THE PHYTOPLANKTON OF SOME KENYA WATERS

By

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An unexpected temporary appointment in the Botany Department of University College, Nairobi, provided the opportunity to make a survey of the phytoplankton of some Kenya inland waters. Attention has previously been paid to some of the larger lakes, particularly those in the Rift Valley, but little information is available about the smaller lakes and reservoirs. The account which follows is an attempt to present the results of the survey in a form which can be understood by those who have had no specialist training in botany.

The term plankton is used to describe the minute free-floating organisms which are present in any body of fresh or sea-water and which form the main food of fish. The phytoplankton consists of algae, which are plants, and the zooplankton of animals. The algae contain chlorophyll and are able to manufacture sugars from carbon dioxide and the water in which they live. They are eaten direct by some kinds of fish and they also provide the food of small water animals which are the food of other fish. When phytoplankton is present in quantity, it colours the water green or brown but if only a small quantity is present the algae can only be seen in a concentrated sample. This may be obtained either by sieving the water through a fine silk net or by allowing the organisms to sediment out after killing them with iodine. The organisms belong to a wide variety of algal classes, but for the purposes of this account it will be sufficient to mention the following major groups which include those types occurring most commonly in Kenya fresh-waters.

CHLOROPHYTA (Green Algae)

Coccoid types: Immotile unicellular green algae, usually grouped together into colonies of various forms. They are often in a state of active asexual reproduction resulting in colonies of different sizes (Fig. 1).

Motile colonial types: In these, a larger or smaller number of green cells, each with two flagellae, are grouped together to make a usually spherical motile colony (Fig. 2).

Desmids: In most desmids the cell consists of two semi-cells joined by an isthmus. The cell wall is often ornamented in various ways or bears spines, and many of the desmids are very beautiful objects under the microscope. In some genera the individual cells are joined together by mucilage to form 'chain desmids' (Figs. 3, 4, 5a and b).

CHRYSOPHYTA (Yellow-green or yellow-brown algae)

Diatoms: Although diatoms contain chlorophyll they are yellow-brown in colour. Each diatom consists of a single cell, often boat shaped or needle-like with a wall composed partly of silica and bearing very delicate markings (Fig. 6). Vast quantities of these in some earlier Kenya lakes have resulted in the accumulation of deposits made up of their silica walls and known as diatomite. In one common diatom the cells are joined together by their ends to form a filament Melosira (See photo).

Tribonema: A filamentous alga, yellow-green in colour. The cells have thin cellulose walls made of two overlapping halves so that the broken end of the filament shows an H shaped piece of wall where the two halves have come apart. This alga does not store starch and therefore does not stain blue with iodine (Fig. 7).

Dinobryon: A curious alga in which the tiny, flagellated, yellow-brown cells are contained within flask-shaped structures open at one end and pointed at the other. These capsules are arranged in a tree-like manner to form a branched structure. Very often broken pieces of the 'tree' are found after the living cells have escaped (Fig. 8).

Botryococcus: The cells lie close together within a brownish or orange-coloured envelope forming small irregular masses. The cells secrete oil which obscures the detailed structure (Fig. 9).

PYRROPHYTA (Golden-brown algae)

Peridium and Ceratium: These unicellular forms are characterised by the presence of a deep transverse groove or furrow and a wall ornamented by a number of plates. Ceratium has conspicuous horns. Both are actively motile by means of two flagellae (Figs. 9, 10).

CYANOPHYTA or MYXOPHYCEAE (Blue-green algae)

There are very many algae belonging to this group, they show a great variety of form and may be unicellular, colonial or filamentous; they are often enclosed in a mucilage sheath. Some are so minute that they pass through the finest meshes of a plankton net and yet they colour the water deep green. Algae of this group are specially common in alkaline lakes (See photo).

EUGLENOPHYTA

Euglena and Phacus: Unicellular motile organisms, bright green in colour and storing a carbohydrate (paramylum) which does not respond to the iodine test. The cells are naked, and while Phacus has a rigid periplast, Euglena is able to change its shape. They are especially characteristic of waters of high organic content (Figs. 11, 12).

Phytoplankton and water

The relative proportions of algae of these groups occurring in any body of water will depend on the chemical composition of the water. Some are characteristic of soft waters and others of hard while highly saline lakes or lakes rich in organic matter have a very distinctive plankton. In temperate countries where these matters have been the subject of close study, there is also a change in the composition of the plankton throughout the year and this has been shown to be associated with climatic changes which bring about first a stagnation and then a mixing of the waters resulting in a redistribution of nutritive material which has collected on the surface of the lake muds.

Though waters in different districts of Kenya show plankton populations related to their environment, the range of temperature in any one place is insufficient to cause the stagnation and mixing seen in places with a big difference between winter and summer temperatures. The biggest climatic change to which Kenya waters are exposed is due to rainfall which in the parts of the country with which we are concerned occurs in two main periods between March and June and between October and December. In 1961-62 all lakes were subject to heavy flooding and in 1963-64 their waters were well above normal level.

It was thought that a survey of the plankton of some Kenya waters might prove of interest from two points of view. Firstly it is possible to collect from lakes and dams in a wide variety of ecological habitats ranging from mountain tarns at 10,000 ft. to Rift Valley saline lakes at 2,000 ft. Secondly, as there are no major climatic fluctuations which would bring about regular changes, other than diurnal, in the temperature of the water, a study of the periodicity of the algae might prove rewarding.

