. — *mesolepta* (Ehr.) W. Smith.?  
13. — *takoradiensis* nov. spec.  
14. — *nsuaemensis* nov. spec.  
16. — *mesolepta* (Ehr.) W. Smith.

Scale 10  $\mu$ .

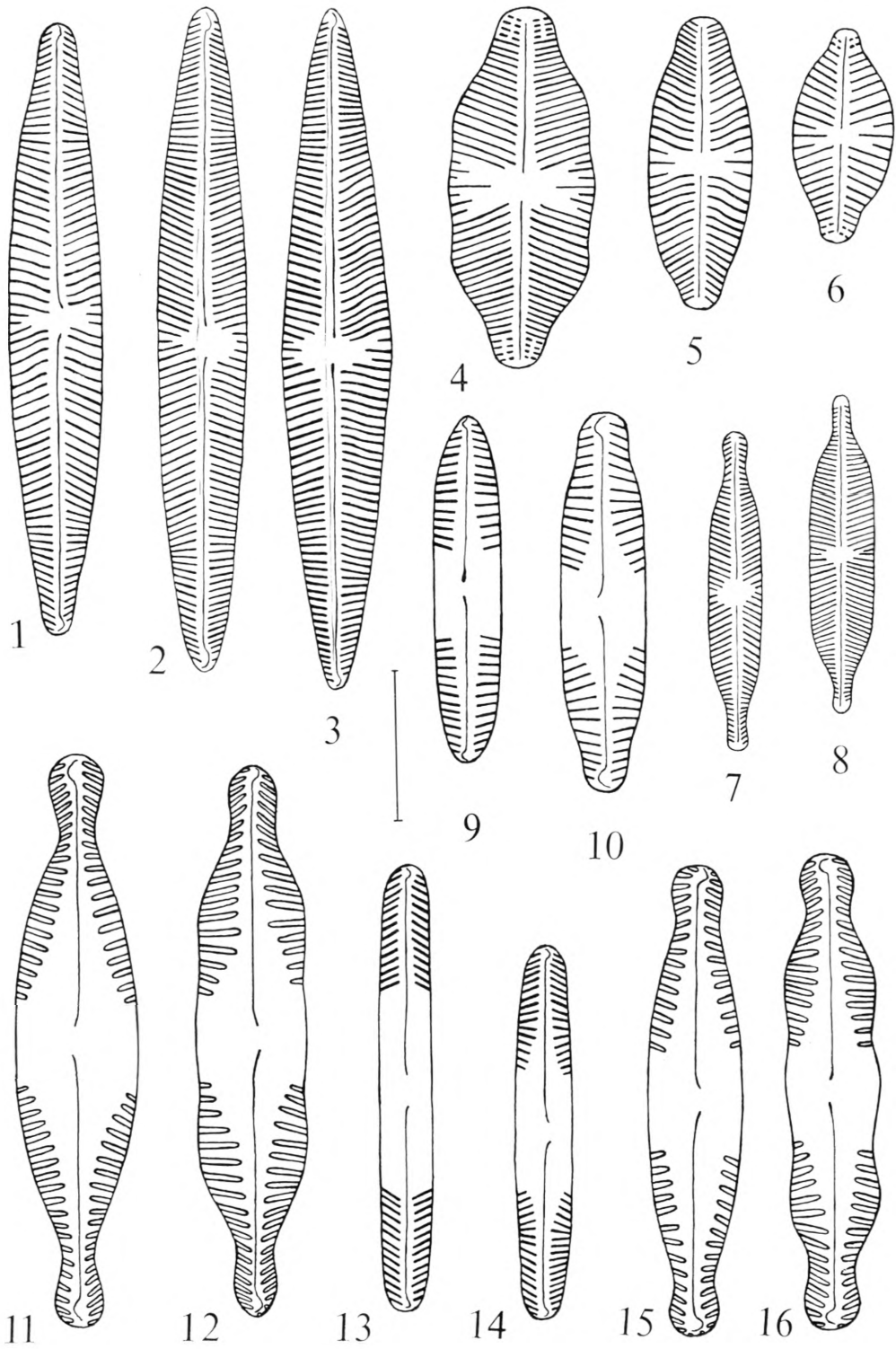


PLATE XVII.

- Fig. 1. *Pinnularia nunguaensis* nov. spec.  
2. — — forma.  
3. — *parva* (Greg.) Cleve var. *lagerstedtii* Cleve fo. *interrupta* Petersen.  
4. *Galoneis bosumtwiensis* nov. spec.  
5. *Pinnularia subinensis* nov. spec.  
6. — *acoricola* Hust.?.  
7. — *agogoensis* nov. spec.  
8. — *odaensis* nov. spec.  
9. — *gibba* Ehr. var. *sancta* Grun.  
10. — *montana* Hust.  
11. — *acoricola* Hust.?.

Scale 10  $\mu$ .



