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STUDIES ON THE VEGETATION AND HYDROCHEMISTRY OF SCANIAN LAKES I–II

BY

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I

HIGHER AQUATIC VEGETATION

BY

ASTA LUNDH

Fig. 1. The distribution of the investigated lakes.

Introduction.

In 1944 the author began an investigation of the higher aquatic vegetation in the lake Krankesjön on the Vomb plain. The following year the lake Yddingen in southwestern Scania was also studied in a similar manner, and in 1946 the lake Råbelövssjön on the Kristianstad plain.

In order to obtain further material for comparison a less detailed investigation of several lowland lakes in southern Scania as well as on the Kristianstad plain was also undertaken in 1946, namely, Fjällfotasjön, Börringesjön, Havgårdssjön, Svaneholmssjön, Krageholmssjön, Ellestasjön, Snogeholmssjön, Sövdesjön, Vombsjön, Araslövssjön,

Table 1. Survey of the areas, maximum depths, heights above sea-level, the rainfall areas and the outflows of the investigated lakes.

Lake	Area sq. km.	Maximum depth m.	The height above sea-level m.	Rainfall area at the outlet sq. km.	Outflow
1. Yddingen	2.6 S	3.3 S	43.1	23	The river Segeå
2. Fjällfotasjön	2.5 S	2.5 S	51.9	15	Into Börringesjön
3. Börringesjön	3.2 L	3.3 S	49.1	53	The river Segeå
4. Havgårdssjön	0.6 L	5.8 S	50.8	11	Into Börringesjön
5. Björkesåkrasjön	1.1 L	about 2 S	59.6	17	Into Häckebergasjön
6. Häckebergasjön	0.9 L	3.5 S	49.1	66	The river Höjeån
7. Svaneholmssjön	0.2 L	2.5 S	58.5	9	The river Skivarpsån
8. Krageholmssjön	2.1 S	9 S	43.4	14	
9. Ellestasjön	2.9 S	5.5 S	38.3	29	Into Snogeholmssjön
10. Snogeholmssjön	3.0 S	8.5 S	36.2	52	Into Sövdesjön
11. Sövdeborgssjön	0.1 L	—	37.4	1	» »
12. Sövdesjön	2.8 S	8.1 S	34.5	99	The river Klingvallsån
13. Heljesjön	0.3 L	—	22.2	2	» » »
14. Vombsjön	12.4 S	15 S	19.5	444	The river Kävlingeån
15. Krankesjön	4.2 H	about 2	19.0	48	» » »
16. Gyllebosjön	0.4 L	—	67.4	10	The river Tommarpsån
17. Tunbyholmssjön	0.1 L	about 2	88	11	» » »
18. Ringsjön, western part	14.5 S	5.7 S	53.7	388	The river Rönneå
Ringsjön, eastern part	26.2 S	15 S	53.7	326	Into western Ringsjön
19. Dagstorpssjön	0.5 L	—	106.7	5	The river Rönneå
20. Kvesarumssjön	0.6 L	—	104.8	8	Into eastern Ringsjön
21. Tjörnarpssjön	0.6 L	about 3 D	109	9	Into Finjasjön
22. Bosarpssjön	0.8 L	—	116.7	16	The river Vramsån
23. Finjasjön	10.9 H	—	43	246	The river Almaån
24. Araslövssjön	5.1 S	1.8 S	0.9	3927	The river Helgeå
25. Hammarsjön	20.7 S	2.6 S	0.7	4154	» » »
26. Råbelövssjön	8.3 S	11.0 S	2.0	49	Into Hammarsjön
27. Oppmannasjön	14.5 S	12.5 S	5.9	91	Into Ivösjön
28. Levrasjön	3.0 S	18 S	7.2	13	» »
29. Siesjön	0.4 L	—	10	14	The brook Sissebäck
30. Västersjön	5.4 H	—	66.4	41	Into Rösjön
31. Rösjön	3.6 H	—	66.4	89	The river Rössjöholmsån

D = DAVIDSSON (1925).
L = the determinations are made planimetrically by A. LUNDH. H = Hydrologiska Byrån, Stockholm, S = SAHLSTRÖM (1945).

The heights above sea-level are taken from the maps (scales 1 : 50 000 and 1 : 100 000) and the rainfall areas are given by Sveriges Meteorologiska Institut, Hydrologiska Byrån, Stockholm.

Hammarsjön and Levrasjön. In 1947 the studies were continued partly in some lowland lakes, namely, Björkesåkrasjön, Heljesjön, Ringsjön, Oppmannasjön and Siesjön, partly in some lakes situated in provinces of different geological constitution, namely, Gyllebosjön, Tunbyholmssjön, Dagstorpssjön, Kvesarumssjön, Tjörnarpssjön and Bosarpssjön. For comparing the lowland lakes with real Archaean lakes, the lakes Västersjön and Rösjön on the ridge Hallandsåsen were investigated in the same year for the first time. In 1948 some excursions were made to Sövdeborgssjön and Finjasjön. The observations in the lakes already mentioned were continued. In the main the investigations were completed in 1949 (with the exception of Ringsjön). Altogether 31 lakes have been studied. The distribution of lakes is given on the map in figure 1, and some other characteristics are to be found in table 1.

The investigation on the vegetation have partly been financed by grants from the Royal Academy of Science, the National Board of Natural Science Research and the fund for field research of Lund University.

Geological survey.

A. Genesis and location of the lakes.

Most of the 31 lakes investigated have probably been formed by the work of glaciers and ice-rivers.

Of the lakes in southern and central Scania only Ringsjön and Vombsjön are situated at faults, which may have taken part in the genesis of these lakes. The southwestern group of lakes, west of the ridge Romeleåsen, is all moraine lakes, formed in connexion with dead ices in a district of end moraines (HOLST 1911). According to WENNBERG (1949) Vombsjön and Krankesjön are also to be regarded as typical dead ice lakes.

The group east of Romeleåsen is located from Vombsjön to Krageholmssjön in an old depression in the bedrock. A compression of the moraine deposits, where these are composed of clay, might here have contributed to the formation of the lake basins (Fil. lic. E. MOHRÉN, private communication). Gyllebosjön and Tunbyholmssjön are situated in a hilly district of glacio-fluvial deposits. On the retreat of the North East ice large dead ice areas were formed in the region of Ringsjön (LINNERMARK 1942, MOHRÉN 1941 and WENNBERG 1949).

The lakes on Archaean rocks are generally moraine lakes. Tjörnarpssjön is situated in a passage of rubble gravel, extending from Ringsjön to Finjasjön. The position of Finjasjön in the intersection of several fault lines indicates, that its basin has tectonical background. Västersjön and Rösjön are situated in the depressed part along a relatively marked fault, which decreases eastwards (Docent A. SANDELL, private communication).

Hammarsjön and Araslövssjön are to be regarded as widenings of the river Helgeå. The origin of the remaining lakes on the plain at Kristianstad, except Siesjön, has been treated by PERSSON (1932). According to his opinion Levrasjön is mainly dammed up by loose soils. The bottom of Råbelövssjön lies beyond the level of the limestone and must here be dug out in the kaolin. Oppmannasjön is situated in a

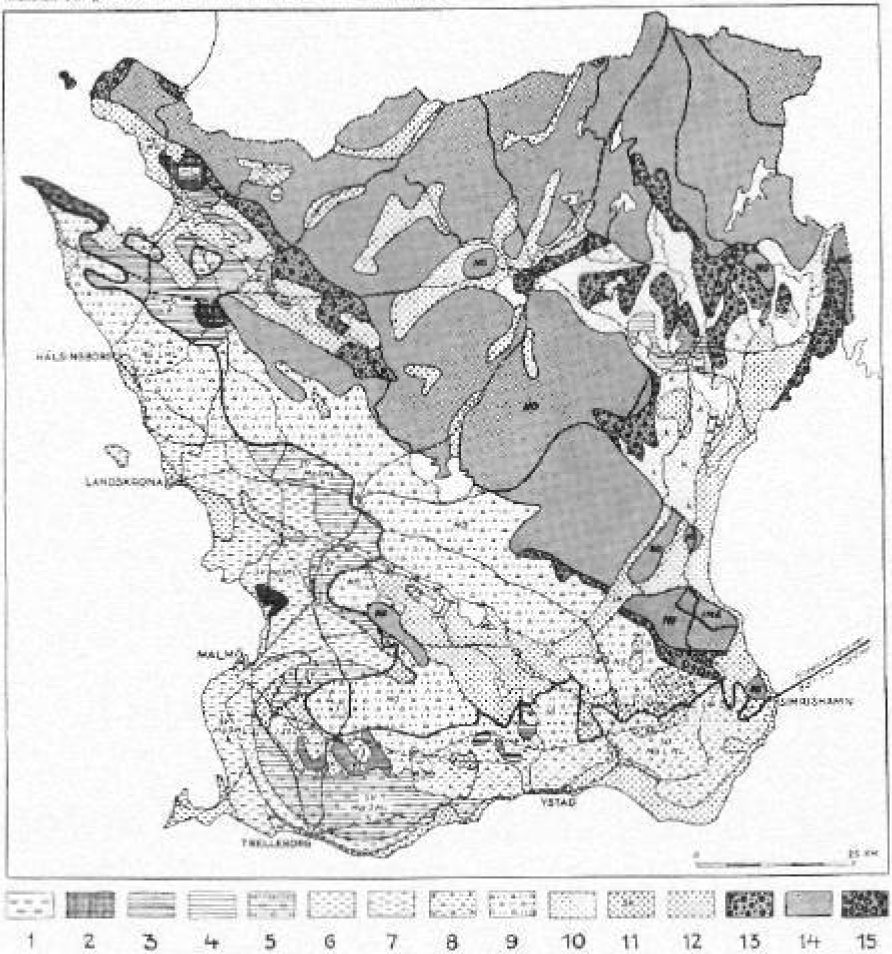

Fig. 2. Regions of cultivated soils in Scania. Map of surface soils. Drawn by Ekström 1949 (Ekström 1950). 1—8 = clays, 9 = clayey moraine sand, 10 = mo soils, 11 = shale-mixed sand, 12 = sand (gravel, rubble-stone soil), 13 = sand (gravel) on moraine, 14 = moraine sand, 15 = moraine stone-soil.

depression in the limestone. Persson does not discuss whether preglacial tectonic has contributed to the genesis of the lakes.

Contrary to Persson, Lundegren (1934) states, that the ice erosion has been important and swept away much of the old cretaceous rocks. He is sceptical as regards tectonical movements.

In table 2 a survey of the location of the lakes is given within the morphological land form districts (Nelson 1935 and 1945) and moraine

Table 2. The position of the lakes within the morphological regions and moraine districts of Scania.

Lake	Morphological region	Moraine district	Dominating soil	Arable land (fields) per cent of land area
1. Yddingen	South Scanian hill district west of Romeleåsen (Sydskånska backlandskapet V. Romeleåsen)	Shale-Archaean moraine NE	Clayey moraine sand	60—80
2. Fjällfotasjön	»	»	»	60—70
3. Börringesjön	»	Southeast moraine B	Clayey moraine sand and clay	60—90
4. Havgårdssjön	»	»	»	50—70
5. Björkesåkrasjön ..	»	Shale-Archaean moraine NE	Clayey moraine sand	50—70
6. Häckebergasjön ..	»	»	»	50—60
7. Svaneholmssjön ..	»	Southeast moraine B	»	70—80
15. Krankesjön	Vomb plain (Vombslätten)	Shale-Archaean moraine NE	Sand and low-moor peat	50—70
14. Vombsjön	»	»	Sand and clayey moraine sand	30—80
13. Heljesjön	»	»	Sand and low-moor peat	30—40
12. Sövdesjön	South Scanian hill district east of Romeleåsen (Sydskånska backlandskapet Ö. Romeleåsen)	»	Sand and fluvial clay	50—60
11. Sövdeborgssjön ..	»	»	Rubble-gravel	50—60
10. Snogeholmssjön ..	»	»	Sand and clay	50—60
9. Ellestasjön	»	Southeast moraine B	Clay	50—70
8. Krageholmssjön ..	»	»	Clay and clayey moraine sand	60—70
16. Gyllebosjön	Southeastern gravel ridge and valley district (Sydöstra grusås- och dalområdet)	Sandstone moraine NE	Rubble-gravel	60—70

17. Tunbyholmssjön ..	»	Shale-Archaean moraine NE	Rubble-gravel and clayey moraine sand	60—70
18. Ringsjön	Central clay shale plain (Centrala lerskifferslätten) and Matteröd—Höör-plateau (Matteröd—Höör-platån)	Shale-Archaean moraine and Archaean moraine NE	Clayey moraine sand and moraine sand	30—70
23. Finjasjön	Central district of Göinge (Göinge mellanbygd)	Archaean moraine NE	Moraine sand and sand	20—40
20. Kvesarumssjön ..	Matteröd—Höör-plateau	»	Moraine sand	20—30
22. Bosarpssjön	»	»	»	30—40
21. Tjörnarpssjön	»	»	Moraine sand and rubble-gravel	20—30
19. Dagstorpssjön	»	»	Moraine sand	20—40
30. Västersjön	Ridge Hallandsåsen	»	Moraine sand and rubble-gravel	< 20
31. Rösjön	»	»	»	< 20
25. Hammarsjön	Kristianstad plain (Kristianstadslätten)	Cretaceous-Archaean moraine NE	Calcareous mo soil and fluvial clay	50—60
24. Araslövssjön	»	»	Calcareous moraine sand and clay	50—60
26. Råbelövssjön	»	»	Calcareous moraine sand	50—60
27. Oppmannasjön ...	»	»	Calcareous moraine sand and mo soil	50—60
28. Levrasjön	»	»	Calcareous moraine sand	50—60
29. Siesjön	»	»	»	50—60

NE = Northeast moraines, B = Baltic moraines.

districts (EKSTRÖM 1940). The most common soils in the surroundings of the lakes are also included according to the map of top soils by EKSTRÖM (1950, figure 2). The table shows their mechanical composition. None of the investigated lakes are situated on the present totally cultivated plains, Ängelholm-Hälsingborgsslätten, Lund-Landskronaslätten, Söderslätt and Österlen. These plain regions nowadays lack lakes. As the peat soils have been strongly drained (EKSTRÖM 1950), the previous lakes have been lowered and ditched. An example of a successful ditching is the drainage of Näsbyholmssjön, west of Skurup.

B. Geological factors and environmental conditions of the lakes.

The geological conditions determine to a large extent the shape and appearance of the lake basins, the constitutions of the shores and the bottom, the chemical and physical properties of the water, and so on. Consequently, the vegetation of the lake is greatly influenced by the geological conditions. The rootless vegetation is restricted to the nutrients of the water, while the rooted plants can absorb nutrients from the substratum as well as from the water, but in varying degrees for different biological types. It seems plausible, that the helophytes obtain their nutrients from the substratum. Hitherto, however, the real facts about the ion absorption of the higher aquatic plants have not been convincingly investigated.

I. Chemical composition of the water.

The chemical properties of the lake water are determined by several factors. Primarily the quality of the water with which the lake is supplied is of decisive importance. Further an exchange of ions takes place in the contact surface between water and underlying substratum. Materials are also introduced into the lake by erosion at shore-line and by winds, and also by the decay of allochtonous organisms.

The contribution of water to a lake is partly composed of ground water, partly of surface water. The investigated lakes have generally (except Araslövssjön and Hammarsjön) few and small tributaries, and, therefore, the ground water must be regarded as the more important water source. The concentration of salts in ground water is influenced both qualitatively and quantitatively by the mineral and petrographical composition of the soils and also by the bedrock. The velocity of the leaching of salts depends to a great extent upon the physical properties of the soils, but it is also affected by climate and vegetation.

Mineral and petrographical composition of the soils.

General survey.

The mineral and petrographical nature of the main types of the moraines varies considerably (the Baltic moraines and the Northeast moraines).

The Baltic moraines belong to the best cultivated grounds of Sweden. Within the district of Baltic moraines lakes only appear on the Southeast moraine. The moraine here is composed of a mixture of various kinds of rocks: Archaean rocks, Cambro-Silurian shales, limestones, sandstones and cretaceous rocks. The most common stone types are Archaean rocks, one-coloured flint, clay shales, grey Baltic limestone and red Öland limestone (Ekström 1940 and 1950). The following lakes belong to this moraine district: Börringesjön, Havgårdssjön, Svaneholmssjön, Ellestasjön, Krageholmssjön. Most of them are surrounded in various degrees by sedimentary soils, especially ice sea clays.

Among the Northeast moraines the Shale-Archaean moraine is an intermediate as regards the fertility (*cf.* Linnermark 1945). It is made up of Silurian shale bedrock and of Archaean rocks. Stones composed of Archaean rocks are dominating, but stones of clay shales, Cambrian sandstone and whitespotted flint are also common. Within this district the following lakes are situated: Yddingen, Fjällfotasjön, Björkesåkrasjön, Häckebergasjön, Krankesjön, Vombsjön, Heljesjön, Sövdesjön, Sövdeborgssjön, Snogeholmssjön, Ringsjön (partially), and Tunbyholmssjön (partially). Among the lakes mentioned, Krankesjön, Vombsjön, Heljesjön, Sövdesjön, Sövdeborgssjön and Snogeholmssjön (partially) are situated on sand and gravel deposits (the Vomb plain).

The calcareous Cretaceous-Archaean moraine of the Kristianstad plain occupies a unique position among the Archaean moraines. The bedrock in this district was formed in the Cretaceous Period. Here Hammarsjön, Araslövssjön, Råbelövssjön, Oppmannasjön, Levrasjön and Siesjön are situated. The main part of the plain consists of sedimentary sand and mo soils. Hammarsjön is, to a great extent, surrounded by such mo soils. Clay also occurs in the vicinity of the lakes, *e.g.*, at Araslövssjön.

The sandstone moraine, which runs in a narrow streak from Fränninge-Långaröd to Simrishamn, is mainly made up of quartzitic Cambrian sandstone. The area is very little cultivated. The lakes, belonging here, are Gyllebosjön and Tunbyholmssjön (partially), but they only contact the moraine to a certain extent, for they are situated in a district composed of glaciofluvial deposits.

In Scania the genuine gneiss moraine has the greatest distribution. It is very suitable for forest-culture, but owing to good physical properties it has also certain advantages as cultivated soil. The following lakes are situated within the gneiss moraine district: Ringsjön (partially), Finjasjön, Kvesarumssjön, Bosarpssjön, Tjörnarpssjön, Dagstorpssjön, Västersjön and Rösjön. Finjasjön, Tjörnarpssjön, Västersjön and Rösjön are to varying extents in contact with glaciofluvial or postglacial deposits.

As is evident from the above only seven lakes belong to the Archaean district. Only five belong to a district, built up of Baltic moraines, *i.e.*, the uttermost contrast to the Archaean area. The remaining lakes are distributed in districts with moraines of transitional types. Only a part of the lakes is completely surrounded by moraine soils. Many are situated on sand, mo or clay deposits. The composition of these sedimentary soils, however, is influenced by the character of the adjacent moraines.

Most of the lakes are located in an area which has not been covered with water since the glacial period. Only the lakes on the Kristianstad plain and Finjasjön lie below the highest coast-line (»högsta strandlinjen»).

Contents of calcium, phosphate and potassium in the moraines.

(a) The calcium content.

The calcium content is great in the Baltic moraines and the soils of the Kristianstad plain. In the Baltic Southwest moraine the content of calcium carbonate can amount to 20 to 25 per cent in the layers, which have not been exposed to leaching (EKSTRÖM 1940). Shale-Archaean moraine has a calcium carbonate content of 4 to 6 per cent. Gneiss moraine and sandstone moraine are most deficient in calcium.

Gyllebosjön is situated in a district built up of sandstone moraine, which has been supplied with calcareous materials from the north by the activity of the ice rivers (*cf.* WALDHEIM 1947, map p. 191).

Vast areas in the district of Archaean rocks, contain also cretaceous materials to various degrees. According to LUNDEGREN (1934), there exists a great possibility, that the cretaceous sea has extended up to the neighbourhood of Sösdala-Tjörnarp. Kaolin occurrences and the present topography are indicative of these assumptions. Further, the Northeast ice has brought calcareous materials from the Kristianstad plain, which is proved by the occurrence of calcareous ground moraine, causing a ground water rich in bicarbonates (LINNERMARK 1945).

Bosarpssjön, Dagstorpssjön, Kvesarumssjön and Tjörnarpssjön are all situated in a region, which, according to the geological maps »Linderöd» and »Trolleholm», shows several findings for calcareous clay and gravel (WALDHEIM 1947, map p. 191).

North and northwest of the connected Cretaceous rocks on the Kristianstad plain several isolated localities of chalk and kaolin occur. As far as in the Röke valley kaolin findings are known. It is only about 30 km. from this westernmost kaolin occurrence to the easternmost chalk locality in the Båstad area (Tormarp, *cf.* LUNDEGREN 1934). In the period after 1934 some new limestone finds were discovered by WEIMARCK (1942) and these are situated farther north than the localities of LUNDEGREN. WALDHEIM (1947, map p. 191) has mentioned a find of limestone and flint from Perstorp.

As is evident from the above Västersjön and Rösjön will be situated in an Archaean area, where limestone finds are not quite unexpected, especially as it is possible, that the material by the fault may have been in a protected position.

The Kristianstad lakes investigated are all situated in an area of coherent cretaceous bedrock or where isolated occurrences are common (LUNDEGREN 1934).