The investigation therefore falls into two parts:-

1. A study at monthly intervals of the phytoplankton of two reservoirs.

2. A comparison of plankton from lakes of different ecological types.

Methods: Plankton was collected by drawing a net of fine bolting silk (180 meshes to an inch) through the surface water as near as possible to mid-day. No attempt at quantitive estimation was made; counts were made under the microscope of approximately 1,000 individuals and the proportion of the major species expressed as a percentage of the whole.

Wherever possible data were obtained of pH, conductivity (an indication of total dissolved salts) total alkalinity (carbonates and bicarbonates) and major metallic ions.

Phytoplankton periodicity in two Kenya Reservoirs

The two waters chosen were Sasamua and Ruiru Reservoirs which form the main water supply for Nairobi. Sasumua, constructed in 1956 is 650 acres in extent and about 90 ft. deep and has a capacity of 2,000 million gallons. It lies at the foot of the Aberdares at 8,140 ft. in a region of bamboo *Arundinaria alpina* K. Schum and Cedar, *Juniperus procera* Hochst. ex Endl. forest. Until June 1964, its drainage was from two rivers, the Chania and the Sasumua. The former has a catchment area mainly on mountain slopes in the forest around 10,000 ft. while the Sasumua catchment is mainly on more level grazed or cultivated land outside the forest reserve. In June, 1964 a third river, the Kiburu, was diverted into the dam through a 33 inch pipe and it now provides 50% of the inflow. The dam wall is to be raised 26 ft. to contain this extra supply. The mean monthly maximum temperature lies between 17 and 25 C° and there is said to be no thermal stratification.

Ruiru Reservoir, constructed in 1949 is much smaller, only 100 acreas in extent, and has a capacity of 656 million gallons. It is situated at 6,450 ft. in an area of Kikuyu reserve and receives its water from the Ruiru and Bathi Rivers flowing mainly through cultivated or grazing land. Ruiru dam is about 60 ft. deep and is said to show no thermal stratification. The mean maximum monthly temperature lies between 21 and 27 C°.

The Phytoplankton

The phytoplankton of the two dams was somewhat similar and consisted mainly of Dinoflagellates, coccoid and colonial Chlorophyta, *Dinobryon* and, at certain times desmids. Diatoms and Cyanophyta were never conspicuous. The main differences were the abundance of *Dinobryon* in Ruiru while in Sasumua it was hardly significant, and the abundance of *Ceratium* at times in Sasumua though scarce in Ruiru.

The periodicity of the various plankton types throughout the period October 1963 to December 1963 is shown in Diagrams 1 & 2 and it will be seen that it was not the same in the two reservoirs. For example, *Peridinium* in Ruiru reached its maxima in May and June and in November following heavy rains, while in Sasumua its two maxima were at periods of low rainfall. *Ceratium* behaves in the opposite manner.

Chlorophyta seem to favour low rainfall but the situation at Ruiru was complicated by a huge maximum in October of the Coccoid and Colonial algae *Kirchneriella* and *Eudorina* which coloured the water bright green. Next month it had almost gone and was replaced by *Peridinium*. This only serves to indicate that a survey of this kind should really be carried out at weekly intervals as various important changes can take place in a month and be completely missed.

Desmids were a major feature of the plankton of both dams when the investigation began and, to a less extent, in November 1964. In Ruiru they rose to a maximum in April just before the high rainfall then fell off abruptly with the rain and did not reappear till November. In Sasumua, after a high start in October, they decreased till May and remained below 10% till December being at their lowest at the time of highest rainfall. It was, perhaps, surprising to find desmids forming 70% of the plankton in water with a pH of 7.3. They were limited to about ten species.

Dinobryon: This alga was so abundant at most times at Ruiru that it was impossible to count it at all accurately. Only in January and August did its numbers fall appreciably . In Sasumua it was always present but only in April did it reach more than 15%. *Dinobryon* was not included in the percentage counts in either reservoir but is shown separately at the top of the diagram.

Periodicity in relation to Rainfall

Sasumua 1964 1730 mm
Ruiru 1964 1482 mm

The Diagram shows that certain algae behaved differently in the two waters in relation to rainfall.

Peridinium maximum occurred at high rainfall at Ruiru.
Peridinium maximum occurred at low rainfall at Sasumua.

<u>Ceratium</u> maximum occurred at low rainfall at Ruiru.
<u>Ceratium</u> maximum occurred at high rainfall at Sasumua.
Desmid maximum was at low rainfall in both dams.
<u>Dinobryon</u> maximum was at high rainfall in both dams.
Chlorophyta maximum was at low rainfall in both except for the <u>Eudorina</u> maximum as the short rains began in Ruiru.

As plankton algae are known to be sensitive to the amounts of dissolved nutrients in the water, this was estimated by measuring the electrical conductivity of the water, a figure which is related to the concentration of ionised salts in the water. These measurements are not complete for the year but they are shown at the top of the diagrams. The pH lay between 6.9 - 7.3 in both reservoirs and the conductivity between 45 and 250.

It will be seen that conductivity increased with high rainfall in April in Sasumua, but in Ruiru the reverse was the case, conductivity being at its lowest at this time. The cause of this difference may lie in the nature of the drainage system.

At Sasumua, water enters mainly from rivers flowing through forest and over base-rich volcanic rocks and therefore likely to bring in extra salts at times of heavy rainfall. The slight rise in conductivity shown in July (a normally dry period) may be due to the entry of the new supply from the Kiburu River.