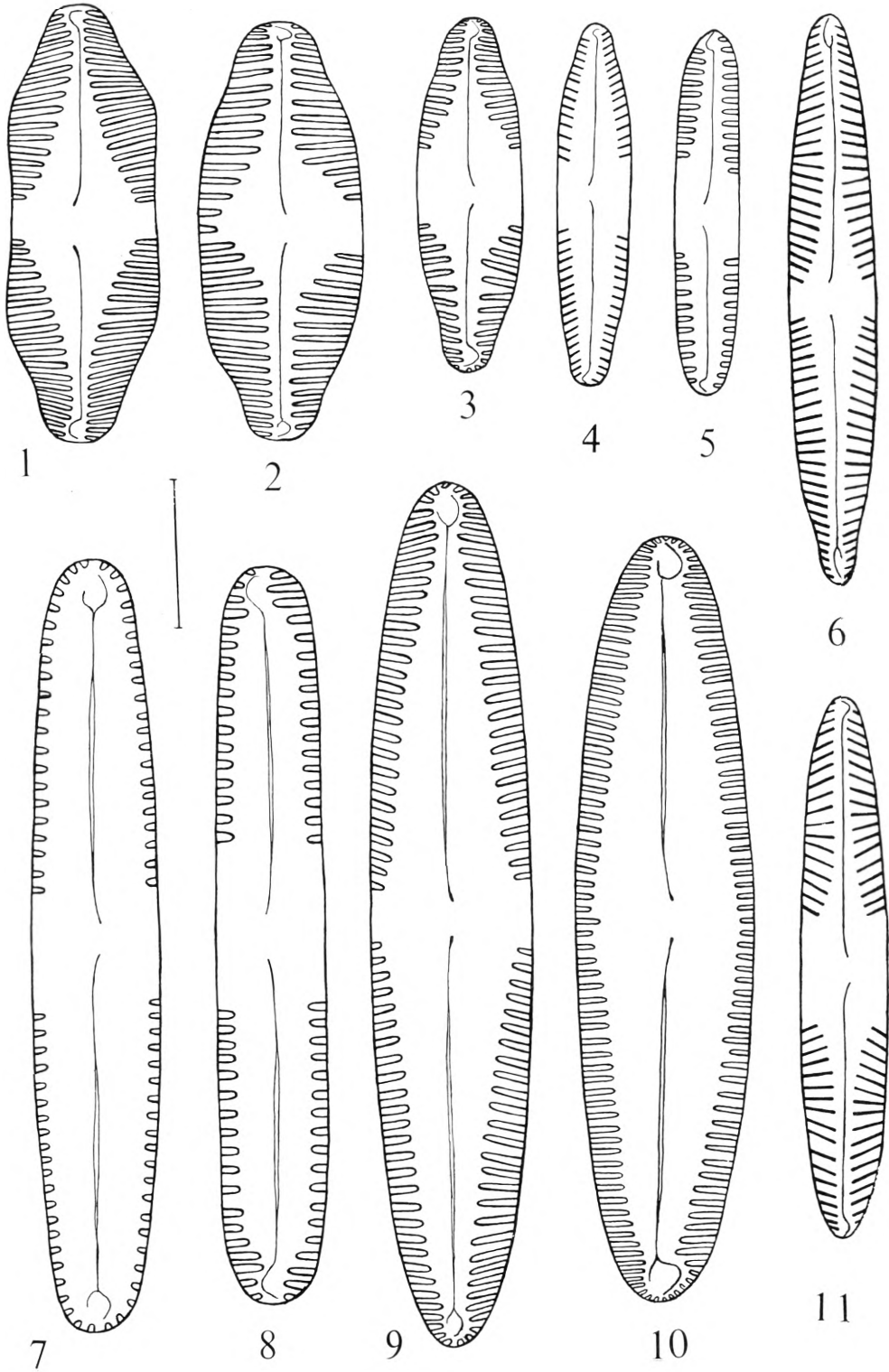


PLATE XVIII.

- Fig. 1. *Pinnularia polyonca* (Bréb.) O. Müller.  
2. — *gibba* Ehr. fo. *subundulata* Mayer.  
3. — *lawsonii* nov. spec.  
4. — *otiensis* nov. spec.  
5. — *mansiensis* nov. spec.  
6. — sp.  
7. — *obscura* Krasske.  
8. — *dubitabilis* Hust.  
9. — sp.  
10. — *mankesimensis* nov. spec.  
11. — *tafoensis* nov. spec.

Scale 10  $\mu$ .