The map of soil acidity of the beet area, published most recently in 1950 by ARRHENIUS, gives a general idea of the calcium carbonate contents of the fields. Only the Baltic moraines and the cretaceous deposits of the Kristianstad plain have an alkaline to neutral reaction, which indicates a high carbonate content, and this condition in spite of the strong impoverishment by the culture. WALDHEIM 1947 (p. 188) has obtained similar results, but from other starting-points.

From the above it seems obvious, that the highest content of calcium carbonate is to be expected in the Kristianstad lakes, and in the lakes on the Baltic moraines, namely Ellestasjön, Krageholmssjön, Börringesjön, Svaneholmssjön and Havgårdssjön. The lowest values are to be expected in the Archaean lakes, especially Västersjön and Rösjön, and in Gyllebosjön and Tunbyholmssjön.

(b) The phosphate content.

In the paper by ARRHENIUS (1934) the analytical results of an investigation of the phosphate content of the fields of all Scanian sugar-beet cultivators are discussed. No values for the remaining field area of Scania, however, are available. According to ARRHENIUS, the bedrock of Scania is generally deficient in phosphate. In most cases, however, it is covered with a thick soil layer, especially in Southern Scania, and it cannot markedly effect the actual phosphate concentration of the fields. Judging from the map (Tavla 1) some districts are very rich in phosphate, *e.g.*, Söderslätt, Lundaslätten and Kristianstadslätten, while other districts, *e.g.*, the centre of Scania and the northwestern parts are very poor. Among the soils the Baltic moraines and the deposits of the Kristianstad plain are especially rich in phosphate. Poor in phosphate are the sand deposits and the Archaean and sandstone moraines. In the Archaean moraines sugar-beet cultivation is impossible. No analyses have been performed in these districts, but the gneiss, the main component of the moraine, has proved very phosphate deficient. The human culture, however, also increases the phosphate content in the soils, and thus the map does not actually indicate the primary conditions, but the results of the effects of the culture.

Within the most phosphate rich areas (see above) lakes are to be found only on the Kristianstad plain. All lakes here are surrounded by phosphate rich arable land. The Archaean lakes are situated, on the other hand, in regions very deficient in phosphate and the rest of the investigated lakes in transitional districts between phosphate rich and phosphate deficient areas.

(c) The potassium content.

In addition to the investigations of the hydrogen ion concentration and the phosphate content in arable Scanian soils, already discussed, Svenska Sockerfabriksaktiebolaget has carried out an investigation of the potassium content of a great number of fields in Scania. The investigation is founded upon analyses of soil samples from farms along fourteen lines, running southwest to northeast through the province. Judging from the values of the analyses and the map, made on the basis of these, a certain so-called potassium class is evidently predominant. The potassium content of this class is from an agricultural point of view not quite satisfactory (the absolute potassium content varies between 6 and 17 mg. K_2O per 100 g. dry soil or 5 and 14 mg. K).

The deviations from this class are rather irregularly distributed all over the investigated part of Scania. From the material available no evident differences between different soil types are to be found. Thus any differences in the potassium concentrations of the lake water cannot be explained by regional differences in the potassium contents of the soils.

Mechanical composition of the soils.

Soils (=jordart according to LINNERMARK's definition 1945) with small particle size have a greater water-holding capacity and decrease, therefore, the velocity of leaching. The soluble substances are brought more slowly to the lakes. A strong leaching, however, depletes the ground, and soluble substances are stored in the lakes. These facts explain that lakes surrounded by poor and acid permeable soils may have a vegetation characteristic of water rich in electrolytes. The concentration of calcium can be so great, that calcareous sediments precipitate on the bottom. An example of the facts related is the lake group Krankesjön, Vombsjön and Heljesjön on the Vomb plain. (As has already been mentioned, leaching is also due to the climate, especially the amount of precipitation).

Sand regions prove considerable more deficient in phosphate than clay regions (ARRHENIUS 1934). Apart from the fact that sandy soils are more permeable to water on account of their mechanical properties, the clayey soils must be richer in phosphate because of their comparatively great adsorptive power, which largely prevents the loss of phosphate by leaching. Certain clay minerals also have a considerable phosphate-fixing power (KELLEY 1942 p. 312). The adsorptive power is still more important as to kations, *e. g.*, potassium, calcium and magnesium (KELLEY 1942, LUNDEGÅRDH 1950 among others). Typical clay lakes are Börringesjön and Ellestasjön.

Clay occurrences are common also at Råbelövssjön and Ringsjön. The reader is referred to table 2 for the details. According to EKSTRÖM (1950) sea clay contains 40 to 50 per cent clay, whereas clayey moraine contains 5 to 15 per cent and moraine sand and sand <5 per cent.

Effects of the climate and the vegetation.

Extreme climatic differences are not to be expected within a small area showing so relatively insignificant differences in level as Scania. The higher central and northern Archaean districts have somewhat lower average temperature (*cf.* p. 31). The precipitation varies more than the temperature, primarily effected by the topography. The highest values are obtained in a streak from north northwest to south southeast to the ridge Linderödsåsen. The climate of Scania has been treated in detail, *e.g.*, by BERGSTEN (1945) and WALLÉN (1945).

Podsolised soils are typically developed on Linderödsåsen and in northern and northwestern Scania, thus in the districts most rich in precipitation. Brown earths are to be found preferably in the southern and western parts of the province (LINNERMARK 1945). The differences in the climate, however, are not especially great, which is evident from the fact that a change in the composition of the vegetation can effect a change in the soil metabolism.

A high precipitation, which accelerates the leaching of the soils and favours the development of mire districts, connected with the mineralogical composition of the soil (Archaean material) probably affects the North Scanian lakes (Västersjön and Rösjön) so that the water becomes deficient in electrolytes and rich in humus. To a certain extent the same conditions are applicable to the lake group Kvesarums-Dagstorpssjön, though the precipitation here is less (BERGSTEN 1945).

Vegetation counteracts leaching (*cf.* ARRHENIUS 1934). By the process of ion absorption the nutrients from the soil are concentrated in the plants. The vegetation richest in herbs creates the humus layer richest in phosphate. Vegetation also diminishes leaching by absorbing a part of the precipitation. The vegetation around the lakes is rather similar in composition, so that it cannot effect any more apparent differences in the leaching processes.

Influence by culture.

By the investigations by ARRHENIUS (1934) it has been established that an old settlement gives rise to an accumulation of phosphates in the soil. By manuring the fields are supplied with considerable amounts of nitrogen, phosphorus and so on. Via ditches and brooks these substances can be transported to the lakes. From grazing cattle some amounts of manure are brought to the lake water.

In such a province as Scania, which has been under cultivation for centuries, the lakes are without exception influenced by culture and settlement, but more or less radically all according to the intensity of cultivation. Figure 3 shows a map of the arable land area in per cent

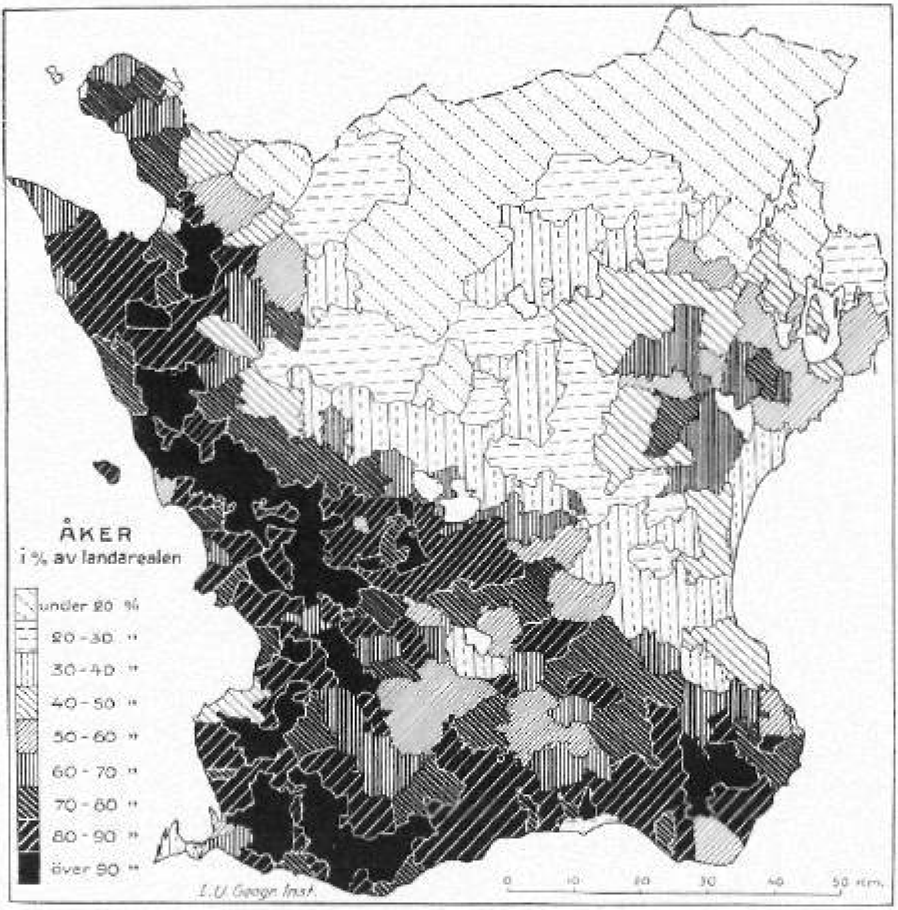

Fig. 3. The arable land area of Scania in per cent of the total land area. The map is taken from ÅGREN (1926 p. 11).

of the total land area. Table 2 gives a survey of the degree of cultivation in the surroundings of the lakes.

Only the lakes on the Vomb plain and on Archaean rocks are situated in districts with a percentage of cultivation below 50 per cent. The wooded Archaean districts have been cultivated later than the lowland districts, which have been more easily tilled. The arable land of the Vomb plain is probably too highly calculated. The fields often lie fallow for several years. All this contributes towards making these two areas considerably less affected by culture than the other districts investigated.

The lake water also receives electrolytes by contaminated water from factories, dairies and so on, a matter of common occurrence nowadays. See further ALMESTRAND (1951).

Summary.

In summarizing the results it can be stated that it should be possible to draw some conclusions concerning the chemical properties of the lake water with the guidance of the factors discussed. The chemical analyses will prove to which extent these conclusions are true.

The lakes on Archaean rocks ought to form a separate group, but those situated on gneiss moraine more or less rich in lime, Bosarpssjön, Dagstorpssjön, Kvesarumssjön, Tjörnarpssjön and Finjasjön should deviate from genuine Archaean lakes. The cultivation should exert less influence.

The lakes on the Kristianstad plain should originally have been most rich in lime and phosphate. The lake bottom sometimes descends to the limestone. Naturally they are also affected by culture. This factor ought to have had a still greater importance for the water quality of those south Scanian lakes, which are small and border on plains, completely cultivated, *e.g.*, Börringesjön, Ellestasjön, Krageholmssjön and Yddingen. The three lakes first mentioned are also rather clayey and should differ from the others with their turbid water and perhaps a higher phosphate content.

The lakes of the Vomb plain lie on leached acid sandy soils. It is probable, however, that the lime content of the soils originally has been high. The strong leaching of the sand should under such circumstances cause a lake type which does not correspond with the surroundings. Some lakes here also receive water by tributaries from other districts.

Gyllebosjön and Tunbyholmssjön, which are situated in a transitional area between Baltic moraines and Archaean moraines, should occupy an intermediate position.

Ringsjön should not completely correspond to the lowland lakes, as it is in contact with vast Archaean districts.

II. Physical properties of the water.

Among the physical features of the water, more or less influenced by the geological conditions, the following are to be mentioned: temperature, water colour, transparency and turbidity.

The water temperature.

The temperature conditions in the lake water are affected by the depth of the basins among other factors. As no considerable depths exist in the lakes investigated, no marked stratification and no distinct thermocline might be expected. The vertical series of temperature records, which have been taken at regular intervals of depths from surface to bottom during the summer in two relatively deep lakes, Vombsjön and Råbelövssjön, gave no proofs of temperature stratification. In summer shallow lakes have generally warmer water than deeper ones, even if the difference is rather insignificant (PEARSALL 1921). The cooling in autumn is also more rapid.

A comparison between Levrasjön, Oppmannasjön (Kiaby), Siesjön and Råbelövssjön (Ekestad) indicates that the temperature of Levrasjön in spring is lower and in autumn higher than in the other lakes. The deep lake thus changes its water temperature more slowly than the shallow ones. The temperatures were observed at similar localities and on the same day (except one observation: Levrasjön April 17), but not at the same time of the day. The differences, however, are so marked (see below), that they cannot completely be ascribed to the day and night variation. Siesjön, the shallowest and smallest lake, shows the greatest changes of temperature.

	April 18	May 23	June 13	July 16	Nov. 6	Nov. 30
Levrasjön	8.8	10.6	18.2	18.6	7.8	4.9
Oppmannasjön	10.0	15.8	20.5	20.6	6.7	4.2
Siesjön	12.5	16.3	23.7	20.3	6.5	1.4
Råbelövssjön	10.2	15.0	20.5	20.8	6.8	3.6

The water colour.

The water colour should be defined as the shade which is given to the lake water by the dissolved and colloidal substances (the true colour of water according to WELCH 1935). Thus, before the determination all suspended matter must be removed. The water colour is probably a very complex phenomenon (WELCH 1935, ÅBERG-RODHE 1942). It is under the influence of, *e.g.*, the content of iron, humus materials and calcium carbonate in the water. These substances exist in varying amounts in the surrounding soils.

In field studies a record of the colour visible against the Secchi disk is generally performed in connexion with the determination of the transparency. This colour is not indicative of the true water colour, for it

Table 3. The lake colour of the investigated lakes.

Green: Levrasjön.
Green to yellow-green: Gyllebosjön, Heljesjön, Råbelövssjön.
Green to yellow-brown: Havgårdssjön, Snogeholmssjön, Vombsjön.
Yellow-green to yellow: Krageholmssjön, Oppmannasjön (Kiaby), Ringsjön (Sätoftasjön and E. Ringsjön).
Yellow-green to yellow-brown: Ellestasjön.
Yellow-green to brown: Krankesjön.
Yellow to yellow-brown: Börringesjön, Oppmannasjön (Norregård), Siesjön, Sövdesjön, Sövdeborgssjön?
Yellow-brown: Tunbyholmssjön, Yddingen.
Yellow-brown to brown: Bosarpssjön, Kvesarumssjön, Rösjön.
Yellow-brown to (red-)brown: Dagstorpssjön, Fjällfotasjön, Tjörnarpssjön, Västersjön.
(Red-)brown: Svaneholmssjön.

The colours according to LUNDQVIST 1937.

is also influenced mainly by the amount and quality of the suspended materials (the apparent colour of water, according to WELCH). This lake colour (»Seefarbe») has been treated exhaustively in Swedish literature, *e.g.*, by LUNDQVIST 1936 and THUNMARK 1937).

Table 3 gives a survey of observations of lake colour carried out during the years 1944—49. The lakes situated on Archaean rocks belong to the brown range. Probably Finjasjön also belongs to this group, but this opinion is only founded upon one determination in the eastern part of the lake. In August 1950 a yellow-brown colour was recorded. It is, however, likely, that such a big lake shows a different lake colour in different parts, as the affluents flow through geologically heterogeneous areas. (As is seen from the table, the two localities in Oppmannasjön have different colours.) A single determination is, in this case, consequently, less informative than usual. The tributaries richest in humic substances do not flow out into the investigated part of the lake.

Most of the remaining lakes with the same lake colour are surrounded by rather vast fens, *e.g.*, Fjällfotasjön, Svaneholmssjön, Tunbyholmssjön and Yddingen. Häckebergasjön probably also belongs to this group, but only two values are available. According to the table the following lakes have a fairly insignificant quantity of humus materials: Börringesjön, Oppmannasjön (at Norregård), Siesjön and Sövdeborgsjön(?). Also in this case the humus materials are probably supplied from surrounding fens and areas with »Verlandung». Since June 1947 no yellow-brown colour has been observed in Börringesjön. This fact is probably explained by the drying of surrounding fen grounds in connexion with the regulation which was carried out that summer.

Ringsjön is partly included in the table, but no sufficient number of determinations have been performed. Judging from the few values available, the lake colour seems to be yellow-green to yellow. No greater differences in the three parts of the lake have been observed. Of lowland lakes investigated only four have green or yellow-green water, namely Levrasjön, Gyllebosjön, Heljesjön och Råbelövssjön. Levrasjön has no large tributaries. Earlier it had no outflow, and then it was a typical seepage lake (*cf.* JUDAY and BIRGE 1933). In such a lake a colour of the present type is to be expected (*cf.* LUNDQVIST 1936). Heljesjön has also been a seepage lake like Levrasjön. Gyllebosjön has very insignificant visible affluents, but a natural outlet exists. Råbelövssjön has a few small tributaries (including one from fen grounds, the brook Ekestadsbäcken), but its big basin is apparently filled mainly by ground water. All these four lakes have also high transparency (table 4) and they are relatively deep (table 1).

Some lakes have a very varying lake colour: Ellestasjön, Havgårdssjön, Krankesjön, Snogeholmssjön and Vombsjön. The causes of the colour variations in the separate lakes are not discussed here.

The transparency.

Light penetration is due to several factors. Among those influenced by geology the content of soluble substances and inorganic and organic suspended matters might be mentioned. The light penetrating ability of the water is naturally of great importance for vegetation, even if the selective light absorption within the light penetrating layers may not be overlooked.

A widely used method for obtaining an idea of the transparency of the water is a measurement of the depth at which the white colour of a Secchi disk disappears. The method is rather rough and subjective but gives, at least in broad outline, comparable results, especially if all observations are performed by the same person. However, the values are often not completely comparable, because the observations must be carried out on the field trips independent of the actual weather and time of the day. The ideal will be a determination of the transparency in days with similar weather and at the same time of the day. The method employing the Secchi disk is very practical, however, and can be used in most field researches.

The present observations (table 4) have been made by using a Secchi disk of 25 cm. in diameter. From Araslövssjön, Björkesåkrasjön and

Table 1. Survey of the transparency in m. of the investigated lakes.

Lake	Minimum	Average	Maximum	Number of determ.	Time of determ.
Råbelövssjön	1.05 (July)	1.95	3.60 (Oct.)	12	April—Oct.
Oppmannasjön, Northern part ..	0.60 (Sept.)	0.70	0.80 (Sept.)	4	Aug.—Sept.
Oppmannasjön, At Kiaby	1.15 (Sept.)	1.20	1.25 (Aug.)	3	» »
Levrasjön	2.85 (Sept.)	4.30	6.35 (May)	10	April—Sept.
Siesjön	1.00 (May)	1.20	1.45 (Sept.)	7	» »
Yddingen	0.40 (July)	0.60	1.00 (April)	17	April—Nov.
Fjällfotasjön	0.30 (Sept.)	0.45	0.70 (April)	12	April—Sept.
Börringesjön	0.25 (Aug., Sept.)	0.35	0.60 (April)	13	» »
Havgårdssjön ...	1.45 (Aug.)	—	> 3.20 (May)	6	May—Sept.
Häckebergasjön ..	0.65 (June)	0.85	1.05 (Aug.)	4	June—Sept.
Svaneholmssjön ..	1.40 (Aug.)	—	> 2.05 (bottom)	8	May—Oct.
Krankesjön	0.25 (July)	0.65	1.25 (Nov.)	15	April—Nov.
Vombsjön	0.60 (Aug.)	0.95	1.80 (April)	9	» »
Heljesjön	3.05 (April)	3.90	4.90 (Oct.)	7	April—Oct.
Sövdesjön	0.45 (Sept.)	0.70	1.10 (May)	10	May—Oct.
Sövdeborgssjön ..	1.40 (Aug.)	1.65	2.30 (Oct.)	4	Aug.—Oct.
Snogeholmssjön ..	0.40 (Sept.)	0.60	0.90 (May)	12	April—Oct.
Ellestasjön	0.25 (Aug.)	0.45	0.75 (May)	9	» »
Krageholmssjön ..	0.75 (Aug.)	1.15	1.60 (April)	10	» »
Gyllebosjön	1.25 (July)	2.50	3.35 (May)	7	May—Oct.
Tunbyholmssjön..		> 1.40 (bottom)		1	August
Ringsjön I	2.10 (Sept.)	3.15	4.60 (April)	34	Febr.—Dec.
Ringsjön II	2.10 (Sept.)	3.65	5.85 (Aug.)	35	» »
Kvesarumssjön ..	0.40 (July)	0.60	0.80 (April)	8	April—Oct.
Bosarpssjön	0.65 (July)	0.85	1.00 (April)	6	» »
Tjörnarpssjön ...	0.75 (Sept.)	1.05	1.70 (May)	7	May—Oct.
Dagstorpssjön ...	1.55 (May)	1.90	2.25 (Oct.)	5	» »
Finjasjön		1.55		1	Aug. 26 1950
Västersjön	2.15 (June)	3.20	3.60 (Sept.)	7	May—Sept.
Rösjön	3.15 (Aug.)	3.70	4.40 (June)	7	May—Nov.

Two values for Häckebergasjön from THUNMARK (1945).

Hammarsjön values of transparency are lacking, and from Finjasjön only one is available. Svaneholmssjön and Tunbyholmssjön are so shallow, that it has been impossible to perform any determinations. Oppmannasjön is represented by two localities (Kiaby and Norregård), the same is the case with W. Ringsjön (I near the outflow, II near the isthmus between W. and E. Ringsjön).