In Ruiru, which is much smaller and surrounded by cultivated land, already probably leached, it may be that the heavy rain runs off the land without percolating much through the soil and thus dilutes the water of the reservoir.

The distribution of Phytoplankton in some Kenya Waters

The waters of East Africa can be classified roughly into the following groups:-

a. Very large lakes such as Lake Victoria.
b. Large freshwater lakes such as Lake Naivasha.
c. Alkaline lakes.
d. Dams constructed to provide water for drinking or for agricultural purposes.
e. Tarns and pools some of which dry up in the dry season.

As considerable attention has already been paid to the very large lakes the present account is concerned only with the groups b to e.

Description of lakes

<u>Lake Naivasha</u>: This is dealt with separately as it in fact consists of three parts with different ecological conditions.

Smaller Lakes

<u>Lake Ol Bolossat</u>

Situated at the foot of the Aberdares at 7,600 ft. receiving its drainage from volcanic rocks and soils. A shallow lake surrounded by grass and sedge swamp with a fringe of <u>Typha</u> and said by the local people to contain no fish.

Lake Narasha

Situated near Timboroa in the Kenya Highlands at 8,800 ft. No inlet so probably fed by springs. An outlet flows in wet weather. Very much overgrown with water-lilies and other water plants and with a deep fringe of *Typha*.

Lake Jipe

On the border of Kenya and Tanzania, south of Taveta and fed by the Lumi River flowing off Kilimanjaro. It is 11 x 3 miles in extent only about 62 ft. deep and surrounded by swamp. Where the collection was made there was a deep fringe of *Typha*.

Lake Chala

A deep crater lake north of the Voi-Moshi road near Taveta. Most lakes occupying craters are strongly alkaline and green in colour owing to the quantities of phytoplankton.

Lake Chala is fresh and must have an inflow and outlet though none is visible. It was not possible to trawl the net owing to the very steep rocky sides. But plankton precipitated in bottles of Chala water kindly provided by the Water Development Dept. showed algae characteristic of fresh rather than saline water. They were insufficient to be able to estimate a percentage but consisted of Dinoflagellates and Cyanophyta.

Alkaline Lakes

The larger Alkaline Lakes were not investigated. Several of the smaller lakes and dams proved to be alkaline.

Dams and Reservoirs

Sasumua and Ruiru reservoirs are described separately in an earlier part of the paper.

Kikuyu Springs

The original source of Nairobi's water supply and still used for that purpose. Situated at about 6,000 ft. at the source of the Nairobi River west of the main Nakuru road near Kikuyu. The water is very clear and derives from springs. The dam is fairly shallow and the bottom is covered with weeds which are kept in check. It is only 6.5 acres in extent.

Tigoni Dam

Constructed by the army in the 1939-45 war. Situated near Limuru about 17 miles north of Nairobi and surrounded by grassland, at about 7,400 ft. There is very little weed round the edge.

Sisal Dam

On the estate of the High Level Research Station near Thika at about 6,000 ft., surrounded by grassland and scrub and with a fringe of *Typha*, papyrus and sedges.

Deacon's Dam

On the Matuu Estate at the foot of Donyo Sabuk, east of Nairobi at about 5,000 ft. It is the oldest dam in the district and receives underground drainage from Matuu Hill. It is partly grown over with water lilies and other plants.

Kwale Dam

In the same neighbourhood as Deacon's but in an area of "black cotton soil". It was emptied when the dam wall broke in the 1961-62 floods and has now refilled.

Ngomeni and Yambuyu Dams

These two dams differed from all others in being rock catchment reservoirs in rock of the basement complex. They were at a lower altitude of about 2,500 ft. in hot, dry bush country. Yambuyu is near Mwingi on the Nairobi-Garissa road, and Ngomeni is about 250 miles from Nairobi to the west of the Garissa road. Ngomeni proved to be alkaline.

Lessos

A large dam situated at 7,300 ft., north-east of Lessos. It is surrounded by grassland and has a deep fringe of Typha, Potomogeton and submerged weeds. It is used by a sailing club.

Molo

A dam in agricultural land situated at 8,200 ft., near the Nakuru Eldoret road, 29 miles from Nakuru.

Tarns and Pools

Gicururu Tarn

A small, shallow tarn at 9,200 ft. near the Aberdare Mountain Road, surrounded by moorland and with a peaty bottom. This and Lake Narasha proved to be the only two true desmid lakes.

Distribution of Phytoplankton

In general the waters fell into fairly distinct categories with regard to the dominant groups in their phytoplankton. Where it was possible to pay more than one visit to a lake, the plankton was seen to vary at different times of the year. Some waters therefore appear more than once in the list with a date to indicate the time of the visit.

Cyanophyta Lakes

Ol Bolossat (12/64), Lodien Bay (Naivasha), Ngomeni: pH 8.5 to 9.3; conductivity 278 to 1,000; alkalinity (as normality) .002 to .0085. These waters usually contained diatoms as well.

Tribonema-Melosira Lakes

Ol Bolossat 3/64, Naivasha (Crescent) 10/64, Lessos, Kwale, Yambuyu: pH 7.2 to 8.0; conductivity 110 to 920; alkalinity (as normality) .001 to .0014. They often contained dinoflagellates and at some times of year had an abundance of Cyanophyta (Eg. Ol Bolossat).

Dinoflagellate Lakes

Sasumua, Deacon's Dam, Tigoni Dam: pH 7.0 to 7.3; conductivity 55 to 155; alkalinity (as normality) .005 to .0008. Dinoflagellates were often associated with Chlorophyta and Desmids.