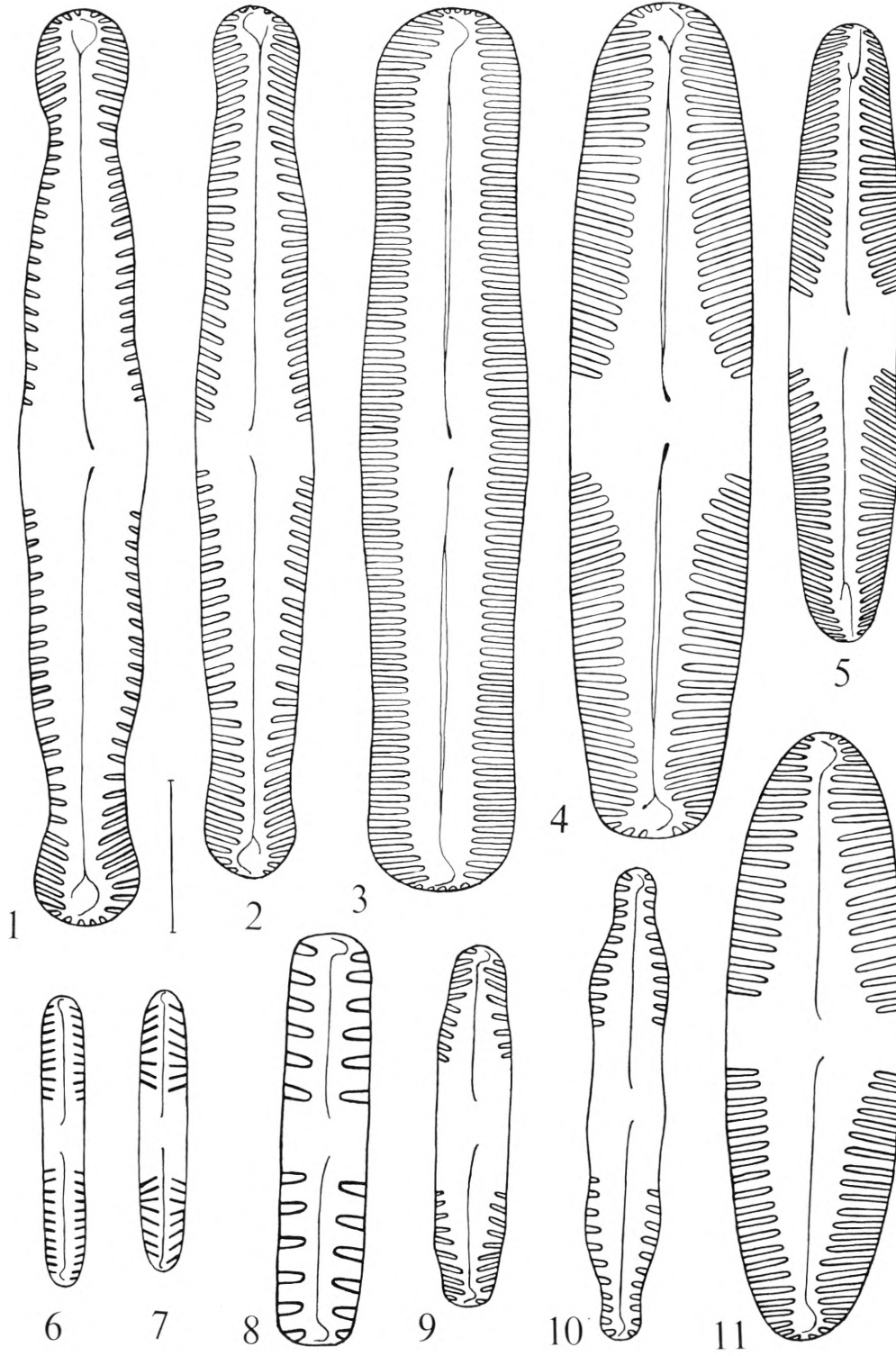


PLATE XIX.

- Fig. 1. *Pinnularia bogosoensis* nov. spec.  
2. — — forma.  
3. — *tomentoensis* nov. spec.  
4. — *rivularis* Hust.?.  
5. — *suchlandti* Hust.  
6. *Amphora abuensis* nov. spec.  
7. — *ayensuensis* nov. spec.  
8. — *crameri* nov. spec.  
9. — *luciae* Chohnoky.  
10. — *fontinalis* Hust.?.  
11. *Cymbella ankobraensis* nov. spec.

Scale 10  $\mu$ .

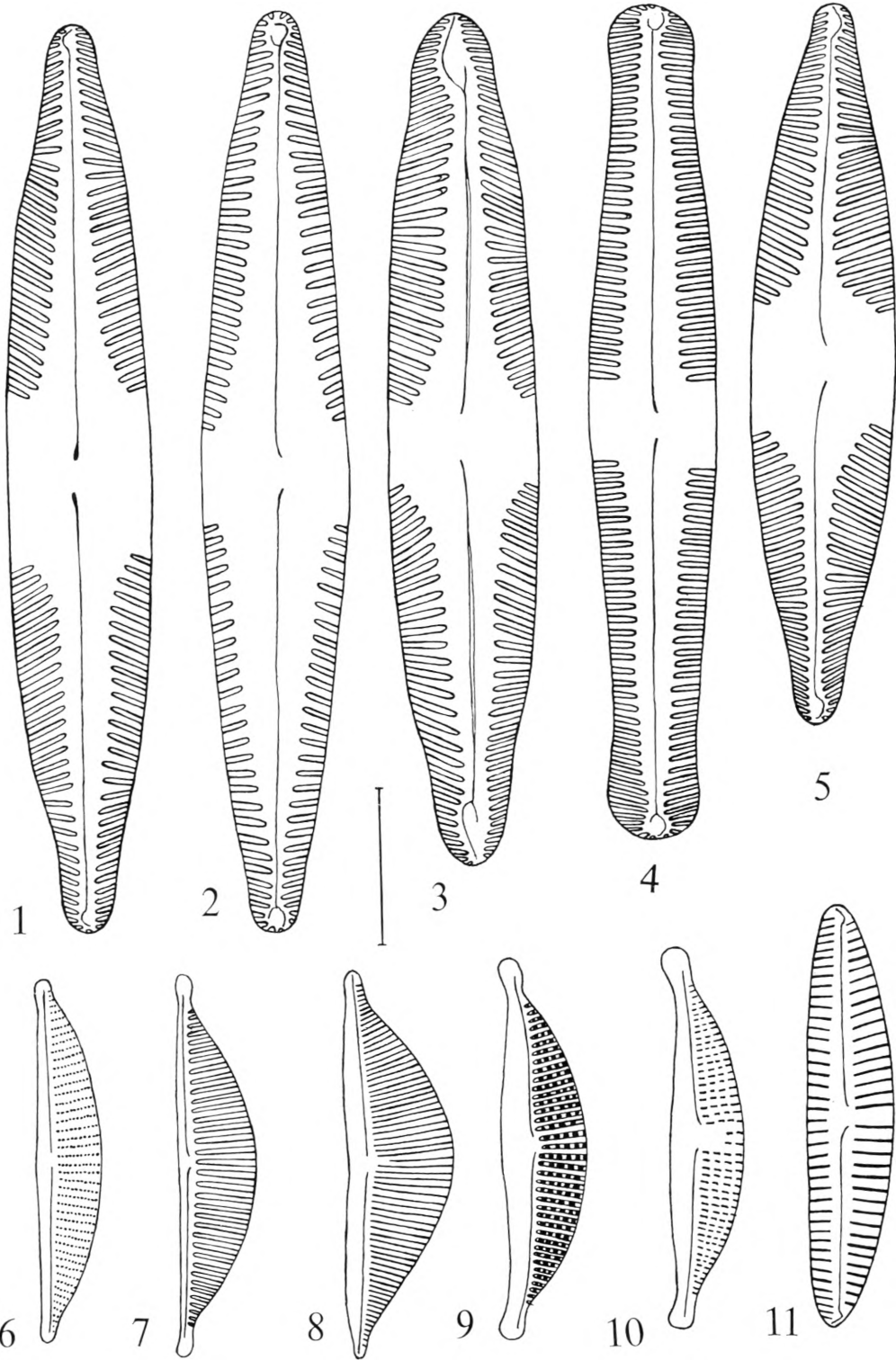


PLATE XX.