The maximum and minimum values and the average value of all observations are given in the table. The determinations have been performed in the period 1946—49 (except in Krankesjön, where they also date back to 1944—45, and Yddingen, where they date back to

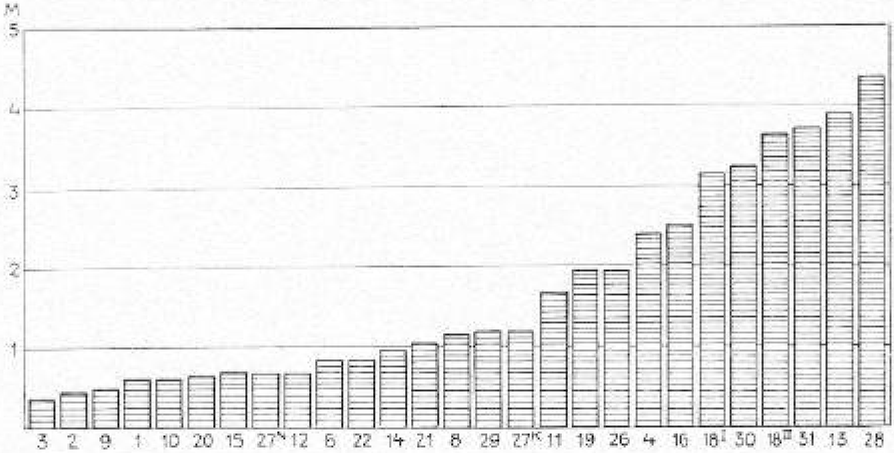

Fig. 4. The transparency of 25 of the investigated lakes. The numbers refer to the numbers of the lakes (see table 1). 18^{I} = W. Ringsjön near the outlet, 18^{II} = W. Ringsjön near the outflow from E. Ringsjön, 27^{K} = Oppmannasjön at Kiaby, 27^{N} = Oppmannasjön at Norregård.

1945). Observations from earlier years, if published, have not been included in the table. The investigated lakes are more or less influenced by culture, and they run, therefore, the risk of having their environmental conditions changed in a short time by man. Thus the old transparency values may belong to a period, when the lake showed another character, and would make the average values incorrect. For the rest, in lakes of normally wide annual variation, as in this case, a single value seems to be of little information.

Generally the values refer to the vegetation period April to October. If determinations have been performed in November to March, the values are included in the mean value, but it is stated that the mean value for April to October is insignificantly different. The averages for several years intend to eliminate the deviation of a certain year from normal, *e.g.*, on account of extreme climatic conditions. Because the lakes are represented by a varying number of observations, the diagram (figure 4) only shows the relative position of the lakes.

The majority of the lakes have a low transparency (about 1 m.). A distinct group is formed by the lakes from Yddingen to Oppmannasjön (Kiaby). All the shallow lowland lakes and Bosarpssjön, Kvesarumssjön and Tjörnarpssjön on Archaean rock belong to this group. It is notable, that Vombsjön, which is relatively deep, also belongs to this group.

A second distinct group is composed of the »highly transparent» lakes (≧2 m.). *Cf.* the survey below, which includes all lakes with a transparency of 2 m. or more.

Lake	Area sq. km.	Lake colour
Dagstorpssjön	0.5	yellow-brown to brown
Rösjön	3.6	yellow-brown to brown
Västersjön	5.4	yellow-brown to brown
W. Ringsjön	14.5	yellow-green to yellow (?)
Gyllebosjön	0.4	yellow-green to green
Havgårdssjön	0.6	yellow-green to green
Heljesjön	0.3	yellow-green to green
Råbelövssjön	8.3	yellow-green to green
Levrasjön	3.0	green

Only one lake, however, is highly transparent (summer transparency >4 m.) according to current opinion (Thunmark 1937 p. 99), namely Levrasjön. As is evident from the survey, all lakes on Archaean rocks have yellow-brown to brown lake colour, that is they are more or less rich in humus, and all lakes situated on sedimentary rocks (except Ringsjön) have green to yellow-green colour. The areas of the highly transparent lakes are very varying, thus Heljesjön is only 0.3 sq. km. and Råbelövssjön 8.3 sq. km. Apparently the area is of no great importance for the transparency. The relation between ground and surface water supply is probably more determining. Ringsjön occupies an intermediate position as regards the lake colour (with a tinge of yellow), which may be due to the fact that the water running into the lake comes from widely different districts, owing to the relatively large rainfall area, and causes a rather heterogenous lake water.

As distinguished from earlier published investigations on transparency and lake colour (Lundqvist 1936 and Thunmark 1937) the lakes in this case are more or less turbid (see below). Vegetation (plankton) turbidity is almost always present during the summer. As the plains are very windy and the lakes often are exposed, a certain amount of detritus is always to be expected, especially in the shallow lakes. In lakes with clayey shores another factor is added, the clayey turbidity. Such a turbidity generally causes a yellow colour (Welch 1935). In this connexion, however, the effects of these factors on the transparency are not discussed in detail.

The water turbidity

The water turbidity is caused by the presence of suspended matter. In addition to plankton organisms and other organic substances the water becomes turbid from inorganic matters, derived from the minerogenous shores and the tributaries. Especially striking is the more or less permanent turbidity, caused by clayey surroundings. (Concerning clayey lakes see p. 19).

III. Characteristics of the lake bottom.

The chemical and physical properties of the minerogenous shores are primarily determined by their geological origin (*cf.* p. 14) but are naturally modified by the work of the waves and the ice.

The deposits of sediments have been formed in a very complicated way, depending upon many local circumstances. Generally speaking, it may be stated, as expressed by LUNDQVIST (1925), that the sediments consists of different kinds of gyttja.

Hydrological and meteorological conditions.

A. Area and depth.

Table 1 gives a survey of the areas, the maximum depths, the heights above sea-level and the rainfall areas of the lakes investigated. As is seen most of the lakes are relatively small, only a few (Ringsjön, Hammarsjön, Oppmannasjön, Vombsjön and Finjasjön) have an area of more than 10 sq. km. Twelve are smaller than 1 sq. km.

As is very often the case with moraine lakes the investigated lakes are shallow. No soundings have been performed by the author (except in Krankesjön), but from several lakes maps of depth have been drawn by the Association of Fisheries in South Sweden and the Agricultural Society of Malmöhus County. These maps are rather old, and in some cases lowerings of the water level have taken place, since the soundings were performed, *e.g.*, in Sövdesjön, Snogeholmssjön, Vombsjön and Börringesjön. An approximation of the depth conditions, however, is achieved. The most recent maps are those of the lakes in the Kristianstad plain, published by PERSSON (1932). Araslövssjön, Björkesåkrasjön, Hammarsjön, Krankesjön, Svaneholmssjön and Tunbyholmssjön are extremely shallow. The sediment layers are often very thick, *e.g.*, in Krankesjön, where a thickness of more than 6 m. has been measured. The greatest depths sounded have been found in Levrasjön, E. Ringsjön, Vombsjön, Oppmannasjön and Råbelövssjön. Västersjön and Rösjön are also relatively deep. In Rösjön a depth of 16 m. has been measured. However, no systematic soundings were made. No depth map of Gyllebosjön is available, but already at a distance of 20 m. from the shore in the northeastern part a depth of 5 m. has been established. According to uncertain information the maximum depth is about 12 to 15 m. The maximum depth of Heljesjön according to an unverified communication is about 18 m.

In spite of the relatively varying depth conditions of the investigated lakes they are to be regarded as shallow ones, if compared with real deep basins.

Some lakes deviate remarkably from the others in the form and size of their basins and the absence of considerable affluents. They are small, have even shore lines and are relatively deep. The surroundings rise rather steeply. The lakes are Havgårdssjön, Heljesjön and Levrasjön.

There is no definition of the term »lake» which is universally accepted without reservation. The boundary between pond and lake must, for natural reasons, be indistinct. The author adheres to the definition given by WELCH (1935 p. 16), who restricts the term »pond» to »that class of very small, very shallow bodies of standing water in which quiet water and extensive occupancy by higher aquatic plants are common characteristics». He classifies all larger bodies of standing water as lakes. Sometimes the term »Weiher» is used as a designation for a lake, which according to FOREL (1901 p. 4) is »ein See ohne Tiefe, er kann in seiner ganzen Ausdehnung von der litoralen Seeflora besiedelt werden». To this type, which without limit passes into the pond type, the following lakes belong: Björkesåkrasjön, Krankesjön, Svaneholmssjön, Tunbyholmssjön, Araslövssjön (?) and Hammarsjön(?). Svaneholmssjön and Tunbyholmssjön, however, may just as well be regarded as ponds.

In fact, the limits between the different lake types are very diffuse owing to continuous transitions, and it is, therefore, futile to distinguish between more than the extremes.

B. Precipitation area.

The rainfall areas are varying, but in most cases small (table 1). Some lakes have practically no drainage area, *e.g.*, Dagstorpssjön, Heljesjön and Sövdeborgssjön. Most of the lakes have visible tributaries, but in summer the small ones often dry up. Araslövssjön and Hammarsjön differ from the other lakes by having vast drainage areas. They receive their water from Helgeå, the largest river in Scania.

C. Climate.

The variations within the temperature climate of Scania are rather insignificant except in the northernmost and the higher central parts, from which only very few values are available. The lakes highest situated lie only about 100 m. above sea-level (table 1), and generally one calculates upon a normal decrease in the annual average temperature of 0°.5 per an elevation of 100 m. (*cf.* BERGSTEN 1945, ÅNGSTRÖM 1938 among others). The annual normal temperature for the period 1901—30 was 7°.5 for Kristianstad, 7°.3 for Lund and 7°.5 for Ystad.

The range in precipitation is, as already mentioned, (p. 20) considerably more apparent. From the northernmost border districts with an annual precipitation of 800 mm. a broad lobe of relatively high precipitation reaches down over the ridge Linderödsåsen (figure 6: station Älmhult 792 mm.). As is wellknown the districts with the least precipitation are the Falsterbo peninsula and the Kristianstad plain (figure 6: station Tommarp 534 mm.). Of the investigated lakes Rösjön and Västersjön are situated in the part of northern Scania with the greatest precipitation (station Ljungaskog 776 mm. in 1946, 558 mm. in 1947, 677 mm. in 1948 and 784 mm. in 1949), while several of the Kristianstad lakes belong to the zone with 500 to 550 mm. The rest of the lakes are located in districts with an annual precipitation of 550 to 650 mm.

It would be of some importance to know the climate of the years 1946—49, when this investigation was performed. It may be supposed that changes in vegetation often are caused by variations in temperature and precipitation. As regards the higher aquatic vegetation, which is treated in this paper, the growth near the shore will be affected by radical changes of the water-level. It is the general opinion of the author, that the year 1947, which had an extremely hot and dry summer, favoured the development of the real aquatic plants, especially the elodeids. The statement is valid for the lowland lakes, unfortunately the lakes situated in Archaean rocks were only sporadically visited that summer. No material, showing the exact distribution of the plants for every year, is available, nor has it been the aim of this investigation. The summer 1947, however, was very unsuitable for drawing vegetation profiles, as vast areas of the normal lake bottom were uncovered. The climate has also an effect upon the lower vegetation, *e.g.*, the plankton production, and to a certain extent also upon the physical and chemical properties of the water.

Table 5 gives a survey of the differences between the temperatures for the years 1946—49 and the normal period 1901—30 (ÅNGSTRÖM 1938). The greatest deviations are shown in 1947, during which the latter part of the winter was very cold and extremely high values were reached in the summer (June, August and September). The year 1949 was warm. The annual average temperature was about 1°.5 above the normal one. The winter months were very mild, likewise the spring

Table 5. A survey of the differences between the monthly and annual average temperatures in 1946—49 and in the normal period 1901—30.

Station		J	F	M	A	M	J	J	A	S	O	N	D	Year
Kristianstad	1946	—0.4	—0.2	—0.5	+ 2.5	+ 0.7	—0.5	+ 1.1	—0.2	+ 1.0	+ 1.7	+ 0.7	—0.9	+ 0.1
	1947	—2.9	—6.8	—4.2	+ 1.2	+ 1.4	+ 2.4	+ 0.6	+ 2.7	+ 2.9	0.0	—0.1	—0.5	—0.3
	1948	—0.6	—0.5	+ 2.1	+ 2.2	+ 1.2	+ 0.7	—0.3	+ 0.8	+ 1.1	—0.2	0.0	+ 1.8	+ 0.7
	1949	+ 1.5	+ 3.1	—0.6	+ 2.0	+ 1.7	—0.2	+ 0.6	—0.3	+ 3.2	+ 1.8	+ 2.0	+ 2.6	+ 1.4
Lund	1946	—0.1	—0.5	—0.5	+ 2.6	+ 1.3	—0.4	+ 1.6	+ 0.5	+ 1.3	—1.3	+ 0.9	—0.4	+ 0.5
	1947	—2.7	—5.8	—3.7	+ 0.7	+ 3.3	+ 3.2	+ 0.9	+ 3.4	+ 3.4	+ 0.4	+ 0.6	+ 0.7	+ 0.3
	1948	+ 0.6	+ 0.1	+ 1.7	+ 3.2	+ 1.1	+ 1.3	+ 0.5	+ 1.3	+ 1.6	+ 0.5	+ 0.8	+ 1.9	+ 1.2
	1949	+ 1.9	+ 3.1	—0.4	+ 2.3	+ 1.7	+ 0.3	+ 1.4	+ 0.3	+ 3.6	+ 2.9	+ 2.2	+ 2.7	+ 1.8
Ystad	1946	—0.2	+ 0.3	—0.7	+ 1.9	+ 0.8	—0.6	+ 1.7	0.0	+ 1.2	—1.5	+ 0.6	—0.8	+ 0.3
	1947	—3.0	—5.9	—3.9	—0.9	+ 1.5	+ 2.4	+ 1.2	+ 2.9	+ 3.3	+ 0.2	+ 0.2	+ 0.2	—0.1

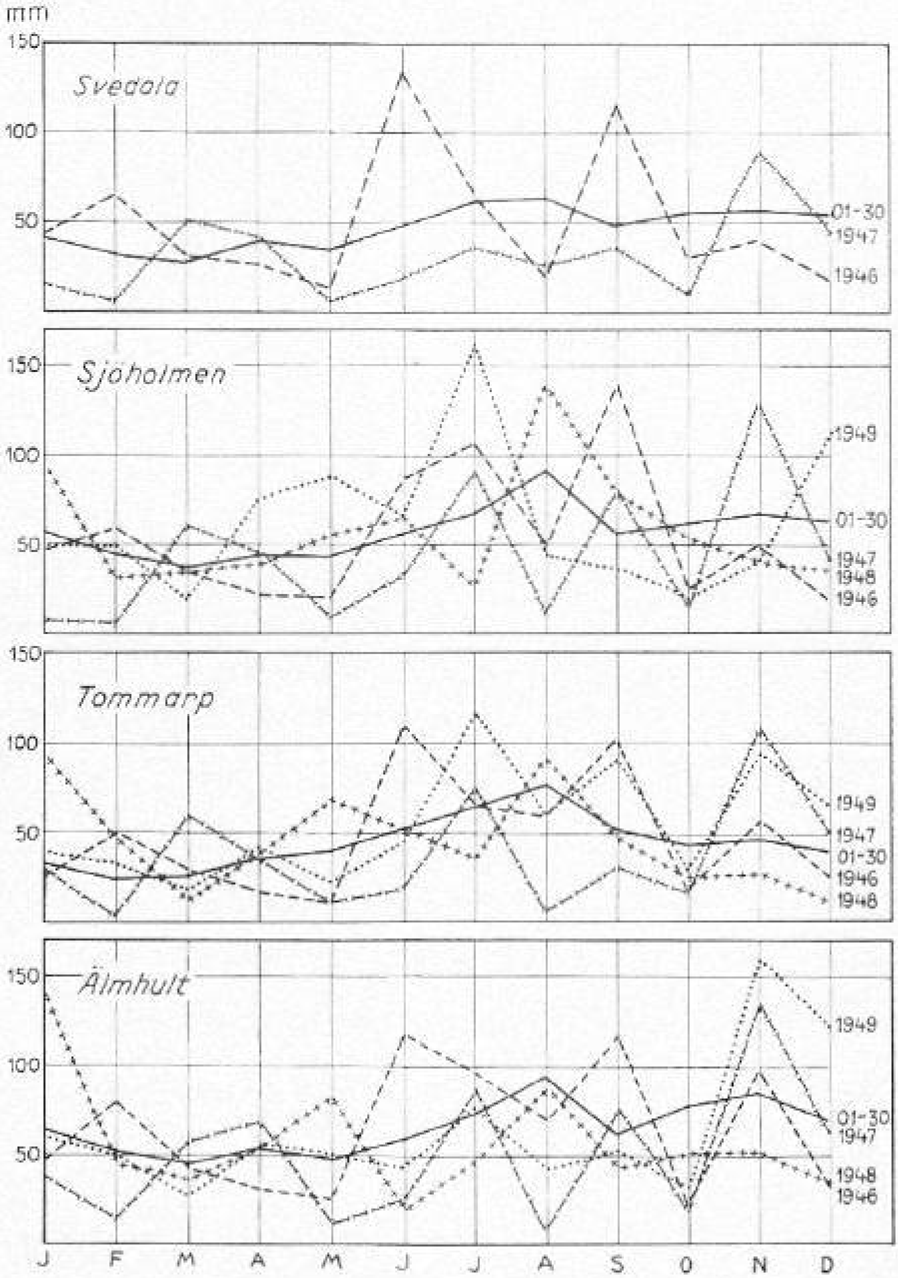

Fig. 5. The monthly average precipitation for the normal period 1901—30 and the monthly precipitation in the years 1946—49 at four stations in Scania. The observations at Svedala discontinued in 1947.

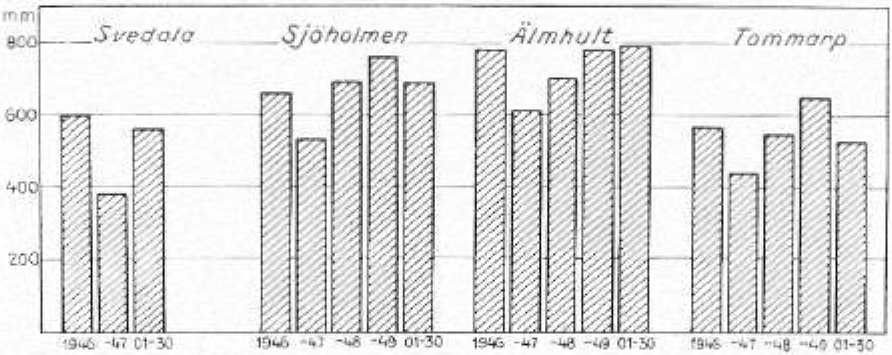

Fig. 6. The annual average precipitation for the normal period 1901—30 and the precipitation in the years 1946—49 at four stations in Scania.

(with the exception of March) and the autumn. The summer, on the other hand, was rather normal. The two remaining years were on the whole normal.

The diagrams for the monthly precipitation (figure 5) include the stations Svedala (Southwestern Scania), Sjöholmen (Central Scania), Tommarp (Northeastern Scania) and Älmhult (Linderödsåsen). Only from these has information of the normal precipitation for the period 1901—30 been available. They are also rather representative for the rainfall areas of the lakes, except Älmhult, which is situated higher than the lake group of Kvesarumssjön-Dagstorpssjön. The diagrams show apparent deviations for the year 1947, which had abnormally small precipitation in January and February, May and June and August (*cf.* also the diagram of the annual precipitation amount, figure 6). The conditions described and the summer heat created a pronounced dry period, which gave rise to very marked traces in the water conditions of the lakes. The three other years showed no exceptional characteristics. The year 1949 must be regarded as rather rich in rain. This is illustrated by the diagrams of the annual precipitation amount and is also seen from the values from stations not published here. July and November and December were especially wet, while October, on the other hand, lay considerably below the normal value. The values of temperature and precipitation have been obtained from Sveriges Meteorologiska och Hydrologiska Institut (partially published in Årsbok 28—30).

It has been very difficult to perform regular and sufficiently frequent measurements of the water-level for several years in succession. Staff

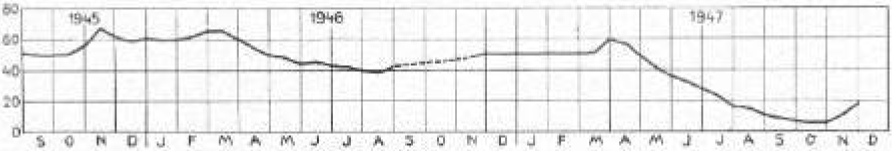

Fig. 7. The fluctuations of the water-level in Yddingen in 1946—47. The exceptionally high water-level in November 1947 was caused by a damming up of the outflow.

gages are established at, *e.g.*, Ringsjön, Vombsjön and Krankesjön, but these lakes are radically regulated by dams and mills, and thus no real natural fluctuations of the water-level can take place. Series of longer duration are available from Yddingen and Råbelövssjön (figures 7—8), but they are unfortunately not complete. They both include, however, the extreme year 1947. It is very striking that different years have different wide variations, which cannot always be attributed to the climate, but are due to intervention by man, *e.g.*, by a damming up of the outflow. In the year 1947 the water-level was as expected very low in the summer and up to November. For Råbelövssjön the lowest values are lacking, but the available ones indicate an abnormal lowering of the water-level. The maximum difference in the water-level was more than 30 cm. in 1947, 12 cm. in 1948, 38 cm. in 1949 and 24 cm. in 1950. The curves for Yddingen show a considerable difference between 1946 and 1947. The maximal water-level differences were about 20 cm. in 1945, 27 cm. in 1946 and 55 cm. in 1947. Such irregular variations in the annual change in water-level as mentioned here must lead to disturbances in the normal development of vegetation.