Dinobryon Lakes

Ruiru, Molo, Sisal Dam: pH 7.2 to 7.5; conductivity 48 to 173; alkalinity (as normality) .00036 to .0017. These were very similar to the dinoflagellate lakes and, like them often had many Chlorophyta.

Desmid Lakes

Narasha, Gicururu, Ruiru, Naivasha: pH 6.3 to 7.7; conductivity 30 to 250; alkalinity (as normality) .0022 to .00038. True desmid lakes were few in number and were characterised by low pH and conductivity (Narasha 6.7 and 30, Gicururu 6.3 and 31). Ruiru and Naivasha were included because at certain times they had a high desmid content in spite of a pH of 7.7 in the case of Naivasha.

Diatom Lakes

Kikuyu Springs: pH 6.9; conductivity 220; alkalinity as normality .0009. This was the only water which consistently showed a maximum of pennate diatoms (i.e. diatoms other than Melosira). It was the only dam shallow enough to have the bottom covered with water plants. It had a silica content of 45 ppm.

Lake Naivasha

This lake deserves fuller treatment as it was visited on several occasions and something is known of its plankton periodicity. It lies in the Rift Valley at 6,000 ft. and has an area of 70 sq. miles. It is fed by rivers from the Aberdares and from the hills above Gilgil and is one of the few Rift Valley lakes with relatively fresh water. As it has no surface outlet and is surrounded by alkaline volcanic deposits, one would expect it to build up a strong salt concentration due to evaporation, as is the case in some other Rift Valley lakes. That this does not happen can only be explained by assuming the presence of a subterranean outlet.

A thorough study of L. Naivasha was made during the Cambridge Expedition to the East African Lakes in 1930-31 when the flora and fauna was related to the chemical properties of the water. The following observations made in 1963/4 may therefore be of interest in comparison with the earlier results.

Lake levels

There is evidence from the study by Leakey and others of the former lake terraces that the water level was at one time much higher than it is now, perhaps 300 to 400 ft. above its present level, and that it may then have found an outlet through the Njorowa gorge. In 1906 the riparian boundary was fixed at 6,218 ft. above sea level. By 1917 the level was 6,219 ft., the highest in recent times and after that it fell considerably. After the 1961 floods it rose to 6,197 ft. and by 1964 had reached 6202 ft., still not quite up to its 1917 maximum.

There are three distinct parts of the lake to be considered.

Crescent Lake: This lies in a depression inside the curve of Crescent Island which is the rim of a volcanic crater. It is deeper than the main lake from which it was almost cut off when the water level was low. In November 1964 the depth of the main lake was 21.6 ft. and there was considerable mixing between its water and that of Crescent Lake. Most of the plankton collections were taken from Crescent Lake which could easily be reached by a rowing boat.

Main Lake: Refers to the main body of water outside the rim of Crescent Lake. At the time of this study, there was also a large flooded area where previous farm land was under water and fencing posts and even telegraph poles were sticking out of the water among dead trees. The original fringe of papyrus was well out into the water and water lilies occupied the shallow lagoons behind it.

Loydien Bay: This is a small lake in the S.W. corner of the basin which was formerly cut off from the main lake by a strip of swampy land. About 1956, a channel was cut through to connect the bay with the main lake whose level was higher than that of the bay. This resulted in a deepening of the bay and in the dilution of its water in respect of certain salts. Since 1961 there has been considerable mixing of the waters and in 1964, during the present study, the dividing strip was often under water. Except when the water level is very high, the phytoplankton of the main lake and Loydien Bay remain quite distinct.

PHYTOPLANKTON

The chief constituents of the Main Lake were diatoms and Cyanophyta though a few Chlorophyta and desmids were always present. There were two kinds of diatoms:- pennate diatoms which are often needle shaped and exist usually as single cells, (Fig. 6) and a centric diatom called *Melosira* (See photo). The cells of *Melosira* are the shape of a cylindrical box and they are joined by their circular ends to form a chain. The place where the lid of the box overlaps the bottom can often be seen as a narrow band and when the lid and the base come apart, an H-shaped piece is left at the end of the chain. Desmids showed a surprising maximum in December 1964 when the pH was 7.7. These organisms are usually associated with acid waters.

The plankton of Crescent Lake at most times resembled that of the Main Lake but had more Cyanophyta and *Tribonema*. As more collections were available from this part of the lake, a distinct periodicity could be seen. *Melosira* was just present in February, reaching a maximum in April which was maintained till October when the numbers decreased again. Other diatoms were always present but were at their lowest at the time of the *Melosira* maximum. In December, as in the Main Lake, desmids increased tremendously at the expence of other constituents.

The changes in the plankton of Loydien Bay were very intersting. The first collection in March 1964 showed very little in a net haul. But when iodine was added to a bottle of lake water the precipitate contained very many minute Cyanophyta, too small to be held by the plankton net but sufficiently abundant to colour the water green. The next collection, 7 months later, had quantities of larger Cyanophyta as well as the minute forms and, in addition, plenty of *Melosira*. A month later, in December 1964, Cyanophyta were still abundant, *Melosira* much less, and even here with a pH of 9.3, there was 2% of desmids.

At least part of these changes in the phytoplankton must be attributed to the flow of water from the flooded Main Lake. A sample taken from the Loydien Bay end of what used to be the connecting channel showed the plankton to be very similar to that of the Main Lake. The pH was 7.5 and the alkalinity (.0042) and conductivity (395) between that of the bay and the lake. If the high level of the Main Lake continues it should result in a conciderable freshening of the water of Loydien Bay.