- Fig. 1. *Amphora mansiensis* nov. spec.  
2. — *ovalis* Kütz. forma?  
3. *Cymbella dadwinensis* nov. spec.  
4. — *tainensis* nov. spec.  
5. — *takoradiensis* nov. spec.  
6. — *theronii* Chlonoky.  
7. *Gomphocymbella ruttneri* Hust.  
8. *Cymbella aspera* (Ehr.) Cleve var. *bengalensis* Grun.  
9. — *moragoensis* nov. spec.  
10. — *raytonensis* Chlonoky.  
11. — *mülleri* Hust.

Scales 10  $\mu$ .

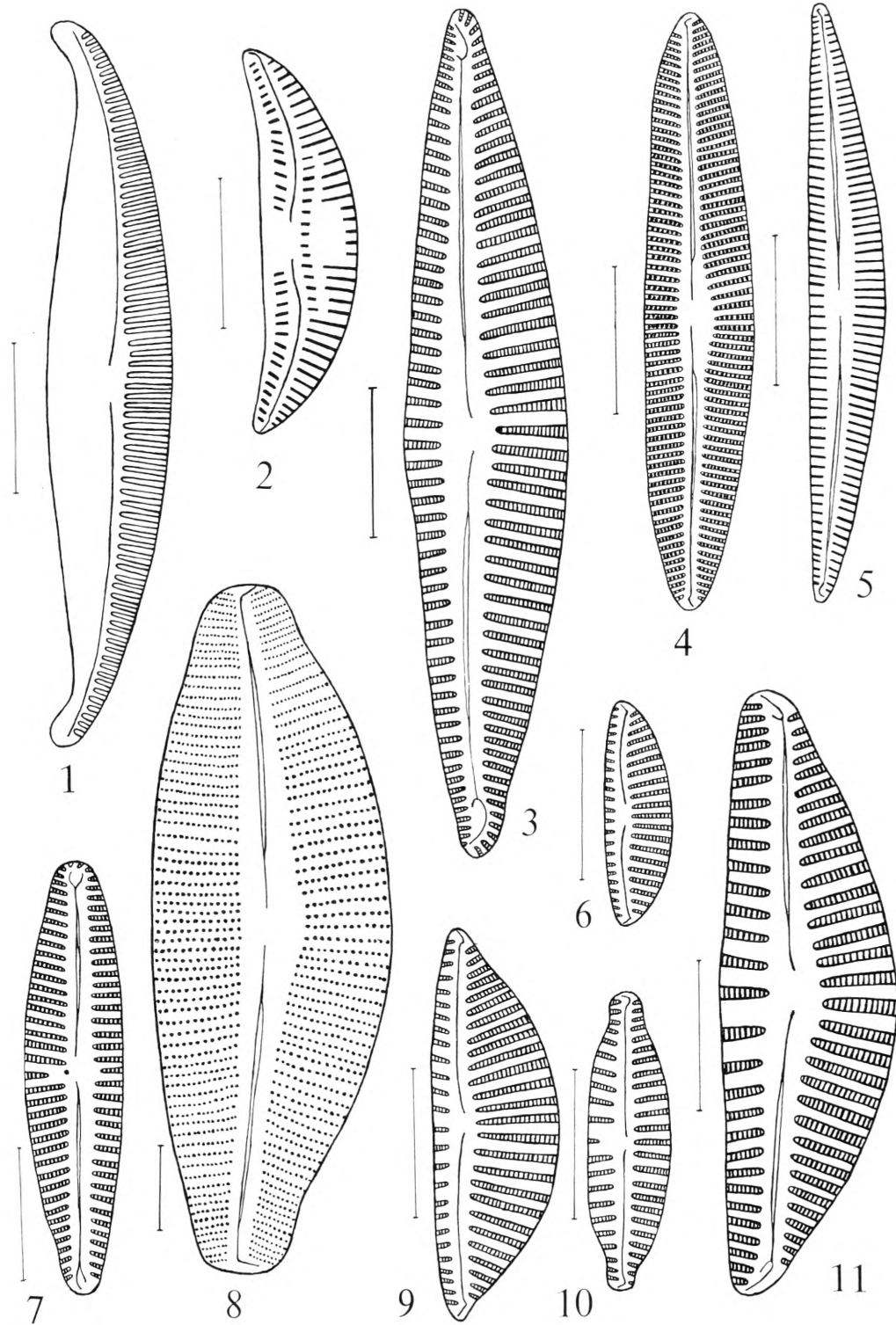




PLATE XXI.

- Fig. 1, 2. *Gomphonema suhmii* nov. spec.  
3. — *lingulatum* Hust.  
4, 5. — *brasiliense* Grun.  
6. — *africanum* G. S. West.  
7. — *wulasiense* nov. spec.  
8. — — var. *voltaensis* nov. var.  
9. — — var. *nunguaensis* nov. var.  
10. — *farakulumense* Foged.  
11. — — forma.  
12. *Nitzschia ovalis* Arnott.  
13. — *ankobraensis* nov. spec.  
14. *Hantzschia amphioxys* (Ehr.) Grun. var. *africana* O. Müller.  
15. *Nitzschia amisaensis* nov. spec.  
16. — *nunguaensis* nov. spec.  
17. — *mankesimensis* nov. spec.