It may be regarded as normal, that the lakes become frozen over in the beginning of January and the ice breaks up in the first weeks of March. The ice conditions varied very greatly in the years of the investigation. During the winter 1945—46 the ice broke up no less than four times. On January 30 it was only 18 cm. thick in Krankesjön. The ice conditions on the Kristianstad plain were not studied this winter. The winter 1946—47 was cold. There was ice on the lake Yddingen on December 15 and on Råbelövssjön on December 20. Then the ice remained on Yddingen to about April 1 and on Råbelövssjön also to the beginning of April. On January 15 the ice on Yddingen was 30 cm. thick and on Råbelövssjön 22 cm. On the latter it was 60 cm. on March 18. This value is probably exceptionally high, for in 1948 and 1950 the ice was only 15—18 cm. thick. Due to the hard winter of 1947 the outflow of Krankesjön was covered with ice, which has not occurred since then.

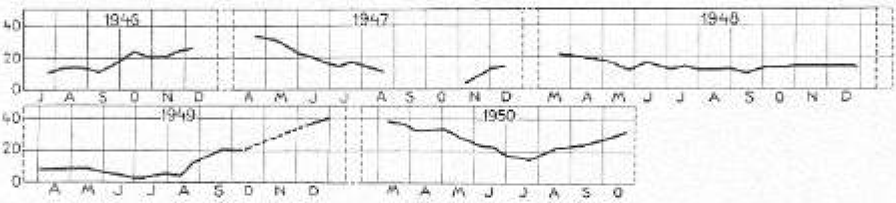

Fig. 8. The fluctuations of the water-level in Råbelövssjön in 1946—50. Observations were not performed in winter. In November 1949 the outflow was dammed up.

It is obvious from the above that similar ice conditions prevail in the lakes of South Scania and those of the Kristianstad plain, but probably not in the lakes on Archaean rocks, which are situated higher and receive more precipitation. Sufficient information is however lacking.

The readings of water temperature, made in connexion with the measurements of the water-level, give information of the temperature of the surface water on these occasions, but they are too few to give knowledge of the continuous variation of the water. On several occasions in 1947 a considerable rise in temperature was recorded compared with 1946. In Råbelövssjön, where the observations have been more irregular, the same tendency is to be seen, but not so clearly.

Investigations performed in U.S.A. have proved, that the different climatic factors are very important for the development of a plant. WENT, who studied several desert annuals in controlled climatic conditions, stresses what decisive importance the right combination of the different factors has on the germination and further growth of the plants (WENT 1949, WENT and WESTERGAARD 1949). Even if climatic factors cannot be the real cause of the extreme differences which are shown in different types of lakes, *e.g.*, a lowland lake and an Archaean lake in Scania, one must not forget the possible role these can play in the formation of the lake vegetation, until investigations have elucidated the relations in question. In any case, it seems to be rather evident, that climatic factors must have a very important part in the varying quantitative development of different species in different years in the same lake. Whether a greater or lesser number of the winter buds lying on the bottom, *e.g.*, of *Potamogeton crispus* are developed in a certain year, may possibly be due to the climatic conditions prevailing at the time for germination.

By observing a lake for several years it is possible to eliminate to a large extent the risk of missing a species, which is very rare or does not occur during a certain year due to unfavourable climate.

Vegetation and flora.

A. The typical features of the higher aquatic vegetation of the individual lakes.

Terminological and methodological remarks.

In the survey below only a short description of the most typical features of the vegetation of the lakes investigated is given. The terms generally accepted in Swedish literature are used here, *e.g.*, the division of the macrophytes into helophytes (graminids and herbids), isoetids, nymphaeids, lemnids (the neusto-pleuston layer) and elodeids according to the biological life form (*cf.* Du Rietz 1930). The charophytes are included among the elodeids.

The division of the macrophyte vegetation in different lacustrine zones according to Blomgren and Naumann (1925) and Thunmark (1931 and 1938) has been until the last decade the most generally accepted in Swedish lake literature. The division as far as the eulitoral is concerned, is based on hydrographic conditions. The eulitoral constitutes the area between the normal high and low water-line. During the last years the suitability of this ground of division has been criticized (Du Rietz-Hannerz 1939 and Du Rietz 1940). The upper limit of the vegetation is apparently not determined by the high water-line except at sheltered places; on exposed shores the storm waves are of decisive importance (according to the Brenner's law). Thus the eulitoral seems to be of limited value from a biological point of view. Du Rietz introduced new designations for the vegetation zones concerned (the terms within parenthesis are derived from Du Rietz 1950): Eugeobiontenstufe, Geoamphibiontenstufe (the geolitoral belt), Hydroamphibiontenstufe (the sublitoral belt) and Euhydrobiontenstufe (the hydrolitoral belt). In 1950 Horn began to use a terminology, founded upon the same principle: the terrestrial, amphibious and aquatic zones (*cf.* Horn 1951).

As the eulitoral in the lakes investigated coincides on the whole with Du Rietz' Geoamphibiontenstufe and Horns's amphibious zone, it seems to be entirely a question of principle what designations should be preferred. The water-levels of the lakes change irregularly from year to year, and therefore those of an individual year cannot be used for establishing the limits of the eulitoral, but these must be based on the composition of the vegetation. Thus, it should be most correct not to employ the hydrographic terminology. In the following the vegetation zone, that on the whole coincides with the eulitoral, will be denoted as the amphibious zone and the zone below as the aquatic zone according to Horn.

The irregular water-level fluctuations are due chiefly to the regulation arrangements at the outflows and the frequent cleanings of these. Furthermore, climatic disturbances may also play a part, the effects of which are often strengthened by the human regulations. During a dry period, for example, the water reserve in the lakes must be exploited more than usual.

The main stress in the description of the amphibious zone is laid upon the parts uncovered for the longest time (the terrestrial and amphibious subzones according to Horn, which correspond to the terrestrial and telmatic parts of the eulitoral according to Naumann and Thunmark, at least in this case).

High reeds designate those reedswamps that are composed of *Phragmites*, *Scirpus lacustris* and other high-growing species. Low reeds are mainly constituted of *Scirpus palustris* and *Carex* species. The *Equisetum fluviatile* clumps form a transition between high and low reeds. In regard to height they deviate considerably from the high reeds, in which they are generally included (*cf.* Almquist 1929, Lillieroth 1938).

Verlandung is the German word for »growing up», and it seems to have been adopted internationally. The process of Verlandung has in the investigated lakes been favoured by the lowerings, which have contributed to a rapid silting up of the lakes. Especially interesting in this connexion are the reeds, rich in herbs and very often quagmire-like, that act as an intermediary between the aquatic vegetation and the fen stage. The investigation, performed by the author on these reed and fen communities is not reported in detail in the present work.

In the descriptions the isoetids are dealt with before the elodeids, which is quite natural, as they only occupy the bottom near the water-line.

Following the lake descriptions a short summary of the sediment conditions is given. It is based mostly upon a small number of samples (3 to 9), collected by a sampler, reproduced by Lundqvist 1940 (p. 112). Generally the samples (consolidated sediment) were taken on the bottom free from vegetation, if such was available. In connexion with the vegetation profiles sediment samples were also collected. Such profiles, however, were not laid in all the lakes. The largest number of samples were taken from Krankesjön, Råbelövssjön and Yddingen. Most of them were investigated by Fil. lic. E. Mohrén. Some samples from Kvesarumssjön, Finjasjön and Västersjön were examined by Fil. dr G. Lundqvist. For the study of the sediments the author has used the terminology of Lundqvist (1925, 1927 and 1940). The presence of iron was shown with 3 % potassium ferrocyanide and 4 % hydrochloric acid, and a gradation was made according to the intensity of the blue colour (slight, moderate and strong). Similarly the evolution of gas was graded, when the lime content was determined by addition of 10 % hydrochloric acid.

All the samples became more or less lighter when dried. If lime or clay was absent, the colour became rather brownish-grey or grey. Diatoms and chitinous crusts were the most common fossils, but remains of *Pediastrum* and rhizopods and sponge needles were sometimes recorded.

The terms sediment limit and sedimentation limit are used according to Thunmark (1950), referred to in Lillieroth (1950).

Vegetation.

The lakes are rather evenly distributed over the investigated area. The vegetation of the shore changes according to its position on a plain or in a forest district. The lowland lakes are generally not situated on the entirely cultivated plains but in transitional areas to less pronounced agricultural regions. These transitional areas contain several of the large Scanian estates, and under their protection the forest has often been saved from being destroyed and the lakes have kept a more natural vegetation than otherwise probably would have been the case.

Most of the lakes have been subjected to an extensive influence by culture. Situated in relatively densely populated districts, colonized for thousands of years, they would have been affected by culture even without the radical interference of the last centuries. The shores have been used as dwelling-places and pasture, and the surroundings have been cultivated as fields. However, very early the need of increasing and improving the cultivable grounds by ditching and drainage of swampy areas arose. In this way several lakes have completely disappeared and still more have been lowered. Especially in the later part of the Nineteenth Century the interest in lake lowerings was very great. Many undertakings were planned, but all were not carried out. (It is rather difficult and sometimes impossible to obtain sufficient information on the lowerings carried out. Many have been quite private undertakings, which have not been reported). Lake regulations have also been carried out in order to exploit the water power in the outflows for mills and factories.

The open shores are at present largely used for pasture. The grazing, which is mostly very extensive, affects the vegetation in different ways. Some species are suppressed and others are added and so on. Besides, grazed individuals cannot always be identified. Haymaking occurs on a small scale in the Magnocaricion fens at some lakes, *e.g.*, Krankesjön, Sövdesjön and Ringsjön. It seems to contribute to a diminishing of the number of typical species. In dry years or when the water-level due to other circumstances is lower than normal, the cattle maltreat the fens greatly and make the study of them impossible. Thus, by the grazing and the irregular changes in the water-level the development of the amphibious vegetation is disturbed and the investigations are made more difficult. This part of the lake vegetation has therefore not been treated so thoroughly as would have been desirable. Permanent changes in the water-level cause, in addition, rather early alterations in the appearance and composition of the vegetation, which have been readily observed at Krankesjön, where the shore profiles, laid in 1944 and 1945, are no longer actual. On the whole, it is a common phenomenon, that aquatic plants are more or less sporadic and can rapidly change in occurrence from year to year. All description of such vegetation has for this reason only a restricted time of validity. This applies to a still greater degree to lakes with strongly varying water conditions.

Lake Yddingen (Figure 9.).

The shores are built up by moraine, apart from a small clay area to the northwest. They are to a large extent covered with forests and have a margin of alder trees near the water-line. The grazing is rather moderate. The lake belongs to the estate of Skabersjö.

According to Ehnbom (1941) the lake was lowered (before 1890) on private initiative. Property owners from the district south of the lake have tried at least twice to effectuate a new lowering, but the project was dropped in 1919 as well as in 1925, because a majority resolution could not be obtained.

The reedswamps are not especially extensive, but almost always dense. The bottom descends rather steeply. The broadest reeds grow naturally in the bays, which, moreover, are fairly numerous. *Phragmites communis* and *Typha angustifolia* are the leading components. The latter prefers deeper water and muddy bottom.

In several bays a rather rapid process of »Verlandung» takes place. Here reedswamp communities rich in herbs occur, forming real quagmires. The composition of these communities will not be described in detail here, but a list of the species may give an idea of the most typical components among the vascular plants: *Cardamine pratensis, Carex Pseudocyperus, Epilobium palustre, E. parviflorum, Galium palustre, Lemna minor, Lycopus europaeus, Lysimachia vulgaris, Mentha aquatica, Phragmites communis, Rorippa amphibia, Rumex Hydrolapathum, Scutellaria galericulata, Solanum Dulcamara, Teucrium Scordium, Typha angustifolia.* A characteristic feature of the reeds in Yddingen is the occurrence of *Teucrium Scordium*, which, moreover, is also distributed in the Magnocaricion fens and even in the amphibious zone on minerogenous substratum.

Nowhere do minerogenous, plain shores occur, on which a broad distinct zonation can be developed. The open parts of the shore are small. Generally they have been formed when groves of alder trees have

Fig. 9. The lakes Yddingen, Fjällfotasjön, Börringesjön and Havgårdssjön. Scale 1 : 100 000. (The maps shown in figures 9, 14, 16, 21, 29, 30, 33, 35, 37, 38, 39, 50 and 51 are approved for publishing by Rikets allmänna kartverk June 13, 1950.) The dots on all the maps show the localities for the water samples investigated by ALMESTRAND (1951).

been cut down. Here the waves erode an edge in the meadow ground and below this a narrow zone with *Juncus articulatus, Carex hirta, Potentilla anserina* and *Scirpus palustris* can be observed. At the shores lined with alders the amphibious zone consists of a very short strip with for example, *Agrostis stolonifera,* bordered above by an edge with

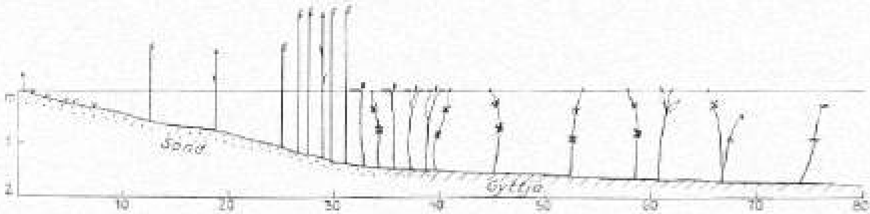

Fig. 10. Vegetation profile P 18 (Aug. 1945) from the western shore W. of Lillön. One of the longest profiles. Nearest the shore-line a rather narrow *Chara aspera* mat. Outside the reed of *Scirpus lacustris* and *Phragmites* grow *Potamogeton natans* and *Polygonum amphibium* together with *Myriophyllum spicatum*. Farthest out a stand of *Potamogeton lucens* is to be found within the *M. spicatum* community.

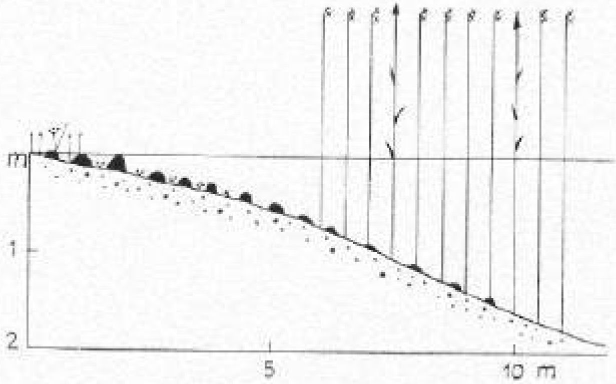

Fig. 11. Vegetation profile P 11 (August 1945) from the point west of Bökebergsslätt. The shortest profile, which is situated close to the deepest part of the lake. It does not reach down to sedimentary substratum. The bottom is extremely stony. Nearest the water-line a narrow border of *Juncus lampocarpus* and *Scirpus palustris*. *Chara aspera* grows between the stones out to a depth of about 50 cm. The reed consists of *Scirpus lacustris* and scattered *Phragmites communis* and ends at a depth somewhat exceeding 1.5 m.

Calamagrostis canescens, *Eupatorium Cannabinum* and *Lysimachia vulgaris* and so on. (Perhaps it should be pointed out that the investigation of the vegetation was carried out in 1945, a summer with exceptionally high water-level).

The most extensive fens are situated inside the large bays, where the process of Verlandung has carried on for a long time. The *Carex elata* fens are the most common ones. To the southwest in the neighbourhood of Stockebro, a fen type rather rare in Scania occurs, the *Carex appropinquata* fen, which at Yddingen is invaded by alders.

Among interesting helophytes the following may be mentioned: *Scirpus maritimus* and *S. Tabernaemontani*, both so-called brackish water species according to SAMUELSSON (1934). The former has been found on one locality, the latter on a few places in small clumps.

The nymphaeid zone is relatively well developed, especially in the bays, but *Potamogeton natans* is also to be found in other places. Both *Nuphar luteum* and *Nymphaea alba* grow in the lake, but the former is predominant.

Isoetids have not been observed.

The lake is apparently poor in elodeids. Thus, for example, *Elodea canadensis, Potamogeton Friesii, P. perfoliatus* and *P. pusillus* are absent. Only uprooted specimens of *Potamogeton pectinatus* have been found. Of the species growing on sedimentary bottom *Myriophyllum spicatum* is the most common one. *Chara aspera* and *Potamogeton filiformis* are widely distributed in shallow water out to a depth of about 50 cm. The vegetation profiles, which have been carried out, are short. At a distance of 20 m. from the shore, depths of 1.5 to 2.0 m. have been sounded. The profiles can envelope three zones: 1. a zone of *Chara aspera* and *Potamogeton filiformis* on shallow, minerogenous bottom, 2. reedswamp outside on muddy bottom and 3. a zone of *Myriophyllum spicatum* farthest out, which may be lacking (figures 10—11).

The organogenic sediments in the open water consists of gyttjas, very often clayey. Near the reedswamp coarse detritus gyttjas can be developed, but otherwise the sediments must be characterized as fine detritus gyttjas with an interspersion of coarse detritus. The fossils are mainly composed of chitinous crusts, diatoms and remains of *Pediastrum*. The iron content is insignificant and the lime concentration varies but it is never especially high. The sediment limit changes, but judging from the profiles it does not run below 2 m. In calm bays the sediments can be found at much lower depth.

Lake Fjällfotasjön (Figure 9.).

The lake is divided into two relatively well separated parts, called in this paper the eastern and western lake. The surroundings are comparatively slightly cultivated. Especially the northern side is surrounded by forests, mostly beeches, and fens, which together form a very desolate region rather unlike the typical landscape of South Scania. In several places the fen grounds reach down to the shore edge. Only in the eastern part of the lake is the shore used for grazing. The shore here is the only open one at the lake.

Where the shore is minerogenous, the amphibious vegetation is mostly composed of *Carex elata* - tussocks. Landwards there is a more or less distinct border of *Calamagrostis canescens, Eupatorium cannabinum* and others. The fens at the shores are of different types, but the poor fens are predominant.

The lake is characterized by vast Verlandung zones containing reedswamp communities rich in herbs. *Phragmites communis* and *Typha angustifolia* occupy the greatest area of the high reedswamps. *Scirpus lacustris* appears only in small patches here and there. The shore-line is almost entirely fringed by more or less broad reed zones. The high reedswamps are scanty on shoaling minerogenous bottom, *e.g.*, at the northeastern part of the western lake and at the eastern part of the eastern lake close to Ebbesjö. They can here be replaced by *Carex lasiocarpa* and sometimes *C. rostrata* and *Scirpus palustris. Scirpus Tabernaemontani* grows on a small islet frequented by birds.

In such a lake as Fjällfotasjön with lobated shore outlines sheltered habitats are developed, favouring the formation of floating leaf vegetation. In spite of this fact the communities of water-lilies are not especially comprehensive, but they occur on relatively many localities. *Nuphar* is more common than *Nymphaea. Potamogeton natans* is the nymphaeid most widely distributed.

Contrary to Yddingen, isoetids are rather well represented, probably due to the occurrences of shoaling minerogenous shores. Quantitatively, however, the rosette vegetation has a limited distribution. *Ranunculus Flammula* ssp. *reptans* is observed on the northern as well as on the southern shore. *Littorella uniflora* and *Juncus bulbosus* are rather common on the northern shore. *Scirpus acicularis* is noticed from a locality close to Ebbesjö. *Pilularia globulifera* is known from a locality on the northeastern shore of the western lake. *Lobelia Dortmanna* has a very restricted occurrence. It grows in a small stand consisting of about 25 to 30 specimens at the same place as *Pilularia.*

In shallow water out to a depth of less than 1 m. together with the isoetids the following elodeids grow: *Potamogeton gramineus, P. gramineus*×*perfoliatus* (*nitens*), *Chara aspera* and *Ch. fragilis.* Otherwise *Myriophyllum alterniflorum* and *M. spicatum* are the dominating elodeids. *Potamogeton crispus* and *P. perfoliatus* have a more limited distribution. *Ranunculus circinatus* has been observed only in uprooted specimens, but in large quantities with fruits and newly formed roots.

Potamogeton zosterifolius has been found on two habitats in the eastern lake in varying quantities in different years. In the western lake only uprooted plants have been observed.

The lake is characterized by a rich development of *Stratiotes Aloides*. For the present only Björkesåkrasjön can compete with Fjällfotasjön in this regard among the lakes investigated.

An example of the composition of species from a profile at the *Lobelia* habitat is given below. The distances are counted from the water-line in the dry year 1947 (August 11). At a distance of 20 m. from the water-line the depth is 1 m. The figures within parenthesis express the degree of covering according to the HULT-SERNANDER method (cf. DU RIETZ 1930, p. 396):

0—4 m.: *Carex elata* (1), *C. lasiocarpa* (3), *Equisetum fluviatile* (1), *Phragmites communis* (1), *Littorella uniflora* (5), *Lobelia Dortmanna* (1), *Pilularia globulifera* (2), *Ranunculus Flammula* ssp. *reptans* (1), *Chara aspera* (1), *Ch. fragilis* (1).

4—10 m.: *Carex rostrata* (1), *Phragmites communis* (1), *Scirpus palustris* (1), *Typha angustifolia* (1), *Littorella uniflora* (1), *Lobelia Dortmanna* (1), *Myriophyllum alterniflorum* (4).

10—18 m.: *Equisetum fluviatile* (1), *Phragmites communis* (2), *Pilularia globulifera* (1), *Chara aspera* (5), *Ch. fragilis* (2).