Unfortunately, it was not possible to get complete water analyses at the time of each collection, but some features of interest are seen if a comparison is made between the water of the three parts of the lake in December 1964 (Diagram 3). Loydien Bay had much the highest alkalinity with resulting high pH and conductivity. 30% of the alkalinity was due to carbonate. Sodium was high. Crescent Lake had only about ¼ the alkalinity of the bay and it was all due to bi-carbonate. Conductivity and pH were lower. Chloride was high and magnesium present. Main Lake was similar to Crescent Lake but chloride and calcium were lower and magnesium absent.

It is known from studies in Lake Victoria and elsewhere that the abundance and size of plankton-eating Tilapia is related to the nature of their food. A cursory glance at the gut contents of Tilapia from Naivasha showed that they had digested the diatom Melosira rather than the other algae. A further study of this kind might be of value in developing the fisheries of this lake.

Summary

The composition of the phytoplankton collected at monthly intervals from Sasumua and Ruiru reservoirs is described. Plankton periodicity is demonstrated for both waters and is shown in some instances to be related to rainfall.

The distribution of the major plankton algae in a number of Kenya waters is described. The lakes and dams are shown to fall into groups characterised by the dominance of certain types of algae related to figures for pH, conductivity and alkalinity. The phytoplankton of Lake Naivasha is described and algal periodicity is demonstrated for this lake.

It is hoped to publish a fuller taxonomic account of this investigation at a latter date.

Acknowledgments

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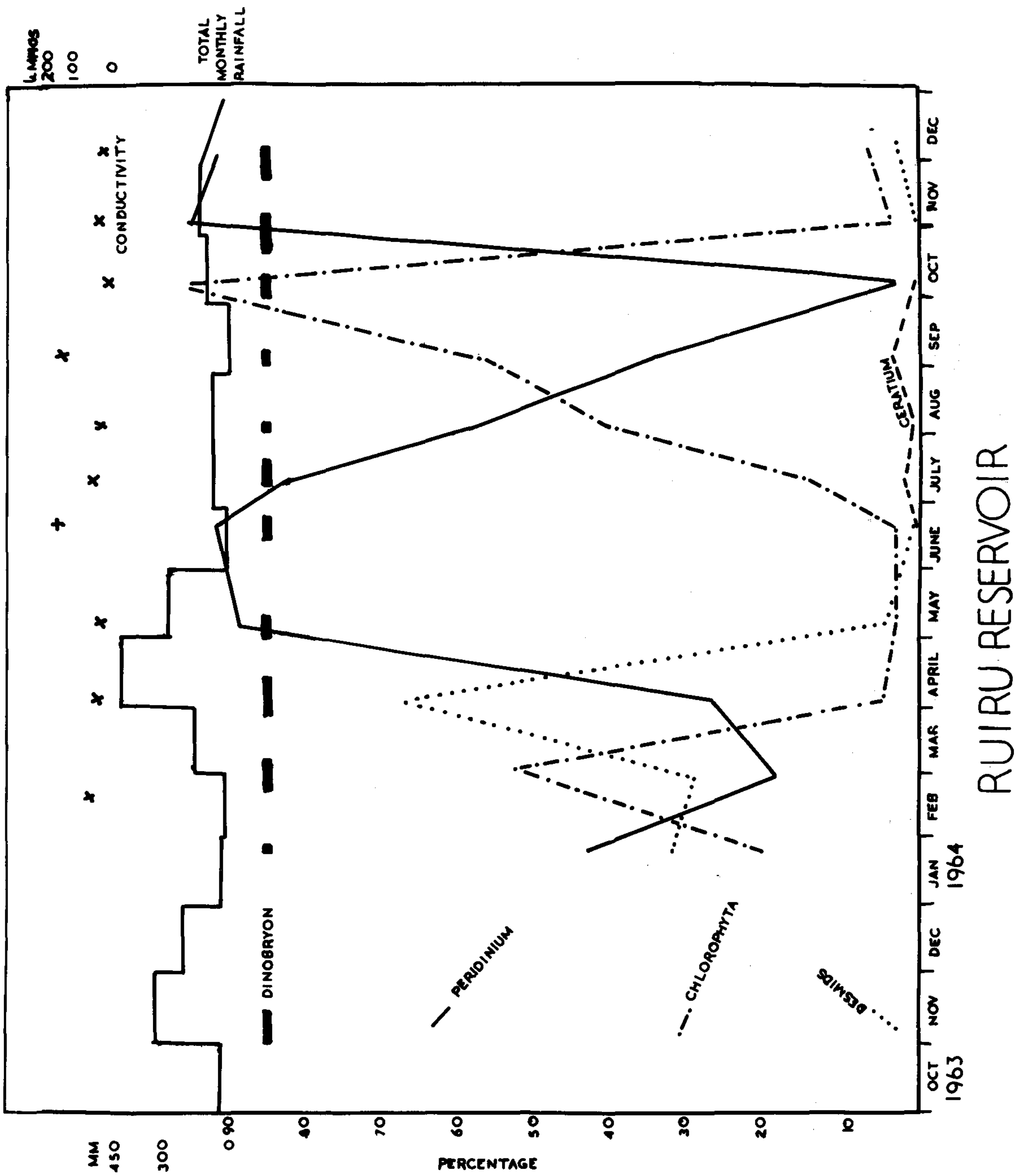