Scales 10  $\mu$ .

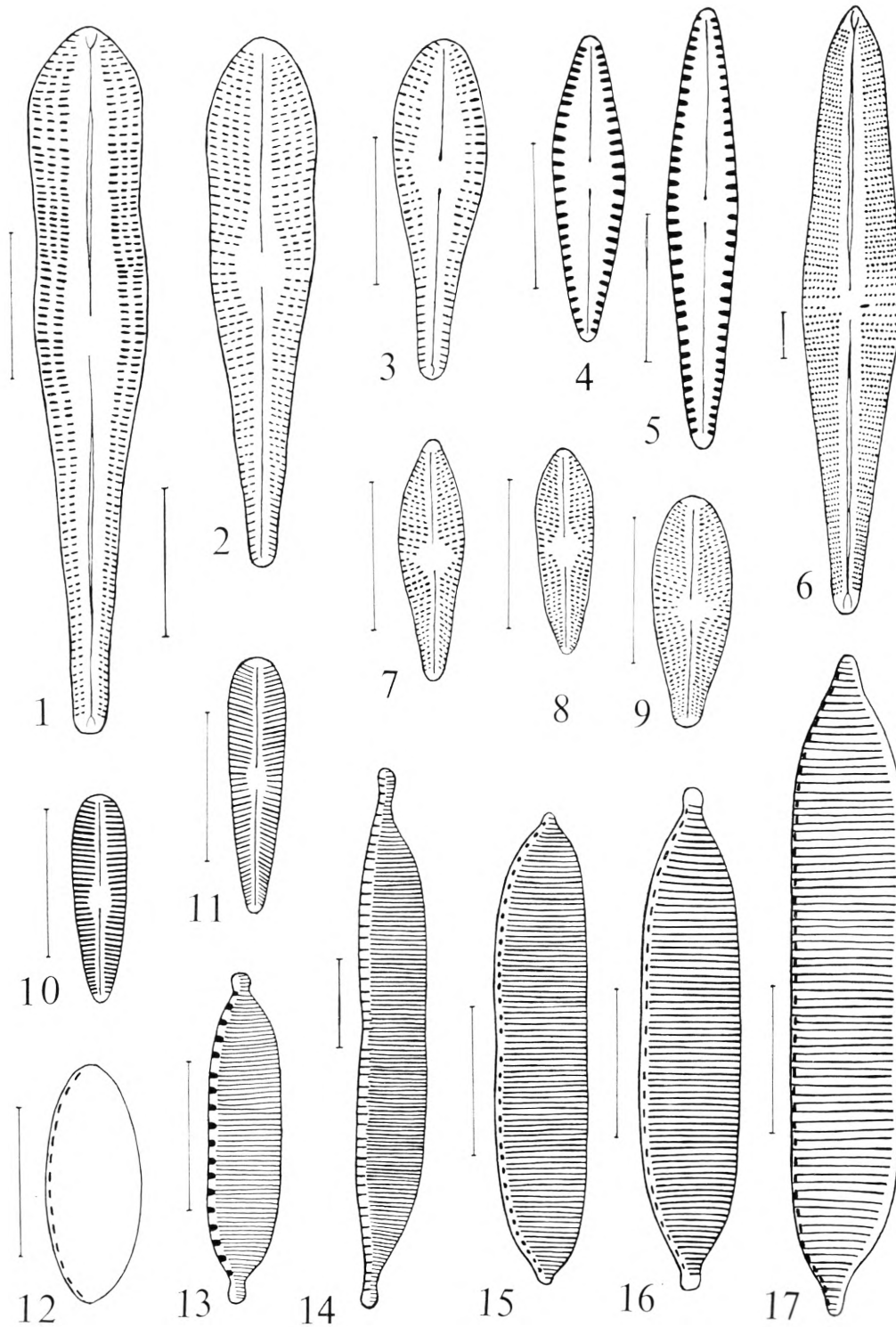


PLATE XXII.

- Fig. 1. *Nitzschia pretoriensis* Cholnoky.  
2. — *aketechiensis* nov. spec.  
3. *Hantzschia distincte-punctata* Hust.  
4. *Nitzschia bansoensis* nov. spec.  
5. — *vedelii* nov. spec.  
6. — *nagbogensis* nov. spec.  
7. — *abraensis* nov. spec.  
8. — *abonuensis* nov. spec.  
9. — *schillerupii* nov. spec.  
10. — *mamataensis* nov. spec.  
11. — *voltaensis* nov. spec.  
12. — *syrachii* nov. spec.  
13. — *lawsonii* nov. spec.  
14. — *svedstrupii* nov. spec.

Scales 10  $\mu$ .