The sediment limit runs at about 1.5 m. in the profiles. Coarse detritus is a relatively prominent fraction in the gyttjas, which are deficient in lime and iron. The most common fossils are chitinous crusts and diatoms. The alkali extract is rather brown.

Lake Börringesjön (Figure 9.).

The northern part of the lake called Klosterviken, isolated by the railway, is not described here. With Börringesjön is meant the great part south of the railway.

The lake is perhaps the most typical lowland lake. It has an open position and is exposed to winds from different directions. The bottom is shallow and the water is always turbid from clay suspension. The neighbourhoods are rolling and ascend sometimes steeply above the water level. The hills are mostly cultivated. Near Markiehage and S. Lindved beech forests are to be found. The shores are grazed very extensively.

The lake has been subjected to several radical interferences by man.

Fig. 12. View from the eastern, narrow bay of Börringesjön in the spring of 1948 illustrating the effects of the lowering of the lake in the preceding summer. Photo by A. ALMESTRAND. 5.4.1948.

In 1902 it was lowered (EHNBOM 1941), probably by a regulation of the outlet, the Segeå, which was decided in 1900 (NILSSON 1900).

The last intervention was made in the summer 1947, when the outflow was cleaned. The water-level was permanently lowered and about 5 to 10 m. of the old lake bottom was laid bare (figure 12).

The description of the amphibious vegetation given below is an attempt to illustrate the conditions before the lowering. Where there is no forest, the cattle normally change the natural development of the vegetation. Besides, in 1947, the year of these studies, the dryness and the cleaning of the outflow contributed to a disturbance of the zonation. On account of the open position the waves erode small edges on the shore meadows. The short amphibious zone below this edge on minerogenous bottom can be overgrown with *Carex hirta, Juncus articulatus, Potentilla anserina, Ranunculus Flammula* ssp. *reptans, Scirpus palustris* and others. Sometimes *Carex elata*-tussocks also appear. On the steeper stony shore of the western wooded side the amphibious vegetation consists of a *Carex gracilis* zone with *Eupatorium cannabinum*, *Lycopus europaeus*, *Phalaris arundinacea*, *Sparganium ramosum* and others. At Markiehage, where the shore is also stony, a similar vegetation is to be found, *e.g.*, *Eupatorium cannabinum*, *Juncus articulatus*, *Lycopus europaeus*, *Lysimachia thyrsiflora*, *Phalaris arundinacea*, *Scirpus palustris* and *Sium latifolium*. In the following years new species have begun to grow in the old amphibious zone, *e.g.*, *Tussilago Farfara*.

At several places the lake is surrounded by Magnocaricion fens, especially well developed in the northern part. Here among others *Carex paniculata* fens occur, which, however, in consequence of the lowering of the water-level have dried out somewhat and are now grazed by the cattle.

The lake is to a large extent bordered by reedswamps, which are relatively narrow except in the bays, *e.g.*, in the southern and northern ends and at S. Lindved. On the eastern side, which is exposed to the prevailing westerly winds, the reedswamps are usually thin and not very continuous. *Phragmites communis* is the only dominant, at some localities with intermingled patches of *Typha angustifolia*. *Scirpus lacustris* is very rare. *Equisetum fluviatile* forms zones here and there outside the high reedswamps, especially in the southern end, where it appears together with an understorey of water-lilies. *Scirpus palustris* occurs, as is already mentioned, in the amphibious zone, but it also forms low reedswamps in the water, where high ones are absent. *Scirpus maritimus* and *Sc. Tabernaemontani* have been found on a few localities. North of Sjuttanäbbet there is a rather large growth of *Sc. maritimus*, which has been brought above the water-line by the regulation.

Verlandung takes place in the inmost parts of the bays, *e.g.*, at S. Lindved and in the north end, where reeds, very rich in herbs occupy a large area (figure 13). Here the silting up is very rapid.

In the sheltered bays the water-lilies are rather widely distributed. *Nuphar luteum* is more common than *Nymphaea alba*. Otherwise water-lily vegetation is absent, probably due to the exposed position of the lake. The remaining floating leaf plants also occur in calm habitats in and near the reedswamps, but never in large quantities. *Hydrocharis* does not generally appear on the open water surface, either here or in the other lakes investigated. It is restricted to the environment created by the thick reedswamps. *Polygonum amphibium* plays only an insignificant rôle in the composition of the vegetation, but it can be observed

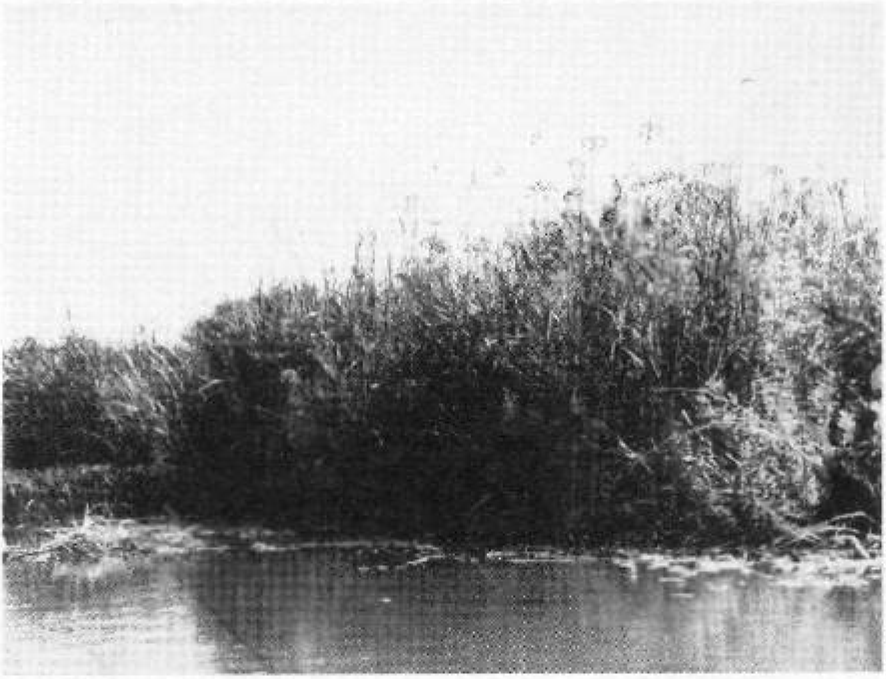

Fig. 13. A luxuriant Verlandung reedswamp at S. Lindved in Börringesjön. Outside a narrow belt of *Stratiotes Aloides* is visible to the left. The *Typha angustifolia* community contains, for example, *Carex Pseudocyperus, Cicuta virosa, Eupatorium cannabinum, Rumex Hydrolapathum, Solanum Dulcamara* and *Sparganium ramosum*. The small floating plants are *Hydrocharis Morsus-ranae*. Photo by the author. 20.8.1947.

at several places in or just outside the reedswamps. *Potamogeton natans* is recorded from a great number of localities.

As minerogenous open shores are relatively common, a fairly considerable development of isoetids can be expected. *Ranunculus Flammula* ssp. *reptans* and *Scirpus acicularis* belong also to the vegetation of these shores. The latter, which normally also has a great distribution in the shallow aquatic zone (sublitoral), was laid bare here in the summer 1947 and formed a green zone just above the new water-level, *e.g.*, on the western shore. (Because of the exceptionally low water-level this year a large part of the vegetation, about 5 to 10 m. on shoaling shores, normally growing in shallow water, was laid bare.) A now rare rosette plant, *Echinodorus ranunculoides*, has been recorded from two localities.

In very shallow water (probably out to a depth of about half a metre) charads (*Ch. aspera, fragilis* and others) and the hybrid *Potamogeton gramineus×perfoliatus* are predominant. *P. gramineus* has only rather seldom been observed. In 1947 extensive *Chara* carpets lay uncovered on the shores.

The lake is, in spite of its shallowness, fairly poor in submerged higher vegetation except in the bays. *Myriophyllum spicatum* is the most prominent component. *Potamogeton pectinatus* is most widely distributed on the eastern shore especially near Sjuttanäbbet. *P. lucens* has been observed in large stands on four localities. *P. perfoliatus* may occur in shallow water like the above-mentioned hybrid but grows also in deeper water. It is rather widespread, but it never forms large masses. *P. crispus* is here as in other lakes more easily found uprooted than fixed. It is recorded as rooted on at least four localities. The plant has its flowering period earlier than the other *Potamogeton* species except *Friesii*, and thus the inquiries about it should be made in the early summer. No linear-leaved *Potamogetons* (except *pectinatus*) have been found in the open lake, but *P. obtusifolius* grows in stagnant water, enclosed from the open water by a thick and broad reedswamp. In the shallow water body three helophytes were noted (*Equisetum fluviatile, Sparganium ramosum* and *S. simplex*) besides the following species: *Lemna trisulca, Spirodela polyrrhiza, Potamogeton natans, Stratiotes Aloides, Chara fragilis, Myriophyllum verticillatum, Ranunculus circinatus, Ranunculus* sp., *Potamogeton obtusifolius*. This is a typical habitat for *Myriophyllum verticillatum*, which also occurs outside the reedswamps but only in connexion with a Verlandung zone. *Stratiotes Aloides* and *Ceratophyllum demersum* also show a decided preference for such localities (at the northern end and at S. Lindved). The distribution of *Stratiotes* is much less than that in Fjällfotasjön. *Ranunculus circinatus* has several occurrences in the lake.

The sediment limit lies high (in the profiles between 1.0 and 1.5 m.). The fine detritus gyttjas are rich in mineral grains, chiefly small particles <5 μ, but for the rest up to the size of coarse mo. Of the fossils chitinous crusts are very apparent, but diatoms and *Pediastrum* remains have also been recorded. The sediments are mostly poor in lime and iron. The alkali extract is only slightly brownish.

Lake Havgårdssjön (Figure 9.).

The lake is completely surrounded by hills, which, if they had been wooded, would have provided a good shelter from the winds. For the present only a few small forest groves and alder fens exist around the lake. The remaining shores are open and employed as pasture grounds.

No description of the appearance of the lake in old times is available, but it gives the impression of having been a very transparent lake, mainly supplied with ground-water. According to EHNBOM (1941) the water-level was lowered early, already before 1890, on private initiative. For about 25 years the sugar mill at Jordberga has pumped water from the lake during October and November, and thus contributed towards keeping the water-level below normal. The water withdrawal is largest in dry years. The minerogenous shores, which are very often sandy, are predominant. To the southeast there are Magnocaricion fens with *Carex acutiformis* and *Scirpus silvaticus*. The grazing is, however, everywhere intensive and allows only imperfect studies of the shore vegetation. To the north an alder fen occurs with *Calamagrostis canescens, Calystegia sepium, Carex acutiformis, Phalaris arundinacea* and others. The vegetation in this part is very much influenced by culture.

Havgårdssjön has very even shore-lines, except the peninsula in the southeast. The conditions for the development of large reedswamps are not especially good. The reedswamps are thickest in the southeastern bay, where they are composed of *Phragmites communis, Typha angustifolia,* some *Equisetum fluviatile* and here and there *Glyceria maxima,* the latter containing, for example, *Carex riparia* and *C. rostrata. Scirpus lacustris* is more widely distributed than in the lakes described above. Disregarding small stands here and there it is to be found chiefly in northwest, where it, however, is intermingled with *Phragmites.* Neither *Scirpus Tabernaemontani* nor *Sc. maritimus* have been observed in the lake. Low reedswamps of *Sc. palustris* occur, *e.g.*, on the peninsula and the western shore. In the northwestern end *Butomus umbellatus* forms a real reedswamp outside *Equisetum* on one locality.

The scarcity in bays and indentations together with the poor protection against the winds probably explain the small patches of water-lilies. These occur preferably as expected in the south end and are formed by *Nuphar luteum. Potamogeton natans* appears as usual on considerably more localities, very often together with *Polygonum amphibium. Hydrocharis Morsus-ranae* has not been recorded in the lake.

The isoetids are only represented by *Scirpus acicularis,* which grows on the sandy shores. To a large extent it has to share the place with *Chara aspera,* which often forms tight carpets. In such a carpet on the western shore, there are interspersed patches of *Potamogeton pectinatus* and *Zannichellia palustris.*

Especially characteristic for the lake is the enormous development of the submerged vegetation. From the end of May to Midsummer extensive flowering *Potamogeton crispus* meadows cover the water surface. On May 31, 1949 a broad zone extended from the north end of the lake towards the northern side of the peninsula. Also in the south end of the lake vast areas were occupied by *P. crispus*. On June 8, 1948 the same abundant distribution of the plant was noted. *P. Friesii* is also early. It begins to flower at the end of May and then forms at some places quiet borders breaking the waves, *e.g.*, along the south side of the peninsula. The plant soon wilts and in the beginning of July large quantities can lie washed up on the shore. *Ranunculus circinatus,* which flowers for a long period during the summer, occurs richly almost everywhere. Also *Myriophyllum spicatum* appears in rather large stands, *e.g.*, at the western shore and north of the peninsula. The remaining elodeids are, in comparison to those mentioned above, fairly local, except *P. pectinatus*, which occurred abundantly in the two vegetation profiles. *Callitriche hermaphroditica* is also comparatively widely distributed. This species was only observed in two other lakes, Ringsjön and Finjasjön, both situated far from Havgårdssjön. *Lemna trisulca* was found in one profile out to a depth of about 2.5 m. Charads are also included in the submerged vegetation, growing in deeper water.

Judging from a statement by NORDQVIST (1937) the main part of the surface of the lake at that time lacked higher vegetation. If this is true, the vegetation seems to have increased during the last ten years.

In the profiles the fine detritus gyttja begins at a depth of about 1.7 m. (the first profile is made at the western shore, the latter at the south end). Lake-marl has been observed at the western side of the peninsula, and in the first profile lime-gyttja was collected. Coarse detritus is never absent, but on the other hand always scarce. The numerous mineral grains are generally small, mostly less than 5 μ. Lime is very often lacking and the iron content is moderate. The alkali extract is insignificantly brown. Fossils consist largely of chitinous crusts.

Lake Björkesåkrasjön (Figure 14.).

Björkesåkrasjön is situated in a rather desolate district uncommon for South Scania. The farming is not very productive. To the south the forests reach down to the lake, to the west and north the lake is surrounded by large Magnocaricion fens.

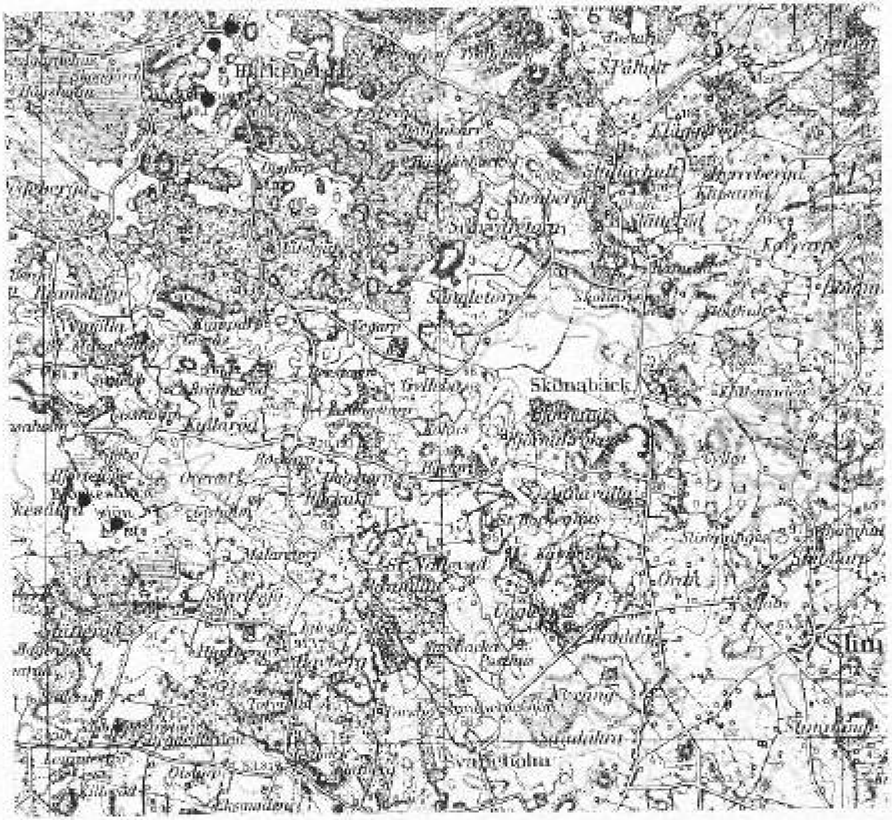

Fig. 14. The lakes Björkesåkrasjön, Häckebergasjön and Svaneholmssjön.
Scale 1 : 100 000.

The lake was lowered in 1892, a project including an area of 300 hectares (Ehnbom 1941).

The lake is almost completely lined by mostly broad reedswamps. *Phragmites* and *Typha angustifolia* are the main components, but patches of *Scirpus lacustris* are also to be found. *Sparganium ramosum* grows at many places in the open lake. Otherwise most of the species, characteristic for shoaling lakes, which are growing up, have been recorded. At many localities the process of Verlandung is in progress, accompanied with a vigorous evolution of hydrogen sulphide. *Scirpus Tabernaemontani* is noticed from two localities.

On account of the slight water depth a rapid filling up of the bottom, which almost everywhere is covered with higher vegetation, takes place. This often reaches up to the surface, and where it is most abundantly developed, the lake is impassable for a row-boat. The floating leaf vegetation is more insignificant as might have been expected. Water-lilies have not been recorded, but *Potamogeton natans* is rather widely distributed. *Hydrocharis Morsus-ranae* occurs at habitats typical for this plant. *Stratiotes*, which forms a very characteristic element in the emerged vegetation, is most common. The submerged vegetation is preferably dominated by *Potamogeton pectinatus*, *Myriophyllum spicatum* and *Chara* species. Also *P. Friesii* is fairly widespread. Moreover, the following elodeids have been observed: *P. crispus*, *P. panormitanus* and *P. perfoliatus*. In shallow water, where minerogenous bottom is present, a *Chara aspera* carpet is often to be found, *e.g.*, at Hjortalöpet.

The gyttjas contain a great deal of coarse detritus and are rich in smaller mineral particles up to coarse mo. The fossils are predominated by chitinous crusts. The sediments are deficient in lime and iron. The alkali extract is very brown.

Lake Häckebergasjön (Figure 14.).

Häckebergasjön is located in a district rich in forests. The western part of the lake is connected with vast fen grounds (cf. HANSEN 1949 b).

The lake has been dammed up for a long time. The dam was in use already in 1863 (according to information from Lantmäterikontoret in Malmö). Previously a sawmill was driven at the outflow (private communication). Inundations are not feared because of the insignificant afflux of water into the lake. During dry years the water-level is very low.

The lake has very winding shore-lines and rather steep shores, which contribute towards creating an effective shelter against the winds. From the sporadic records of the author it seems to be apparent that *Scirpus lacustris* is the dominant component of the high reedswamps, but both *Phragmites* and *Typha angustifolia* are included in the reedswamp communities. The comparatively narrow reedswamp belts are probably due to the fact, that the bottom declines fairly sharply. Along very steep shore sections the high reed can disappear and a zone of *Carex gracilis* form the helophyte limit towards the water surface. As in Yddingen, the litoral vegetation contains a species, which is very rare nowadays, *viz. Teucrium Scordium*. *Ranunculus peltatus*, which begins to flower in May, at that time partly covers the water surface close

Fig. 15. Flowering *Ranunculus peltatus* in the northern part of Häckebergasjön. Photo by A. ALMESTRAND, 12.5.1948.

to the water-line at an open shore strip near the road (figure 15). Later on a great part of this vegetation becomes dried out.

Because of the position and form of the lake with many coves, the conditions for growing together are considerable and also for the creation of floating leaf vegetation. Both *Nuphar luteum* and *Nymphaea alba* are common, and the same holds true of *Potamogeton natans* and *Polygonum amphibium*. The latter has a considerably wider distribution than in the lakes already discussed.

The submerged vegetation is apparently poor in species. *Ceratophyllum demersum* grows richly at several places and also *Myriophyllum spicatum* occurs in large quantities. Of other elodeids only *Potamogeton crispus* has been observed. *Stratiotes* is found in rather small stands in at least three localities.

Contrary to the above-mentioned lakes and to several of those discussed below the floating leaf vegetation in this lake is better developed than the elodeid one.

The fine detritus gyttjas seem to have an insignificant iron content and do not liberate carbon dioxide with hydrochloric acid. The alkali extract is brown. The amount of coarse detritus varies.

Lake Svaneholmssjön (Figure 14.).

Svaneholmssjön is surrounded by vast fen grounds. The open minerogenous shore is confined to a very narrow area on the eastern shore. The entire northern shore is bordered by a broad zone of Verlandung. Apart from *Phragmites Scirpus lacustris* is the main component of the reedswamps, especially in southeast. As usual in lakes of this type *Sparganium ramosum* forms a prominent element of the emerged vegetation. A vigorous sedimentation takes place, a process rapidly silting up the lake.

The largest part of the lake surface is covered with floating leaves, and the bottom is largely covered with elodeids. *Nymphaea alba* occupies an abundant area. In addition *Nuphar luteum, Potamogeton natans* and *Hydrocharis Morsus-ranae* are included in the floating leaf vegetation. Characteristic for Svaneholmssjön, as for Tunbyholmssjön, is the fact, that *Sparganium simplex* grows with floating leaves anywhere in the open lake.

Ceratophyllum demersum is the dominant among the elodeids. *Potamogeton crispus* and *P. perfoliatus* are relatively common. As in Tunbyholmssjön *P. obtusifolius* belongs to the submerged vegetation of the open lake. Of the remaining elodeids *P. pectinatus* is found but only in uprooted specimens.