DIAGRAM 1: DISTRIBUTION OF PHYTOPLANKTON IN RELATION TO RAINFALL. NO COLLECTION WAS MADE IN DECEMBER 1963

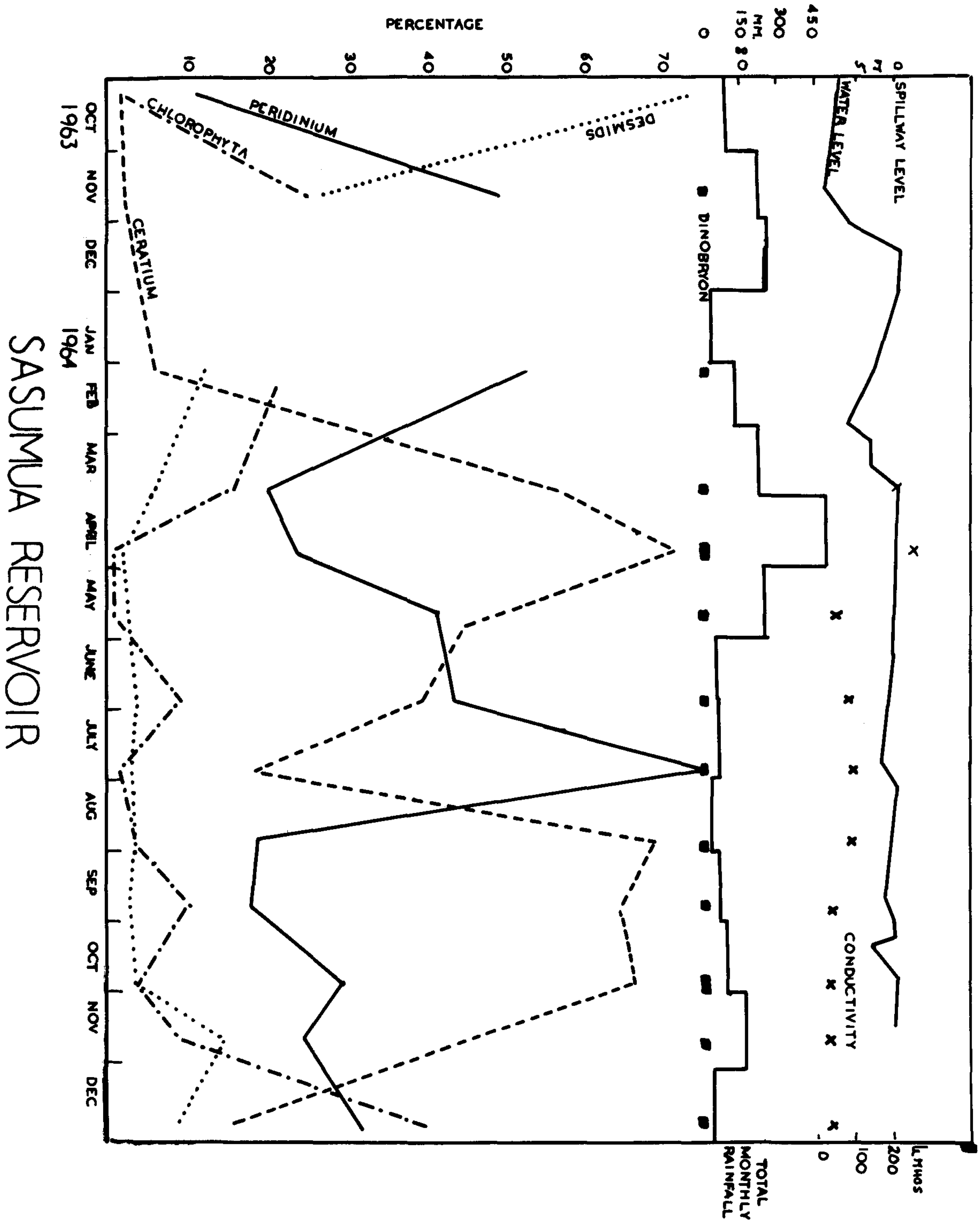

DIAGRAM 2: DISTRIBUTION OF PHYTOPLANKTON IN RELATION TO RAINFALL. NO COLLECTION WAS MADE IN DECEMBER 1963

	pH	Cond.	Alkalinity (normality)	Na ppm.	Ca ppm.	Mg ppm.	Cl ppm.	Melo-sira	Diatoms other	Cyano-phyta	Desmids
Loydien Bay	9.3	900	.0099	84	24	Nil	5.2	X	X	XXXX	X
Crescent Lake	7.7	250	.0023	29	27	11.2	20.6	X	X	+	XXXX
Main Lake	7.7	250	.0023	26	3.5	Nil	1.3	X	X	+	XXXX

Diagram 3 : Comparison of water and phytoplankton of three areas of Lake Naivasha, December 1964