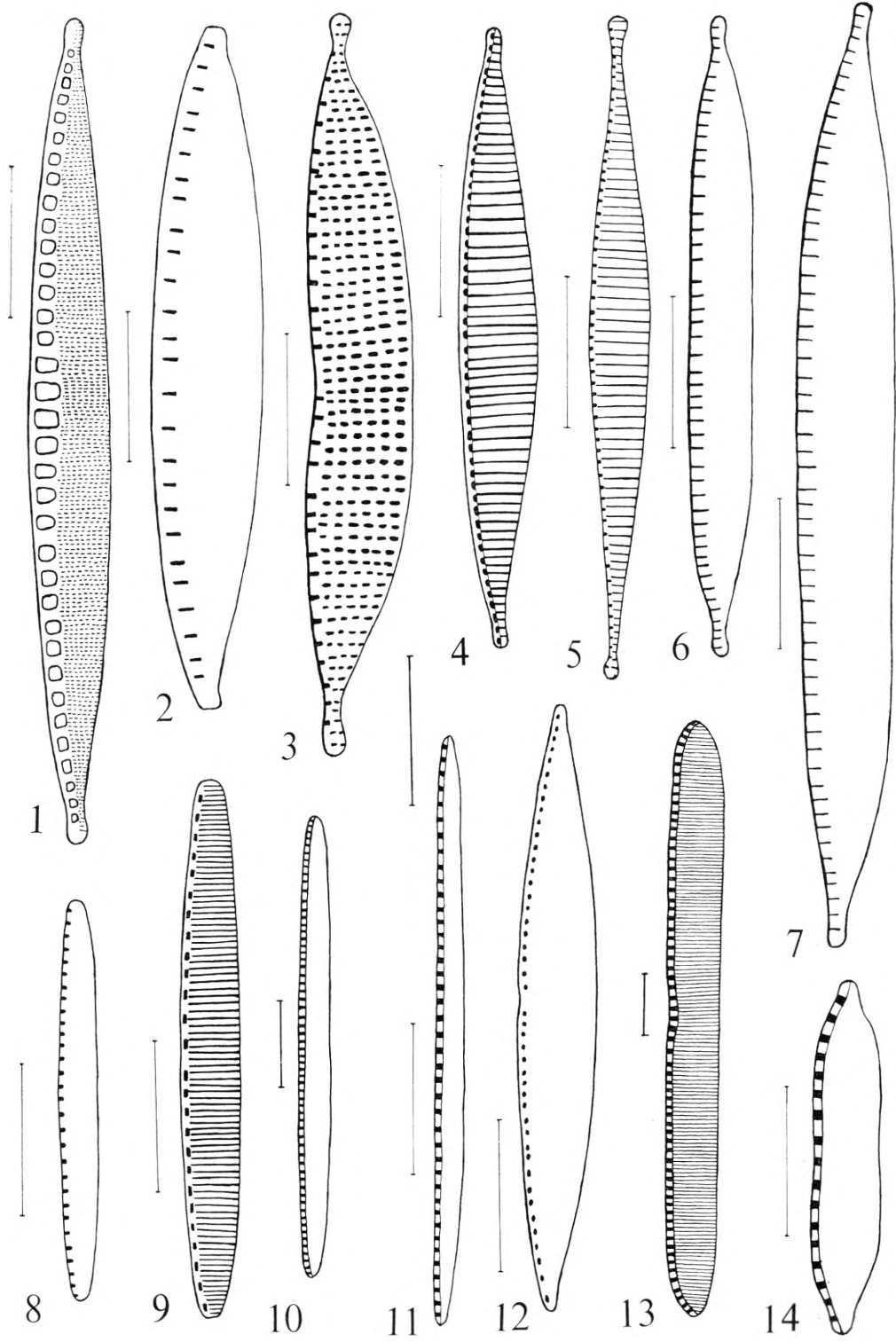


PLATE XXIII.

- Fig. 1. *Nitzschia tarda* Hust.  
2. — *subvitrea* Hust. var. *capensis* Cholnoky.  
3. — *plicatula* Hust.  
4. — *sansomei* nov. spec.  
5. — *tonoensis* nov. spec.  
6. — *navrongensis* nov. spec.  
7. — *spiculoides* Hust. ?.  
8. — *palea* (Kütz.) W. Smith.  
9. — *obsidialis* Hust.  
10. — *dadwinensis* nov. spec.  
11. — *palea* (Kütz.) W. Smith fo. *dubia* Manguin  
12. — *paleaeformis* Hust.  
13. — *bosumtwiensis* nov. spec.  
14. — *tainensis* nov. spec.

Scales 10  $\mu$ .