The sediments, which can mostly be denoted as coarse detritus gyttjas, lie sometimes immediately below the water surface. The colour of the fine detritus under the microscope is browner than that of the fine detritus previously described. Only very small mineral grains have been observed in the samples. The iron content as well as the lime content are low. The alkali extract is brown.

Lake Krageholmssjön (Figure 16.).

Krageholmssjön is situated in a hilly landscape and at least half the lake is surrounded by open shores. As usual the shores are in use for grazing. On the southeastern shore there are meadows covered with sparsely grown trees. To the west and northwest large forests extend to the lake. The island Lybeck is also woody.

According to EHNBOM (1941) the lake was lowered in 1932.

Fig. 16. The lakes Krageholmssjön, Ellestasjön, Snogeholmssjön, Sövdeborgssjön and Sövdesjön. Scale 1 : 100 000.

The eastern shore is stony and very often gravelly. In the southwest the ground consists of sand mixed with clay. The amphibious zone is often characterized by *Carex* zones (*C. elata* and *gracilis*), where *Inula britannica* sometimes grows. Towards the lake the zone is replaced more or less rapidly by reedswamps. At some places the reeds are succeeded landwards by a *Eupatorium* zone. The eastern shore is largely lined by Magnocaricion, chiefly *C. elata*.

The reedswamps are broadest and thickest along the western shore and in the northern end, which are sheltered by forests. *Phragmites* is here dominant. In the southwest a reed zone is not developed. The projecting peninsula in the southern end is bordered by a narrow zone consisting of *Phragmites* intermingled with *Scirpus lacustris*. At the eastern side the reedswamps are disconnected and of varying breadth. *Phragmites* and *Scirpus lacustris* alternate also here. *Typha angustifolia* has a very restricted distribution. At some places the *Carex elata* fens reach down to open water. Around Lybeck the *Phragmites* reeds predominate. *Typha latifolia* is a component of the reeds in the northwest and south. *Scirpus Tabernaemontani* is recorded from the southernmost corner, where the road touches the shore. Here it forms a relatively limited stand on land near the water. At the same locality small reedswamps of *Typha latifolia* and *Equisetum fluviatile* occur inside the *Scirpus lacustris* reed. Low reedswamps of *Scirpus palustris* are found in the northwestern corner. *Butomus umbellatus* may grow even in the amphibious zone, which is less common. It is known from several localities around the lake.

Verlandung takes place chiefly at the eastern shore (*cf.* figure 17).

Floating leaf vegetation occurs, even if relatively slightly developed, in different parts of the lake. The water-lilies have their most extensive distribution along the eastern shore, where both *Nymphaea alba* and *Nuphar luteum* have been observed. The latter may also be found in the southern and northwestern parts. *Potamogeton natans* has the same distribution as *Nuphar*. *Polygonum amphibium* forms larger stands in Krageholmssjön than in many of the other lowland lakes studied, except Börringesjön and Häckebergasjön. *Hydrocharis* is restricted to the zones of Verlandung.

The isoetids have a relatively vast distribution on the minerogenous, coarse-grained, often clay-mixed shores. Of the lakes situated in the neighbourhood only Ellestasjön has *Littorella* carpets. In Krageholmssjön they are generally broader and extend into deeper water. In 1947 they were up to about 10 m. wide and reached out to a depth of about 30—40 cm. It is possible, that this is due to the more transparent water. Also *Ranunculus Flammula* ssp. *reptans* and *Scirpus acicularis* grow in shallow water out to a depth of about 20 cm.

Together with the isoetids mentioned above charophytes and *Potamogeton gramineus*, *P. gramineus*×*perfoliatus* and *P. gramineus*×*lucens* are to be found. These two hybrids seem to have an especially wide distribution in Krageholmssjön. The lake contains large stands of

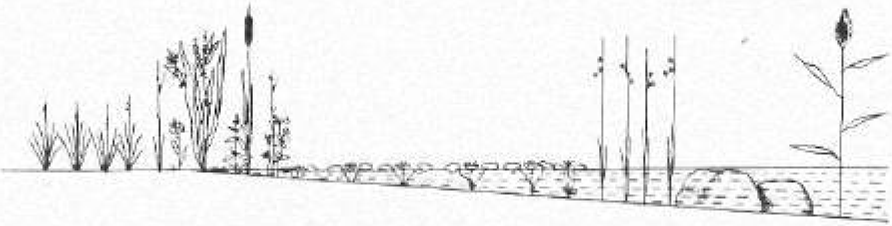

Fig. 17. Profile from the Verlandung zone at the eastern shore of Krageholmssjön. Inside the *Scirpus lacustris* reed the *Nymphaea* belt is well developed. Near the water-line a zone rich in herbs (*i.a.*, *Carex elata*, *Iris Pseudacorus*, *Lysimachia thyrsiflora*, *L. vulgaris*, *Rumex Hydrolapathum*, *Scutellaria galericulata*, *Sparganium ramosum* and *Typha latifolia*) and including the floating *Hydrocharis Morsus-ranae* forms a transition to the *Carex elata* fen.

P. lucens, which is the predominating elodeid outside the shallow minerogenous zone. *P. praelongus* occurs at some localities along the western shore. *Ranunculus circinatus* is likewise found in this part of the lake with occurrences in the southwest and northwest. *P. perfoliatus* is probably somewhat more common than is evident from the notes, which include only four localities. *P. crispus* has been sampled as young shoots at one locality by dredging and as drifting individuals at another. *P. pectinatus* seems to be local, interspersed in a *Chara* carpet. *Myriophyllum spicatum* is only observed at the same locality, the northwestern corner of the lake. Linear-leaved *Potamogetons* as *Friesii* and *pusillus* have not been found.

The fine detritus gyttjas contain a slight amount of lime. Small particles (<5 μ) characterize the sediments. The iron content seems to be insignificant.

Lake Ellestasjön (Figure 16.).

Ellestasjön and Börringesjön are the most characteristic clayey lakes included in the investigation. The surroundings rise steeply and from the hills there is a beautiful view over the lake. Forests occur only on the southern shore from the castle and eastwards, but a thin alder border edges the main part of the lake. The more or less wet western shore is covered with brushwood. Many farms are situated near the lake, especially to the north. The grazing on the shores is at many places considerable.

The lake has been lowered (Ehnbom 1941).

Sandy shores are rare. The clayey ones are often very stony and

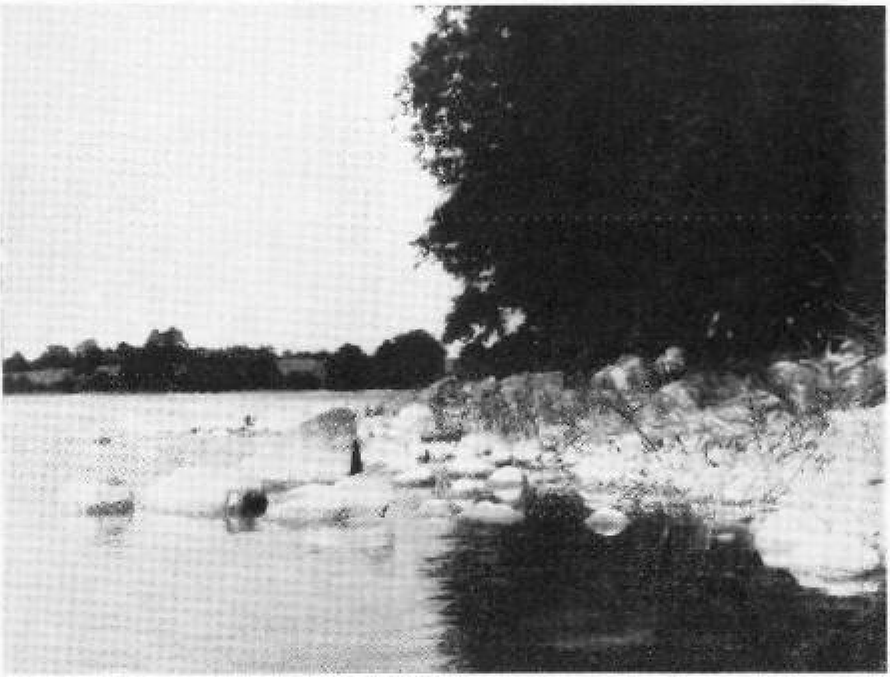

Fig. 18. View from the eastern part of Ellestasjön, showing the sterile stony shore grown only with scattered individuals of, for example, *Phalaris*. In the summer of 1947 the water surface was exceptionally low. Photo by the author. 16.7.1947.

covered with a thin layer of fluvial sand. The amphibious zone is rather poor in plants. Very often a border of *Eupatorium* is developed, as in Sövdesjön, Sövdeborgssjön and Krageholmssjön, mixed with *Calamagrostis canescens*, *Carex gracilis*, *Lycopus europaeus*, *Lysimachia vulgaris* and others. On the stony shores at the eastern side the vegetation is extremely scanty (figure 18). Here grow, for example, some isolated tussocks of *Carex elata* or straws of *Phalaris arundinacea*. On the northern side, where the ground permits, a more or less broad *Carex fusca* zone is included in the amphibious vegetation. The wettest part of the amphibious zone may be covered with isoetids, mainly *Littorella uniflora*, *Ranunculus Flammula* ssp. *reptans* and *Scirpus acicularis*. Sometimes *Echinodorus ranunculoides* is to be found. A profile from the southern shore (coarse gravel with stones at least on the surface) has the following zonation: Thin reed of *Scirpus lacustris* and *Phragmites* → *Littorella* zone with *Ranunculus Fl.* ssp. *reptans* and

Fig. 19. From the northwestern corner of Ellestasjön. This part is filled up with vast reedswamps of *Typha angustifolia* and floating leaf vegetation of *Nuphar* and sometimes *Stratiotes*. Photo by A. ALMESTRAND, 6.8.1949.

Chara fragilis → Thin *Carex gracilis* zone with *Calamagrostis canescens, Equisetum fluviatile, Eupatorium cannabinum, Lycopus europaeus, Lysimachia vulgaris, Mentha* sp., *Phalaris arundinacea, Scutellaria galericulata* and *Stachys palustris*. The water-level reached on this occasion (July 16, 1947) just above the borderline between the two first mentioned zones. The organogenous shores consist of Magnocaricion fens. Along the western side *Carex elata* is the most frequent dominant. Towards the outlet other species form the communities, *e.g., C. acutiformis* and *C. appropinquata*. South-southeast of Stenshult *C. elata* - *C. gracilis* fens occur.

Along the entire western side from the outlet to the beginning of the forest the reedswamps are richly developed. *Typha angustifolia* forms the parts of broad belts visible from a boat. Rather narrow reedswamps have arisen along the southern lake's edge consisting mainly of *Phragmites*, but here and there also of *Scirpus lacustris* and *Typha angustifolia*. Otherwise the reeds are relatively restricted and disconnected.

containing all the three common high reedswamp components. Other reed-forming species occur only rarely or are completely lacking. *Scirpus maritimus* and *Tabernaemontani* are not recorded from the lake. Low reeds of *Scirpus palustris* grow on the northern shore. *Butomus umbellatus* forms only small isolated patches mainly in the eastern part.

In the western part, where the large *T. angustifolia* reedswamps are to be found, a rapid process of Verlandung takes place, and the sedimentation limit runs fairly near the water surface. In the neighbourhood of the outlet the enormous reedswamps are impassable (figure 19). The composition of species agrees with that generally characteristic for the plant communities of Verlandung zones (*cf.* Yddingen and Krankesjön).

The floating leaf vegetation includes all the typical species: *Nuphar luteum, Nymphaea alba, Potamogeton natans, Polygonum amphibium* and *Hydrocharis Morsus-ranae*. Apart from the western part the water-lily vegetation only occurs outside a brook outlet in the south end. *Potamogeton natans* is a little more common. *Polygonum amphibium* is noted from a bay in the southeast.

The isoetids found in the lake have already been discussed in the description of the amphibious zone. *Littorella,* which of the three common species advances into the deepest water, reached in the summer 1947 out to a depth of 10—15 cm. *Echinodorus* is probably more widely distributed here than in any other South Scanian lake. Certainly it has been difficult for the plant to survive on the grazed shores. At Sövdesjön it seems to have died out, and at Börringesjön only a few specimens were found. The present habitats are all clayey.

Together with the isoetids *Chara aspera, Ch. fragilis, Potamogeton gramineus* and *P. gramineus×perfoliatus* are very often found. The charophytes occupy a relatively small area in the lake, which is, on the whole, deficient in elodeids. Only in the western part outside the water-lilies is *Myriophyllum spicatum* richly developed. Here also a few localities for *Potamogeton crispus* have been noted. The two species are also found outside the brook outlet in the southern part of the lake. *P. lucens,* which grows here together with the above-mentioned species, extends into deeper water, in 1947 out to a depth of 1.80 m. *P. praelongus* has been recorded from three localities. Linear-leaved *Potamogeton* species have not been observed.

Gyttjas occur in the profiles already close to the reeds, *i.e.,* at a depth of less than 1 m. One profile is situated at the western shore and the second near the brook outlet in the south. The fine detritus gyttjas taken from a bottom without higher vegetation contain some coarse detritus and a great deal of mineral grains up to 20 μ, but mainly below 5 μ. The iron content is insignificant. The samples do not liberate carbon dioxide with hydrochloric acid. The colour of the dried samples is light grey. The alkali extract is very slightly brownish.

Lake Snogeholmssjön (Figure 16.).

Snogeholmssjön is situated in a large forest district extending from the neighbourhood of Sövdeborg northeast to Eriksdal and south to Krageholm. Only the northern part of the lake is surrounded by sandy areas. Otherwise the ground consists of moraine clay and sea clay. The shores of the lake are to a large extent covered with forests, and next to the water there is always an alder border. Only on the shore at Assmåsa are grazing grounds to be found.

The lake was lowered about 1932 (Ehnbom 1941). According to information from K. Lantbruksstyrelsen the intention was to lower the water-level about 1 m. below the mean water-level.

The shores are generally stony, but sandy ones occur at some places. The stony shores are characterized by a sparse vegetation of, *e.g.*, *Carex riparia*, *Epilobium hirsutum*, *Eupatorium cannabinum*, *Lythrym Salicaria*, *Phalaris arundinacea* and *Sium latifolium*. A typical feature of the lake is the *Carex* zones, which consist mainly of *Carex acutiformis* and *C. gracilis*. Sometimes, however, *C. riparia* and *C. rostrata* grow at similar habitats. Landwards the *Carex* zone is bounded by a border of *Calamagrostis canescens* and *Phalaris*. Towards the lake it is generally replaced by high reeds or very often *Scirpus palustris* reedswamp.

The high reeds are chiefly composed of *Phragmites*, but relatively considerable patches of *Typha angustifolia* are also to be found. *Scirpus lacustris* is less prominent. *Typha latifolia* grows in small stands here and there. Low reedswamps can be formed by *Scirpus palustris*, as mentioned above, and also by *Carex* species, *e.g.*, *C. riparia* and *C. rostrata*. *Scirpus Tabernaemontani* seems to be local, it is found on the southern shore at the Assmåsa bay. *Scirpus maritimus* is recorded from three localities, all of which are situated in the same bay. The high reedswamps are comparatively narrow. On the eastern shore they are very slightly connected. In the northern part of the lake there are many shoals and islets, which make the area unsuitable for boats.

Verlandung takes place here with a rich development of *Lemna* species and *Hydrocharis*, e.g., near the outlet.

Snogeholmssjön belongs to the lakes, which are characterized by a comparatively wide distribution of *Butomus umbellatus* (*e.g.*, Havgårdssjön, Krageholmssjön, Oppmannasjön (Arkelstorp) and Sövdesjön).

The nymphaeid vegetation is physiognomically dominated by the naturalized *Limnanthemum nymphoides* (*Nymphoides peltata*), which has replaced the water-lilies. The plant has spread over the entire lake and grows in some bays, *e.g.*, at the castle, at Vasavillan and in the northern end. *Nuphar luteum* is rather infrequent. *Potamogeton natans* has not been found as widely distributed as might have been expected (three localities). *Polygonum amphibium* seems to be rare.

The isoetid zone is insignificantly developed. *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis* are observed only at the western and northern shores.

A great part of the lake is filled with *Myriophyllum spicatum*, especially the northern end, which is the shallowest. In fact this is the dominating elodeid. In the small bay at Assmåsa the following species are also present: *Potamogeton Friesii*, *P. lucens* and *P. pectinatus*. *Elodea canadensis* has been observed at some localities at the western shore, especially abundantly below the castle. Drifting branches of *P. crispus* have been noted. *P. praelongus* has been collected by Professor Weimarck and others in the Nineteen Thirties.

The organic sediments (fine detritus gyttjas) of the open lake contain numerous small particles (<5 μ). The iron as well as the lime content are insignificant.

Lake Sövdeborgssjön (Figure 16.).

The small lake Sövdeborgssjön is relatively deep in comparison to its area and has rather steep shores. The greatest observed depth is about 4 m. (no systematic soundings have been carried out). Its physiognomy is probably typical for a lake, formed in a rubble stone field (an area built up by glaciofluvial material). The lake is situated in a large woody area. Especially the western shore is occupied by shrubbery and alder-fen grounds with *Carex paniculata* and *C. elata*. The short amphibious zone is otherwise covered with a luxuriant vegetation of, among others, *Cicuta virosa*, *Eupatorium cannabinum*, *Glyceria maxima* and *Sium latifolium*.

The reedswamps are rather narrow with *Phragmites* and *Typha angustifolia* as the most common components. *Scirpus lacustris* has only a restricted distribution. Verlandung is well marked in the southwestern part. At some places the fen ground reaches down to the open water surface without being edged by reeds. The lake is in this case similar to Svaneholmssjön, which it also resembles in the rich occurrence of *Thelypteris palustris*. (This fern grows also in Fjällfotasjön in the same manner.) In the Verlandung zone many of the herbids usually growing at such localities are to be found.

In this calm part of the lake the water-lilies occupy a large area, but they also occur at other places, *e.g.*, in the southeastern end. *Nymphaea alba* is more common than *Nuphar luteum*. From the southwestern part also *Potamogeton natans* and *Hydrocharis Morsus-ranae* have been recorded. The vegetation in this »growing up» zone also includes *Stratiotes Aloides*, which is not unexpected, as the environment resembles its habitats in, for example, Sövdesjön and Börringesjön. It seems to be more surprising that the species does not grow in Svaneholmssjön, which as already mentioned, resembles Sövdeborgssjön in many respects. Another species, *viz. Potamogeton obtusifolius*, occurs in both lakes. This plant seems to thrive in habitats which are rapidly silting up (*cf.* its occurrence in Börringesjön). In the separated shallow cove in Sövdesjön, where *Stratiotes* is to be found, however, *P. obtusifolius* has not been observed. A few small stands of *P. crispus* have been noted in the part of the lake referred to above.

The submerged vegetation outside the Verlandung zone consists mainly of *P. lucens*, extending to a depth of 3 m. *P. praelongus*, which is entered in the survey (table 6), is not found growing in the open lake but in the mouth of the moat round the castle.

The fine detritus gyttjas contain a great deal of coarse detritus and a varying amount of mineral grains. The iron content is moderate. When coarse detritus is abundant, the alkali extract is deeply brown. Lime gyttja has been collected, but otherwise the lime content of the sediments seems to be slight.

Lake Sövdesjön (Figure 16.).

Sövdesjön is situated in a sandy district, which mostly lacks forests. On the hill Salsbjer pines have been planted, and to the west at Dösjö there is a grove of the same tree. The southern shore is lined by a narrow alder border and around the winding bay near the church leafy wood covers the ground, where the shores are not occupied by forest, an intensive grazing takes place.

The lake was lowered as late as in 1936 (EHNBOM 1941).

The shore is to a large extent minerogenous. Typical for the amphibious vegetation is a border of *Carex gracilis* intermixed with herbids. Sometimes the herbids are dominating, *e.g.*, *Cicuta virosa*, *Lysimachia thyrsiflora* and *Rumex Hydrolapathum*. Frequently *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis* are associated. At the southwestern shore Magnocaricion fens are to be found, which in 1947 were strongly injured by grazing.

Except in the bay close to the church and adjacent shore parts the reedswamps are narrow and disconnected. In the wide bay east of Salsbjer there are small stands of *Glyceria maxima*, *Phragmites communis*, *Scirpus lacustris*, *Typha angusifolia* and *T. latifolia*. Particularly along the western part dominates *Sc. lacustris*. In the southernmost corner of the lake *T. angustifolia* occupies a relatively large area outside lined by an *Equisetum fluviatile* belt. In the bay south of the church *Phragmites* is dominant, but the other reed component may also be found.

This bay is characterized by a rapid process of Verlandung. The reed communities are here intermingled with luxuriant herbs, *e.g.*, *Cicuta virosa*, *Rumex Hydrolapathum* and *Solanum Dulcamara*, *i.e.* those generally appearing on such habitats. Among the reed-forming helophytes *Scirpus Tabernaemontani* must also be mentioned. It is recorded from several localities, but the patches are rather limited. It grows generally in very shallow water and thrives also on dry land.

The main part of the lake is very exposed and does not form suitable habitats for floating leaf vegetation. Apart from small occurrences of *Nuphar luteum* in the southern end and at the western shore the waterlily vegetation is restricted to the bays north and south of the church. In the bay south of the church the *Nuphar* cover is well developed. *Nymphaea* has not been observed. *Polygonum amphibium* is more frequent than *Nuphar*. It seems to be easier, however, for a small-leaved floating plant to find shelter behind the high helophytes. *Potamogeton natans* is surprisingly rare. It is only observed in the bays north and south of the church. *Hydrocharis* belongs to the vegetation in the bay south of the church.