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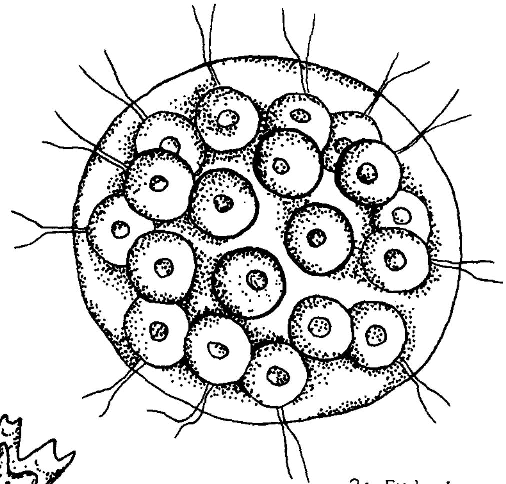
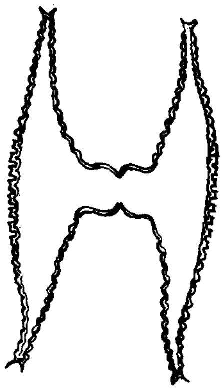
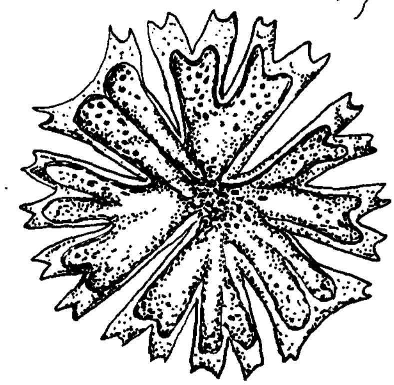
1: Kirchneriella sp.



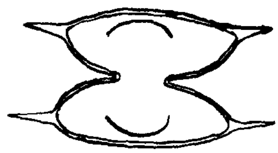
2: Eudorina sp.



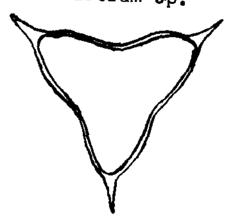
3: Staurastrum sp.



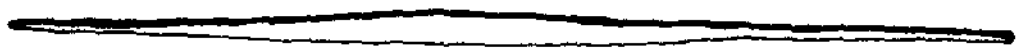
4: Micrasterias sp.



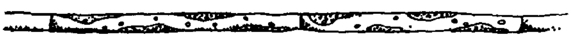
5a: Staurastrum sp.



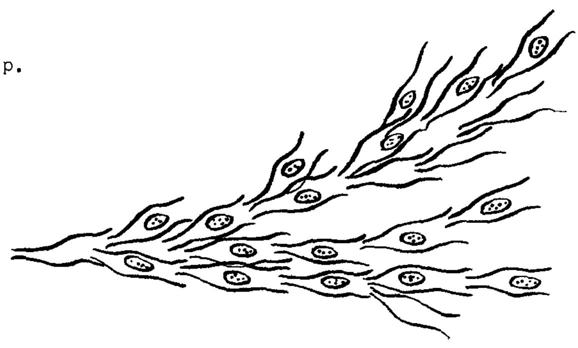
5b: end view of 5a



6: Pennate Diatom

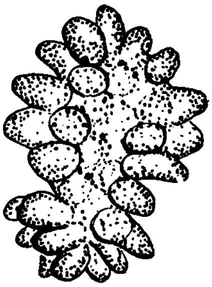


7: Tribonema sp.

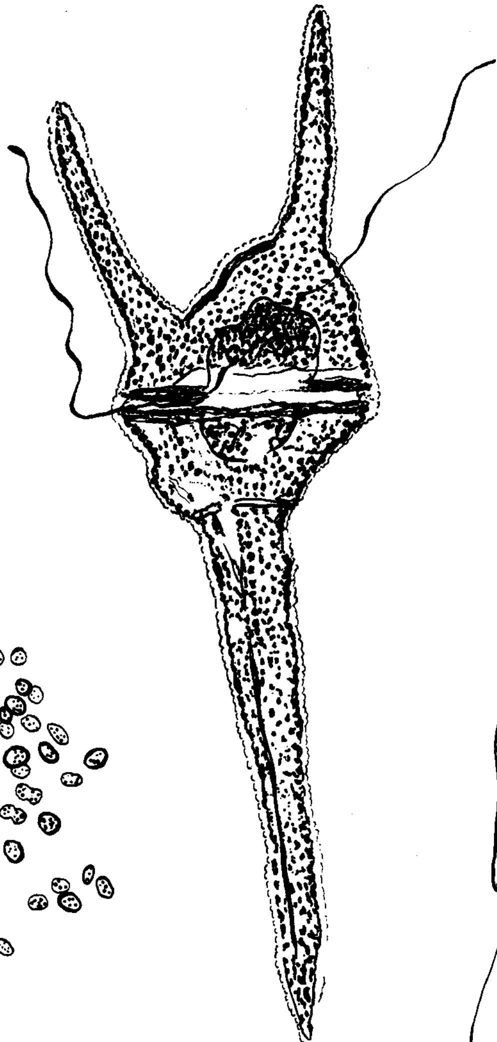


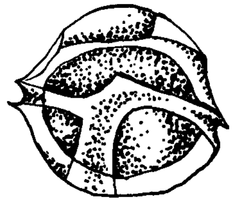
8: Dinobryon sp.