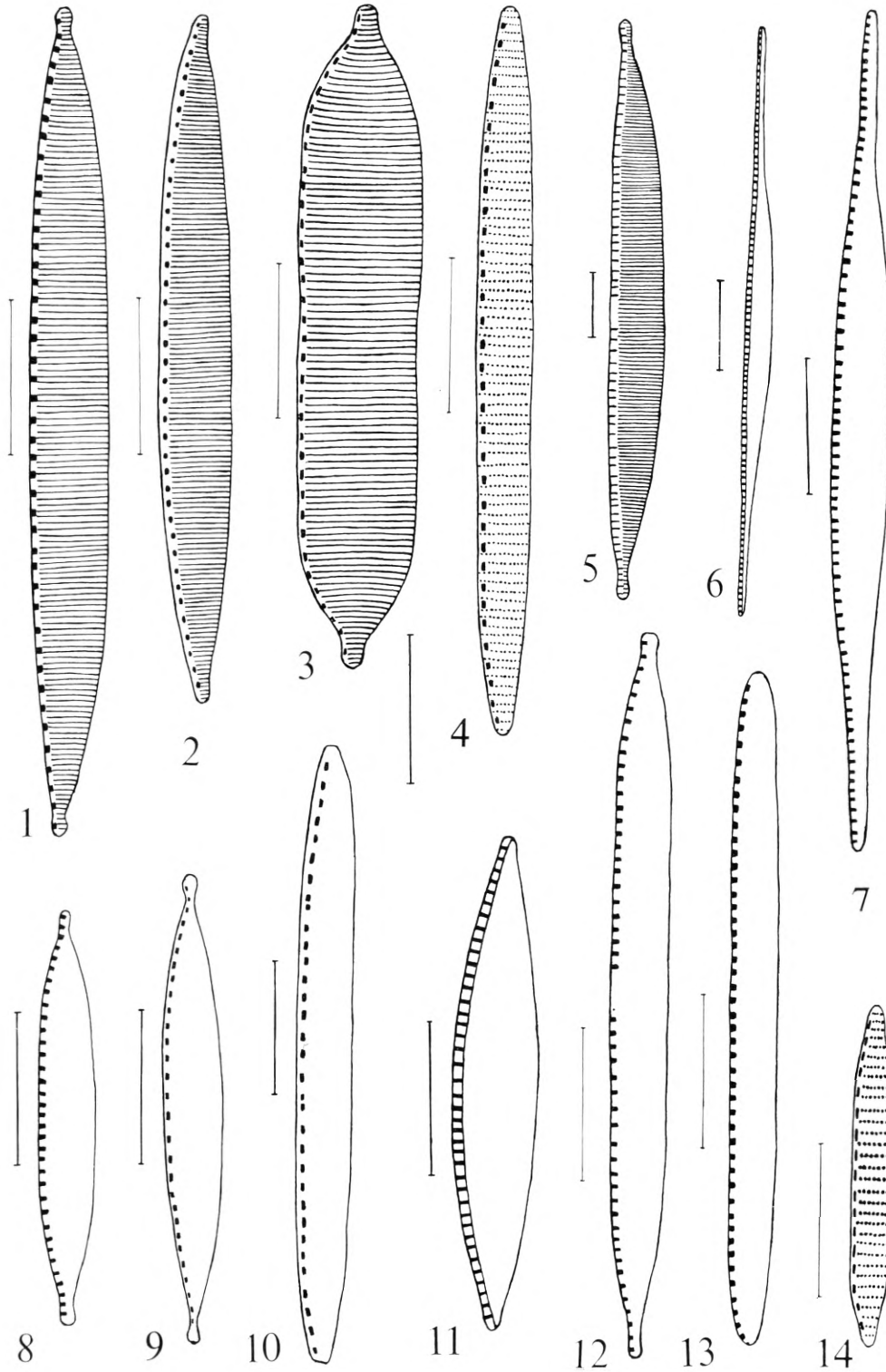


PLATE XXIV.

- Fig. 1. *Nitzschia krachiensis* nov. spec.  
2. — *adiembraensis* nov. spec.  
3, 4. — *obtusa* W. Smith var. *scalpelliformis* Grun.  
5. — *ignorata* Krasske.  
6. — *lorenziana* Grun. var. *subtilis* Grun.  
7. — *apowaensis* nov. spec.  
8. — *chuchiligaensis* nov. spec.  
9. — *densuensis* nov. spec.  
10. — *irresoluta* Hust. fo. *minor* nov. fo.  
11. — *towutensis* Hust.  
12. — *ofinensis* nov. spec.  
13. — *apropongensis* nov. spec.  
14. — *closterium* (Ehr.) W. Smith.  
15. — *ghanaensis* nov. spec.  
16. — *sakaensis* nov. spec.  
17. — *huniensis* nov. spec.

Scales 10  $\mu$ .