Low reedswamps of *Scirpus palustris* occupy very often the large areas that are destitute of high reeds, *e.g.*, at the northern and western shores, where the patches of *Sc. palustris* landwards are succeeded by the *Carex gracilis* border, mentioned above.

Only *Ranunculus Flammula* ssp. *reptans* and *Scirpus acicularis* are represented among the rosette plants. They may grow in shallow water and extend into the lowest amphibious zone (judging from the conditions prevailing in the years after 1947). The two species are relatively frequent, which is probably due to the occurrence of sandy shores. It is, however, conspicuous, that the *Chara* mats, which generally compete with the isoetids in shallow water, do not occur at all.

A minute part of the lake bottom is covered with higher vegetation. The bottom often descends steeply, which is evident from the depth values in the profiles. At the southern point of Salsbjer the depth amounts to 2,60 m. at a distance of 30 m. from the shore-line. At Dösjö the same depth is to be found at a distance of 50 m. and in the southern end at 80 m. In the part of the lake last mentioned the bottom is alternately deep and shallow. *Potamogeton pectinatus* has a conspicuously wide distribution. It occurs in many different parts of the lake, very often in large quantities. *Myriophyllum spicatum* and *P. perfoliatus* are also very widespread. *P. lucens* grows in several places in rather large clumps, *e.g.*, in the northwestern bay, along the western shore and in the southern end. It seems to prefer »deep» water and grows always outside the other elodeids. *Ranunculus circinatus* has been observed at least at three localities, one of which is situated in the bay east of Salsbjer, the second in the southern end and the third in the bay south of the church. The species mentioned above are the only elodeids found in the open lake except the hybrid *P. nitens*, which has been observed in the southern end. It is true that *Elodea canadensis* has been recorded, but only in the immediate neighbourhood of the tributary from Snogeholmssjön, which here and there is completely filled up with this plant.

In the survey of the submerged vegetation given above, that part of the lake, previously called the bay south of the church, has been excluded on purpose. It is rather isolated from the remaining part and has irregular contours, possibly related with its position on rubble gravel. It is clear, that this lobated bay, well sheltered, offers other environmental conditions than the extensive open water surface, exposed to winds from different directions. The sedimentation takes place more rapidly here and the »growing up» is more vigorous. The decay of organic material is also greater, which is indicated by an enormous evolution of gases. In this habitat (figure 20) *Stratiotes Aloides* is found

Fig. 20. The Verlandung zone with *Stratiotes Aloides* in Sövdesjön (the bay south of the church). In the background a herb-rich *Phragmites* reed. Photo by the author, 15.7.1947.

thus under similar conditions as in Börringesjön. Hitherto the only locality for *P. Friesii* in the lake has been noted here.

In the lime-deficient fine detritus gyttjas coarse detritus and smaller mineral grains occur in varying quantities. The iron content is relatively high. Diatoms and chitinous crusts are the most common fossils. The alkali extract is slightly brownish. In the profiles gyttja material began to appear at a depth of 2 to 2.5 m.

Lake Heljesjön (Figure 21.).

A description of South Scanian lakes must always include a chapter on human interferences in the natural development of the lakes. The description of Heljesjön is no exception. In the spring of 1949 the water-level was abnormally low for the season. In the summer the water-level was kept considerably below normal. This lowering is a consequence of the fact, that the water-works of Malmö pumps ground water at

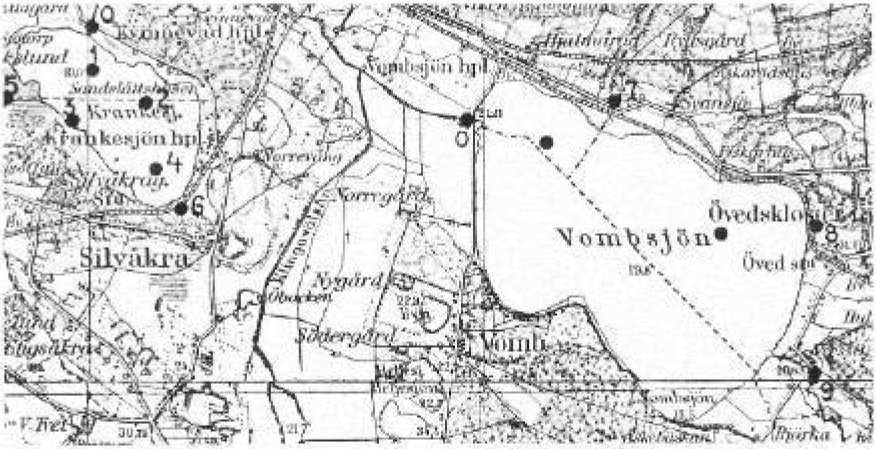

Fig. 21. The lakes Heljesjön, Vombsjön and Krankesjön. Scale 1 : 100 000.

Vomb from several wells dug in the sandy ground south of Heljesjön. Since the autumn of 1949 water is supplied to the lake from Vombsjön. By this process, however, the normal seasonal fluctuations of the water-level are not obtained.

The lake is surrounded by rather steep slopes. The shores are open except in the northwest. In the neighbourhood of the excavated outlet wet birchwood is to be found. The beautiful calcareous fens and a great part of the reeds have been destroyed by grazing. The reeds are thickest at the western shore. *Phragmites communis* is the leading reed-forming component.

The absence of any nymphaeid vegetation probably is brought about by the exposed position of the lake. No isoetids have been registered either.

Hitherto the charad vegetation has survived the altered conditions and is for the present the best developed one in South Scania. Figure 22 gives an illustration of the rich growth of *Chara hispida* at the north-western shore in September 1949, when the water surface was so low, that a great deal of the *Chara* vegetation was in danger of being dried out. The main charad dominant in deeper water is *Chara hispida*. There is also a considerable occurrence of the reddish *Ch. tomentosa*. Both are visible from a boat.

The small lake contains in addition a surprisingly great number of elodeids. The predominating species are *Elodea canadensis*, which seems to have increased since 1947, *Potamogeton Friesii*, *P. pectinatus*

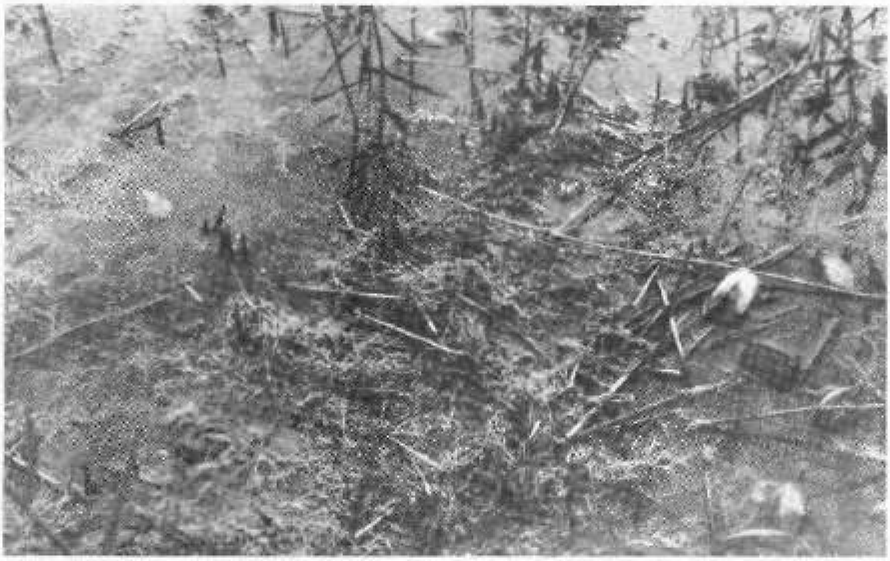

Fig. 22. The bare laid *Chara hispida* vegetation in Helgesjön in the autumn of 1949. Photo by A. ALMESTRAND. 12.10.1949.

and *Ranunculus circinatus*. In 1950 *P. lucens* was also especially well developed.

The sediments in the northwestern part are rich in lime. Here even pure lake-marl has been recorded. Otherwise the gyttjas (fine detritus) have a varying lime content. Notable is the high content of coarse detritus (*i.a.* moss leaves). The iron content is rather insignificant. Where the profile was laid (locality: the southeastern corner), the bottom declines steeply at a distance of 12 to 15 m. from the shore-line. The gyttja commences immediately below the steep.

Lake Vombsjön (Figure 21.).

The physiognomy of Vombsjön has radically changed after the regulation of Kävlingeån in the beginning of the Nineteen Fourties, and the vegetation has not become stabilized to such an extent, that a closer description is justified. The extensive shore parts, sometimes more than 100 m. broad, which were laid bare by the lowering of the surface, appeared for the first time like naked sandy or stony deserts. Since then a luxuriant vegetation has developed over the sandy areas, a vegetation, which requires many years for stabilization.

It is clear, that a lowering of such an extent must cause a strong disturbance in the aquatic vegetation. On large parts of the shallow bottom the sensitive plants were destroyed by drying out, and on the remaining bottom the vegetation had to adapt itself to other depth conditions and associated factors. The most natural consequence seems to have been a reduction of the area covered with plants and of the number of species. It is, however, hardly possible to obtain a reliable idea of the real effect of the lowering, as no botanic description of the lake from earlier times is available.

The present vegetation, in any case, does not seem to reflect the old conditions, least of all as the water-level at present no longer need follow the seasonal fluctuations but can be regulated arbitrarily by the dam at the outlet.

By the lowering the main part of the reeds were brought on land, and after that they have advanced only very slightly into the water. The so-called brackish water species *Scirpus maritimus* and *Sc. Tabernaemontani* have progressed very much on the uncovered lake bottom.

Water-lilies are completely absent, and *Potamogeton natans* has not been observed. In shallow water abundant *Chara* mats are to be found, which are often laid bare at low water-levels. The shoaling shores, preferably to the north, are excellent habitats for *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis*. On account of their amphibious character they survive the drying out very well.

In comparison to the extension of the shores the submerged vegetation is slightly developed, which is due, perhaps, to the fact that organic sediments do not appear until rather great depths. On the northern side gyttja is found at a depth of 3 to 4 m. On the southern side a precipice touches the present shore. The species, which seem to thrive best, are *Myriophyllum spicatum*, *Potamogeton pectinatus* and *P. perfoliatus*. They are all species, which in other lakes occur on minerogenous as well as muddy bottom.

In the northwestern part pure lake-marl is exposed. Five samples collected at depths between 4 and 9 m. outside the northern shore, have been examined and proved to be fine detritus gyttjas. They contain a varying lime content, with the sediments richest in lime nearest the shore. The iron content is relatively high. The alkali extract is very slightly brownish.

Lake Krankesjön (Figure 21).

For a long time Krankesjön has been well known among ornithologists, but apparently the botanists have been less interested in it, as no studies of its vegetation have been published.

The lake has been subjected at least twice to radical human interferences. In 1892 an extensive drainage of the lake Silvåkrasjön was carried out, which also gave rise to a lowering of Krankesjön, the recipient of the outflow from Silvåkrasjön. Before the lowering Krankesjön resembled Vombsjön (before its regulation in 1944), but thereafter the sedimentation increased very strongly. Even recently bathing was possible along the entire eastern shore, but now it is confined to a very small area in the northwestern corner. Out in the lake the layers of gyttjas are very thick (an iron rod of 6 m. length disappeared completely). Previously the outflow ran towards the northwest, but now the lake is drained by the excavated ditch, Ålabäcken.

The author began the studies of the vegetation in 1944. The results may give a description typical of the stabilized conditions after the first lowering in 1892. Unfortunately the year 1944 was the last year, in which the lake could be investigated in an undisturbed state. A lowering of the water-level had proceeded since 1940 (HANSTRÖM 1945) as a result of the dredging of the river Kävlingeån. In 1944 this work was completed at Vombsjön. The author could state that the water-level of Krankesjön this year was much below normal. The dams in Ålabäck, which were intended to prevent excessive tapping, were constructed of very poor materials. Already in the autumn of 1945 the dams were broken and the water rushed forward in the brook, effectively eroding the sandy bottom material. In this way the lake surface was lowered abnormally. Later on more stable dams have been raised.

The description given below, refers to the conditions prevailing in 1944. The summer water-level was so low, that boating was impossible in the most shallow parts of the lake. An attempt to sound the lake was made difficult by the enormous layers of gyttja. The weight sank down into the sediments and therefore the observations were somewhat uncertain. The greatest depth, measured by the author, was 2.75 m., but probably the maximum depth was higher. A small »deep basin» (>2 m.) was registered in the northeastern part. (In 1947 this basin had disappeared and the lake was considerably silted up in this part. The map of depths, drawn by the author, is thus no longer valid.)

Nowhere does the forest reach down to the lake, but the shores are

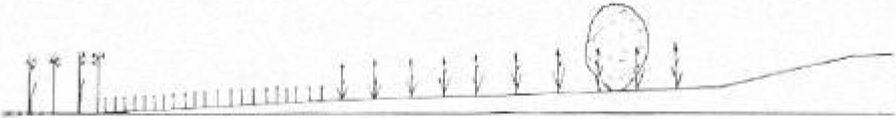

Fig. 23. Profile from the northern shore of Krankesjön, showing the vegetation of the amphibious zone. The *Scirpus Tabernaemontani* reed is succeeded by a *Scirpus pauciflorus* zone, which landwards passes into a *Molinia coerulea* meadow. Since 1944 the ground has become drier and a large number of alder bushes has grown up in the *Molinia* zone. The distance between the water-line and the top of the slope is about 70 m. (in the next figure about 45 m.).

open and sandy, where they are not bordered by fens. The shores at Silvåkra and to the northwest are used for grazing. The remaining parts now lie unemployed, since the government has purchased the grounds. As the shores are plain, the zonation of vegetation becomes very distinct, as long as the high water-levels are not changed by interferences by man. Normally the winter and spring inundation has been very great according to information from the local people. As late as in April 1946 the author herself observed a considerable overflow. In the summer of 1944 the vegetation was still in such a state, that the zonation could be studied.

On the northern side the reedswamp, in the profile (figure 23) consisting of *Scirpus Tabernaemontani*, was succeeded by a zone of *Sc. pauciflorus*, which landwards was replaced by a *Molinia coerulea* meadow, followed by dry vegetation. Normally the *Molinia* meadow was probably inundated during the high water period, but in the winter of 1944—45 the water only reached up to the borderline between the *Sc. pauciflorus* and *Molinia* zones. At the eastern shore, inside the thick *Phragmites* reed, there was a zone containing a mixture of several species, characteristic for the herb-rich reedswamp and high sedge communities, but without anyone predominant. This »mixture zone» seems to correspond to that part of the eulitoral, which by the limnologists is called the telmatic one (*cf.* Thunmark 1931 and others) and at Krankesjön often may contain a typical fen vegetation with, for example, *Carex rostrata*, *C. elata* and *C. gracilis*. Above this zone a meadow community with *Holcus lanatus* predominating was to be found (figure 24). At the Silvåkra shore the most apparent feature of the vegetation was the large stands of *Cladium Mariscus* (figure 25). With respect to the South Scanian lakes this plant occurs also at Yddingen and Fjällfotasjön, but not to such a large extent as here. The distribution of *Cladium* in Scania has been dealt with by Hansen (1949 a).

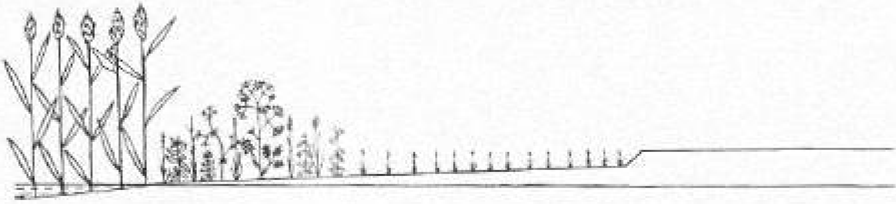

Fig. 24. Profile from the eastern shore of Krankesjön, showing the vegetation in 1944—45. The high *Phragmites* reed is followed by a zone rich in herbs, where none predominates. The species belong to that group, which is characteristic for the Verlandung reeds and several Magnocaricion fens (*cf.* the list of species p. 75). Later on the vegetation has considerably changed its character.

C. elata fens occurred at some places, *e.g.*, in the northwestern and southwestern corners. Especially characteristic for Krankesjön were, however, the extensive *C. gracilis* fens in the western end. Sometimes they had a breadth of 200 m. or more. The vegetation illustrated the different stages in the development of the lake. Farthest towards the lake a very broad reedswamp with *Phragmites* and *Typha angustifolia* occupied the wettest ground. Next came a *C. rostrata* zone, which landwards was replaced by a *C. gracilis* fen (figure 25). The effects of the last lowering on the amphibious vegetation has not been studied in detail, but changes have been registered.

In connexion with the lowering in 1892 the area of the reedswamps increased. For the present the lake is to a large extent surrounded by reeds. The two largest reed areas are to be found to the west and southeast. Furthermore, the entire southern shore is bordered by broad and closed reeds. Along the northern side the reedswamps are relatively thin. *Phragmites* is the most frequent component. *Typha angustifolia* occurs in the western and the southeastern end, while *Scirpus lacustris* has a very limited distribution. *Typha latifolia* grows in the same areas as *T. angustifolia*, but more rarely. *Glyceria maxima* is also found here in the neighbourhood of the mouths of the tributaries. *Equisetum fluviatile* plays a very secondary rôle. *Scirpus Tabernaemontani* occurs in thin stands at several places, *e.g.*, on the eastern and the northern shore, where the higher reeds are thin or absent.

In the west and southeast the reeds have the character of quagmires and contain a rich flora. The predominating reed species are *T. angustifolia* and *Glyceria maxima*. An abundant decay of plant remains takes place, which is evident from the vigorous gas evolution. An

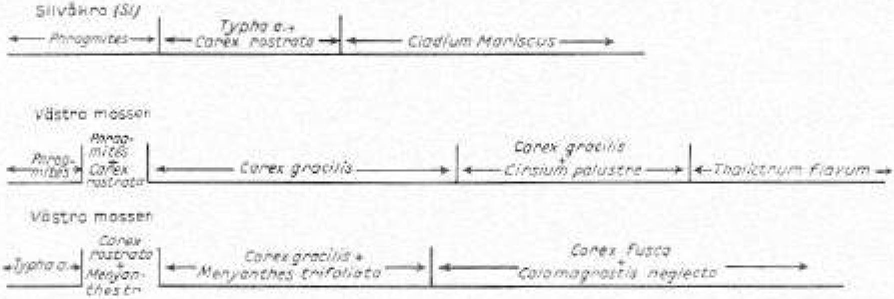

Fig. 25. Scheme of the different stages of succession in the amphibious zone at the southern and western shore of Krankesjön (»Silvåkra» and »Västra mossen» respectively).

example of the composition of the vascular plants in a *T. angustifolia* community from the southeastern corner is given below:

Graminids

Agrostis stolonifera
Carex paniculata
— *Pseudocyperus*
Glyceria maxima
Phalaris arundinacea
Phragmites communis
Poa trivialis
Scirpus lacustris
Typha angustifolia
— *latifolia*

Herbids

Alisma Plantago-aquatica
Bidens cernua
— *tripartita*
Cardamine pratensis
Cicuta virosa
Epilobium hirsutum
— *palustre*
Galium palustre
Hottonia palustris
Iris Pseudacorus
Lycopus europaeus
Lysimachia thyrsiflora
Lythrum Salicaria
Mentha aquatica
Myosotis palustris
Peucedanum palustre
Potentilla palustris
Rorippa amphibia
Rumex Hydrolapathum
Scutellaria galericulata
Sium latifolium
Solanum Dulcamara
Sparganium ramosum
Stellaria palustris

Lemnids and nymphaeids

Hydrocharis Morsus-ranae
Lemna minor
Spirodela polyrrhiza

The above description of the reedswamps refers to the conditions in 1944. On the whole it is still true, but in detail some changes have taken place. The reeds tend to become more dense. This tendency is most apparent concerning the *Sc. Tabernaemontani* reeds.

The nymphaeid vegetation is very slightly developed. Of the water-lilies only *Nuphar luteum* occurs. In this regard Krankesjön agrees with the lake Tåkern (Du Rietz, Hannerz and others 1939). In the south-eastern bay there is the only considerable stand of the yellow water-lily. *Hydrocharis Morsus-ranae* belongs to the reed communities.

The rosette plants are represented by *Ranunculus Fl.* ssp. *reptans*, which in 1944 had a very restricted distribution, and *Scirpus acicularis*, which was rather common.

In the summer of 1944 the main part of the lake bottom was covered with higher vegetation. Only the small deep basin could be regarded as completely deficient in plants. Without any doubt the charophyte flora was the predominant component of the submerged vegetation. *Chara* species were present in all parts of the lake. On the deepest part of the floor covered with higher vegetation the *Characeae* disappeared except *Ch. stelligera*. Here the vegetation consisted of mainly *Elodea canadensis*, accompanied with, *e.g.*, *Potamogeton Friesii*, *P. pusillus* and *Ranunculus circinatus*. In addition most of the species characteristic for the lowland lakes were recorded. Remarkable was the insignificant distribution of *P. crispus*. It was not included in the profiles. *P. panormitanus* was only observed in the western part, and that was also the case with *Zannichellia palustris*. *P. lucens* was very local. It was found at one locality. The remaining elodeids were spread here and there.