All figures x 160

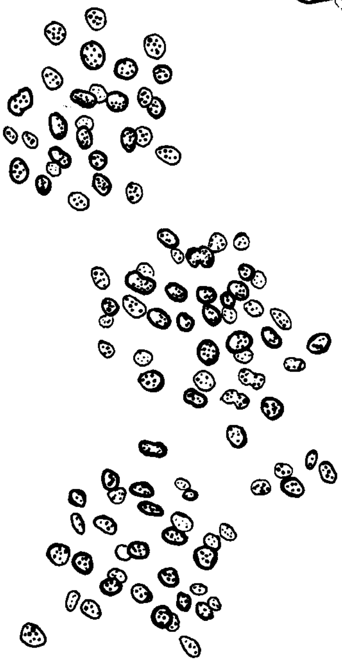


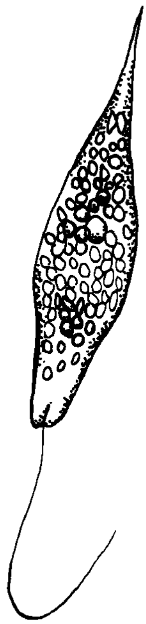
9: Botryococcus sp.





11: Peridium sp.

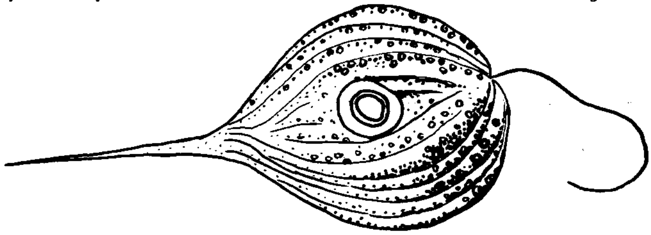




10: Ceratium sp.

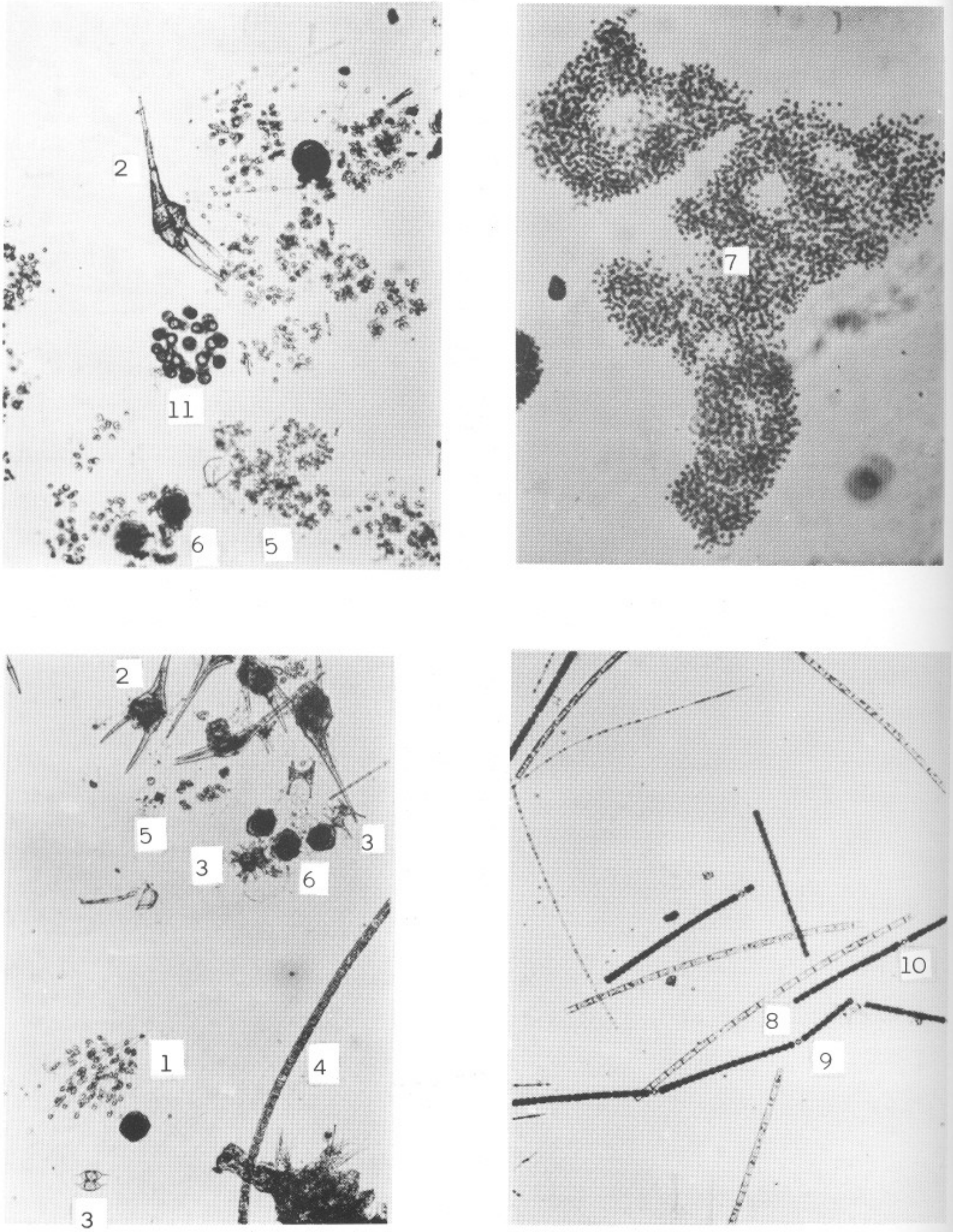
12: Microcystis sp.

13: Euglena sp.



14: Phacus sp.

All figures x 160



1 Dinobryon. 2 Ceratium. 3 Desmid. 4 Chain Desmid. 5 Chlorophyta.
6 Peridinium. 7 Microcystis. 8 Melosira. 9 Tribonema.
10 Cyanophyta. 11 Eudorina.