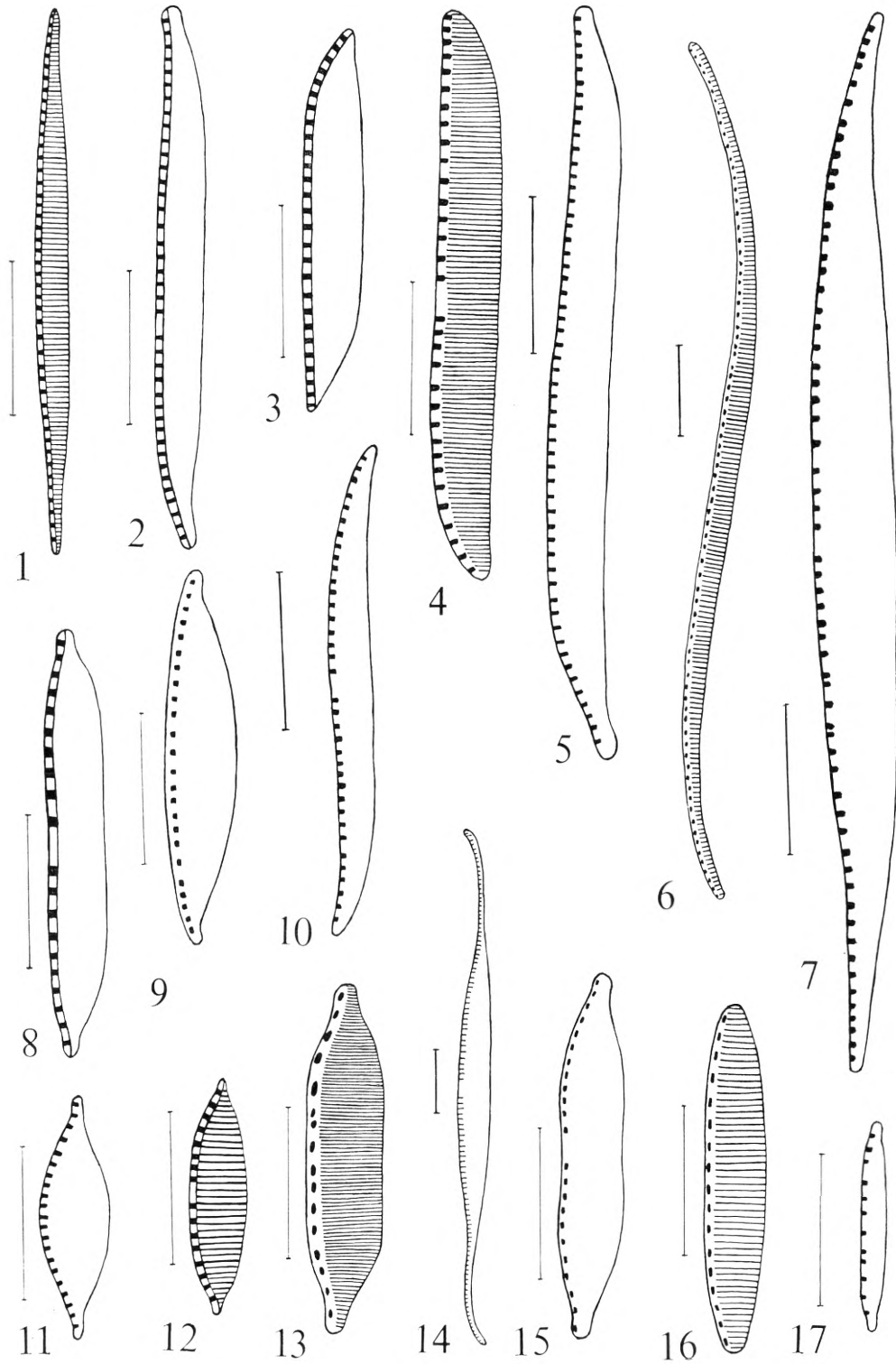
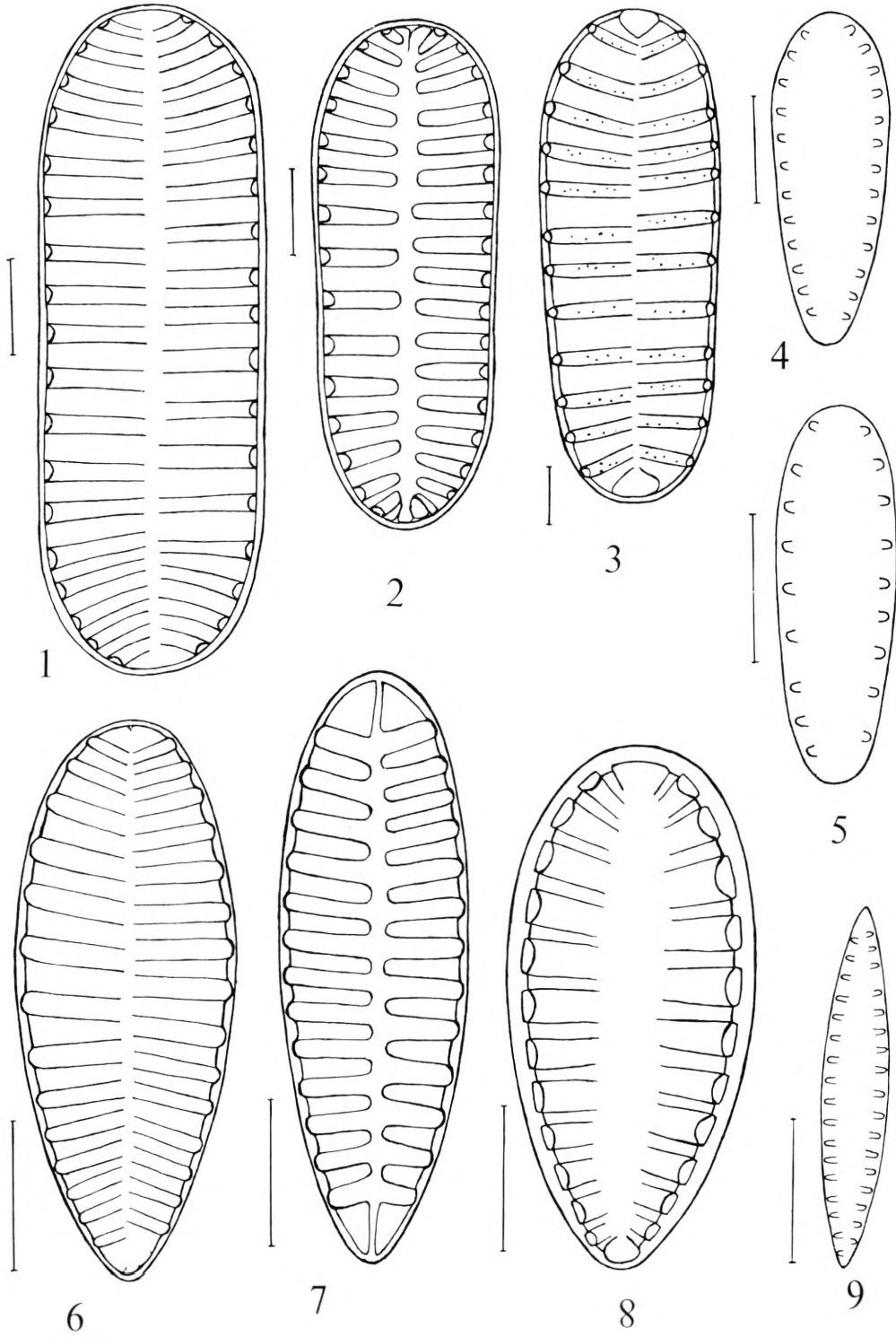


PLATE XXV.

- Fig. 1. *Surirella bonsaensis* nov. spec.  
2. — *esamangensis* nov. spec.  
3. — *agonaensis* nov. spec.  
4. — *takoradiensis* nov. spec.  
5. — — var. *suhinensis* nov. spec.  
6. — *dodowaensis* nov. spec.  
7. — *nagbogensis* nov. spec.  
8. — *sorriensis* nov. spec.  
9. — *delicatissima* Lewis var. *ghanaensis* nov. var.

Scales 10  $\mu$ .







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