Stratiotes Aloides, which nowadays is observed in a few South Scanian lakes (Björkesåkrasjön, Börringesjön, Ellestasjön, Fjällfotasjön, Sövdesjön and Sövdeborgssjön), was in 1944 abundantly developed in Krankesjön. In August the water surface appeared in many places like a green meadow, formed by the *Stratiotes* rosettes. Since then, however, the plant seems to have vanished. Later inquiries have been in vain.

The seven profiles, three of which are published here, vary greatly in length, from about 350 m. to more than 1000 m. P 1 did not reach to the so-called deep basin. P 2 shows a cross section through the vegetation in the northeast, where one of the *Stratiotes* meadows was situated. The vegetation ended on the bottom, where a sandy layer began at a relatively great depth. P 3 illustrates, that the bottom here descended very markedly to the deep basin. Three zones are to be distinguished in the profiles discussed here: 1. a *Ch. aspera* zone, which extends as far as the sandy bottom reaches, 2. a *Ch. contraria-rudis* zone, which ends at a depth of about 1.30 m. 3. an *Elodea - Ch. stelligera* zone, which disappears at a depth of about 2.50 m. (figures 26—28).

The environmental conditions have apparently been radically changed since 1944. It seems difficult, however, to explain the change in the vegetation as a direct result of the lowering of the water-level, caused by the regulation of Kävlingeån.

Already in 1945 an unexpected change was observed. The charads had wilted, and only small remains could be found in the dredge. Green algae had spread over the bottom. In 1946 from a boat the lake gave an impression of sterility. Nothing of the vegetation previously reaching up to the water surface could be observed. On a visit in August 1947 in search of *Chara stelligera*, neither this species nor the large quantities of submerged plants, characteristic for the lake in 1944 could be found. The water-level was very low and more than 10 m. of the shoaling bottom lay bare. The climate, as mentioned above, was also extremely dry this year. The single species recorded were *Myriophyllum spicatum, Ceratophyllum demersum* (only one branch) and *Chara aspera* (dry remains on the shore). Lektor O. Palmgren, who visited the lake this summer, observed *Potamogeton filiformis, P. pectinatus* and one individual of *P. crispus*. The *Chara* mats had completely disappeared.

In 1948 the vegetation had recovered but had a different appearance. The *Chara* mats were still absent in deeper water. In shallow water near the water-line, on the other hand, large quantities of some *Chara* species were found. In addition a mass development of *Ceratophyllum demersum* and *Myriophyllum spicatum* was observed in the eastern part of the lake. *Potamogeton crispus* had spread enormously. *P. pectinatus* and *filiformis* were also more common. Furthermore *Ranunculus circinatus* was recorded.

In 1949 the main part of the open water surface was covered with *P. crispus*. In other regards the vegetation had a similar appearance to that of the preceding year. Of the species registered in 1944 the following have not been refound: *Elodea canadensis, Potamogeton Friesii, P. lucens, P. panormitanus, P. pusillus, Stratiotes Aloides* and *Zannichellia palustris*. Furthermore, the extensive *Chara* mats out in the lake were completely absent. A visit to the lake now cannot give an idea of the appearance of the lake before 1945.

The water already in 1944 was very intermingled with detritus, but in 1949 it resembled that of a duck-pond. The table below illustrates

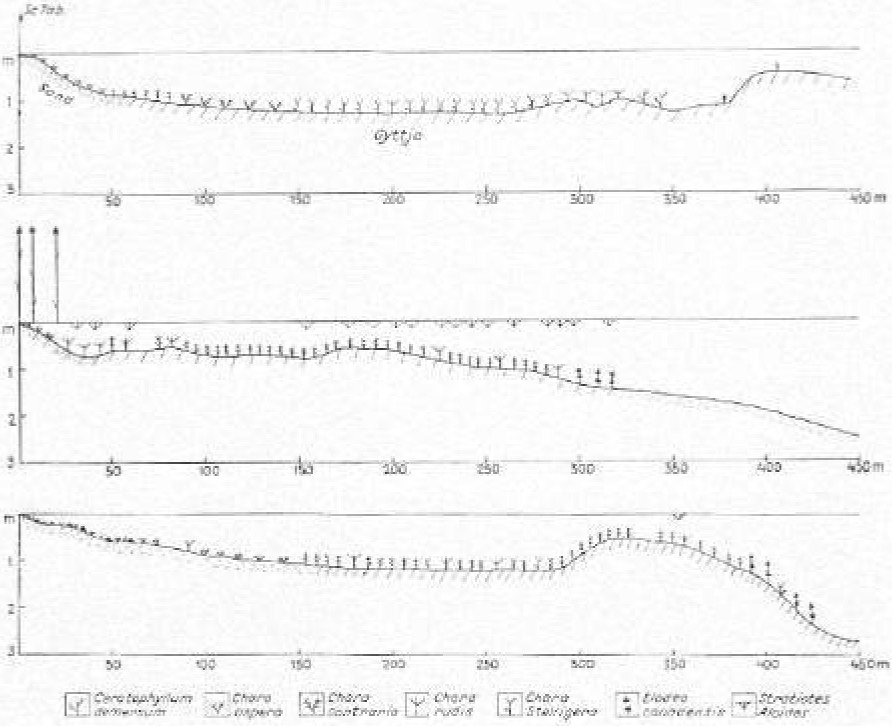

Fig. 26 (above). Vegetation profile P 1 (Aug. 1944) from the eastern shore. Its greatest depth is 1.40 m. The reed: *Scirpus Tabernaemontani*.

Zone 1: a *Chara aspera* mat (with *Potamogeton filiformis* and *Scirpus acicularis* in the inner part and *Ceratophyllum demersum* and *Potamogeton perfoliatus* in the outer part) out to a distance of about 60 m. from the water-line.

Zone 2: a *Chara contraria* meadow with *Ceratophyllum demersum* [1], *Chara rudis* [1], *Potamogeton perfoliatus* [1] and *P. pusillus* [1] out to about 140 m.

Zone 3: a *Chara stelligera* meadow with *Chara rudis* [1—3], *Ceratophyllum* [1], *Elodea canadensis* [1] and *Potamogeton Friesii* [1] out to about 290 m.

Zone 4: a *Chara rudis* meadow with *Stratiotes* [1—3], *Ceratophyllum* [1—2], *Ch. contraria* [1], *Elodea* [1] and *Potamogeton Friesii* [1] out to about 320 m.

Zone 5: a short *Ceratophyllum demersum* zone with *Ch. rudis* [2—3], *Ch. stelligera* [2—3], *Elodea* [1], *P. Friesii* [1] and *Stratiotes* [2] out to about 350 m.

After that the vegetation becomes more irregular, alternating with bare areas. *Ch. contraria* is most frequent but the species already mentioned (except *Ch. aspera*) and *Ranunculus circinatus* are also to be found. As is seen from above *Ch. stelligera* occupies the deepest part.

The figures within [] are the approximate covering according to HULT-SERNANDER's scale (*cf.* p. 46), estimated for 100 sq. m. at a time (corresponding to a length of 10 m. along the profile).

a number of measurements of the transparency, performed in the period 1944—49.

Date	1/8-44	17/9-44	29/7-45	9/9-45	13/7-46	23/8-48	15/9-48	19/8-49
Transparency cm.	67	42	78	82	27	53	50	42

The sediment limit reaches at sheltered localities almost up to the water surface. On the northern shore lake-marl lies bare. The organic sediments consist of different types of gyttjas, lime-rich gyttjas, lime-gyttjas, shell-gyttjas, algae-gyttjas and coarse detritus gyttjas. The samples, examined by the author, were rich in mineral grains. The lime content was varying and the iron content relatively high.

Lake Gyllebosjön (Figure 29.).

Gyllebosjön is situated on the borderline to the forest region. South of the lake the cultivation is still rather extensive. It is a long and narrow lake, bound in the north by high slopes, covered with beech

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Fig. 27 (in the middle). P 2 (Aug. 1944) from the northeastern corner of the lake. The higher vegetation ceases at a depth of about 1.40 m., where a sand layer occurs. The reed: *Phragmites communis.*

Zone 1: a *Chara aspera* mat out to a distance of about 20 m. from the water-line.

Zone 2: a *Chara rudis* meadow with *Stratiotes Aloides* [1—5] and *Chara contraria* [1—4] out to about 80 m.

Zone 3: a *Chara contraria* meadow with *Ch. rudis* [1—4], *Stratiotes* [1—5] out to about 290 m. In the most distant part *Ch. contraria* decreases and other species are included, *viz.*, *Ch. rudis* [3—4], *Ch. tomentosa* [0—3], *Ceratophyllum* [1—3], *Elodea* [0—2] and *Potamogeton pusillus* [1—2], while *Stratiotes* is covering the water surface.

Zone 4: an *Elodea canadensis* meadow with *Ceratophyllum* [2—3], *Ch. rudis* [1], *Ch. stelligera* [0—1], *P. Friesii* [0—1], *P. pusillus* [0—1] and *Stratiotes* [2—3].

Fig. 28 (below). P 3 (Aug. 1944) from the northern shore just west of Tallhem. It extends out to the so-called deep basin, and the vegetation does not cease until a depth of about 2.40 m. The minerogenous part is wider than in the other profiles, probably due to the exposed position of the shore.

Zone 1: a *Chara aspera* mat intermingled with *Ch. rudis* in the most remote part out to a distance of about 150 m. from the water-line.

Zone 2: a *Chara contraria* meadow with *Ch. rudis* [1—4], *Elodea* [0—1], *P. perfoliatus* [1—2], *Ch. stelligera* [1—5], *Ranunculus circinatus* [0—1], *Ceratophyllum* [0—1] and *Stratiotes* [0—1] out to about 380 m.

Zone 3: an *Elodea canadensis* meadow with *Ch. contraria* [0—2], *Ch. rudis* [0—1], *Ch. stelligera* [0—2], *Ceratophyllum* [1], *Ranunculus circinatus* [0—1], *P. Friesii* [0—2] and *P. pusillus* [0—2] out to about 430 m.

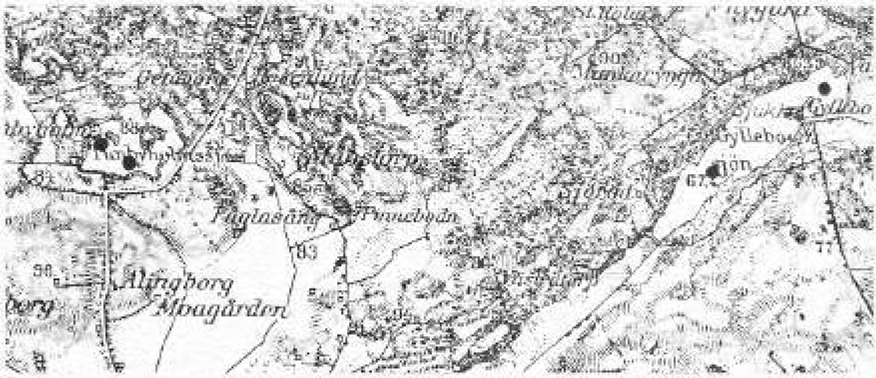

Fig. 29. The lakes Tunbyholmssjön and Gyllebosjön. Scale 1 : 50 000.

woods. All around the shores there are forests, brushwood or alder edges.

The zone between high and low water is fairly short and often stony, especially on the northwestern side, where it is covered with a sparse vegetation of *Carex elata* - tussocks, *C. gracilis, Equisetum fluviatile* and *Lysimachia thyrisflora*. In the profile east of the hospital the amphibious vegetation consists of *Equisetum fluviatile, Glyceria maxima, Lysimachia thyrsiflora* and *Mentha aquatica* (sandy stony soil). On the southeastern side fen grounds reach down to the water surface (*C. elata*).

In spite of its position on sandstone rock the lake is rich in lime, demonstrated by a thick lime covering on leaves and stones (cf. p. 16). The vegetation agrees completely with those of the lowland lakes.

Only on the southeastern shore are large connected reedswamps to be found. They are mainly composed of *Phragmites* and *Typha angustifolia*. The northwestern shore descends too abruptly for forming suitable habitats for reeds. Here *Scirpus lacustris* occurs, but also single *Phragmites* stands are to be found.

The lake is relatively well sheltered on account of its shape and surroundings. Therefore it is not surprising that water-lilies grow now and then in the bays. The most abundant stands are to be found in the southwesternmost end and consist mainly of *Nymphaea alba*. Besides *Nuphar luteum* and *Potamogeton natans* occur here. Even at the steep northwestern shore, where the reeds are thin, small water-lily patches are sometimes found. Farthest to the northeast the water-lily covers are composed of *Nuphar luteum*.

Because of the nature of the shores only few suitable habitats for isoetids are available. On the southern part of the southeastern shore the bottom is shoaling for about 10 m., before it descends steeply. On this shallow peaty ground a border of *Carex lasiocarpa* grows between *Phragmites* lakewards and *C. elata* landwards with an understorey of charads (but no isoetids). There is an important lime precipitation on the bottom.

As the bottom declines abruptly, there is no place for extensive elodeid meadows. Southwest of the hospital a large shoal is situated, which is richly covered with *Myriophyllum spicatum*, *P. perfoliatus* and *P. crispus*. These three plants also occur at many other localities. *P. lucens* is widespread. *P. pectinatus* has been met with at two localities, one at the bathing-place in the northeast and the second close to the hospital. *P. Friesii* is found at the locality last-mentioned. In addition to these species, characteristic for the lowland lakes, *P. zosterifolius* is also registered, previously reported in connexion with its occurrence in Fjällfotasjön. It occupies at least two habitats in Gyllebosjön. At the bathing-place the hybrid *P. lucens*×*perfoliatus* has been observed.

Gyttja is not to be found until depths below 2 m. Sometimes it contains a great deal of coarse detritus, *e.g.*, in the profile mentioned above, where gyttja commences at a distance of 10 m. from land. Otherwise, it can be denoted as a fine detritus gyttja. The lime content is considerable in the sandy bottom, rich in shells, that is situated south of the hospital.

Lake Tunbyholmssjön (Figure 29.).

The investigated part of Tunbyholmssjön is situated east of the castle. On the map the lake looks larger than it is in reality, because the entire area north of the islands has grown up and is impassable. According to LINNÉ (LINNÆUS 1751) it is not an original lake but has been formed by a damming up. The lake was emptied as late as in 1913 or 1914 according to a private communication. In 1948 the water surface was lowered about 1 m., an effect of a drainage.

The shallow lake is like Svaneholmssjön. Perhaps it is equally correct to call them ponds. The northern side is woody, the other shores are open or edged by an open alder border. North of the lake fens and Verlandung areas form a terrain, which is difficult to traverse.

The reeds are not especially broad except in the northern end. *Scirpus lacustris* is the most frequent component, but *Phragmites* is also relatively common. Particularly in the southwestern corner there are reeds rich in herbs with *Scirpus lacustris* and *Acorus Calamus* as dominants. A strong evolution of hydrogen sulphide was noted on the visits to the place. Landwards these reeds pass into a *C. gracilis* zone. *Equisetum fluviatile* and *Sparganium ramosum* grow even in the open lake. On the southern shore the reed belt sometimes is absent and replaced by *C. elata* - tussocks. Here it may also be mentioned that *Oenanthe aquatica* grows at one locality on the eastern shore. This plant does not usually belong to the vegetation of the lakes investigated.

The main part of the water surface is covered with floating leaves of *Potamogeton natans* and *Nymphaea alba*. Curiously enough *Nuphar luteum* has not been recorded. *Polygonum amphibium* grows in the small pond west of the castle. Remarkable is the absence of *Hydrocharis Morsus-ranae*. *Sparganium simplex* grows out in the open lake and is furnished with floating leaves.

Where open minerogenous shores exist, *e.g.*, at the bathing-place in the southeast, isoetids are to be found, *viz. Juncus bulbosus* and *Scirpus acicularis*, accompanied with *Chara fragilis*. The submerged vegetation occupies the main part of the floor. The dominant species are the following elodeids: *Myriophyllum spicatum*, *M. verticillatum* and *Potamogeton zosterifolius*. Furthermore, *Myriophyllum alterniflorum* (near the bathing-place), *P. obtusifolius*, *P. perfoliatus*, *Ranunculus circinatus*, *Utricularia vulgaris* and *Nitella opaca* are common. Notable is the occurrence of *Myriophyllum alterniflorum* and *M. spicatum* in the same lake (*cf.* Fjällfotasjön). *Ceratophyllum demersum*, which is frequent i Svaneholmssjön, has on the other hand not been found.

The content of coarse detritus of the sediments varies, but sometimes this element constitutes the dominant component. The iron content is low. The alkali extract is very brown, as is to be expected.

Lake Ringsjön.

As has been pointed out in another paper (LUNDH 1951) Ringsjön must be treated as three distinct units: Western Ringsjön, Eastern Ringsjön and Sätoftasjön. Previously the lake was more unitary. As late as at the end of the twelfth century the castle Bosjökloster was still situated on an island, Bosieön (ANDERSSON 1947). Later on the tongue of land from Orup to Bosjökloster, which now divides Western and Eastern Ringsjön, was formed, when the two islands grew together with the mainland to the north (NELSON 1935). The communications between the different parts were further reduced by the lowering in 1883.

Western Ringsjön (Figure 30.).

The sandy shores gently graded are mostly grazed and their vegetation is therefore difficult to identify. The amphibious vegetation seems to consist of at least two distinct zones, the drier, covered with a *Carex fusca* community and the wetter, thinly covered with *C. elata*, *C. Oederi*, *Juncus articulatus*, *Lycopus europaeus*, *Mentha* sp., *Potentilla anserina*, *Ranunculus Fl.* ssp. *reptans*, *Scirpus palustris* and others. Where the shore is stonier and steeper, *e.g.*, around Lillö and east of Stakettehus the amphibious zone becomes short and is characterized by a border of *Phalaris arundinacea*, containing *C. elata*, *Eupatorium cannabinum* and other intermingled species. *Calamagrostis canescens* prefers the distal part of the *Phalaris* border. The shelving sandy bay at Boo is edged by a border of *C. elata*. Fen grounds reach to the lake, *e.g.*, at the northwestern shore.

By the lowering in 1883 the then existing reeds were largely brought on land (TRYBOM 1893). The present ones are in comparison to the size of the lake highly insignificant. *Phragmites* is the most important component. *Scirpus lacustris* is local. *Typha angustifolia* is not recorded, and if it occurs, it is very local. The thickest reedswamps are developed outside the woody sections of the shores, *e.g.*, at Råröd, Kulleberga and the southern side of Lillö. Otherwise only small reed patches are to be found here and there, often very sparse. Low reeds of *Scirpus palustris* grow at several places, where high reeds are absent. Bays with appropriate conditions for a marked Verlandung are rare. The only bay with a hint of such a vegetation is situated south of Stanstorp, where the reeds, in which also *Equisetum fluviatile* is included, occupy a large part of the water surface. Here is also the only habitat for *Nuphar luteum* in the western Ringsjön. *Butomus umbellatus* is found in small isolated clumps, not flowering, at varying distances from the shoreline, sometimes on stony shoals.

The water-lily vegetation outside the reedswamps is completely absent. The small-leaved floating plants are on the other hand often found behind the reed straws in very shallow water. *Polygonum amphibium* seems to be more abundantly developed than *Potamogeton natans*.

The shores are practically everywhere minerogenous, and if they are

Fig. 30. The lake Ringsjön. Scale 1 : 100 000.

shelving and not too stony, a well developed isoetid vegetation is to be expected. *Littorella uniflora* forms here more or less dense swards, mostly comparatively narrow. *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis* are regular associates. In addition to these isoetids the shallow water is occupied by the following elodeids: *Myriophyllum alterniflorum*, *Potamogeton filiformis*, *P. gramineus*, *P. nitens* and charads (principally *Ch. aspera* and *fragilis*).

The larger part of the lake bottom is covered with submerged plants, especially in the western end. The charophytes form important components, but in addition there is a great number of species growing in dense masses, *viz.*, *Ceratophyllum demersum*, *Elodea canadensis*, *Myriophyllum alterniflorum*, *Najas flexilis* and *Potamogeton perfoliatus*. The dredge also often contains individuals of *P. crispus*, *P. panormitanus* and *P. pectinatus*. Possibly somewhat more unfrequent are *Callitriche hermaphroditica*, *Myriophyllum spicatum*, *P. Friesii* and *Ranunculus* *circinatus. P. lucens* is only known from a few localities. The proportion, in which the elodeids are combined on the bottom, is merely estimated in connexion with the dredging along the shores.

In the western part the lime-rich gyttjas are dominant, and here, lake-marl has also been sampled. According to FRÖDIN (1911—12) the sediments rich in lime are confined to this part of the lake. The sediment limit seems to run nearer the water surface than in Eastern Ringsjön.

Eastern Ringsjön (Figure 30.).

Eastern Ringsjön is the most extensive of the three lakes. The shores are almost completely minerogenous and at the eastern side lobated. Sand is to be found in the innermost parts of the bays, *e.g.*, in Fulltofta bay and Nunnäs bay. The remaining shores consist of coarse material, often very stony, *e.g.*, at Bosjökloster and Fogdarp. Clay appears now and then at the shore-line.

On the very stony shore outside the alder bushes grows a *Phalaris* border with numerous associates: *Alisma Plantago-aquatica, Carex gracilis, Eupatorium cannabinum, Lycopus europaeus, Lysimachia thyrsiflora, L. vulgaris, Lythrum Salicaria, Sium latifolium, Solanum Dulcamara* and others. The *Phalaris* border contains at Bosjökloster also such high herbs as *Calamagrostis canescens, Rumex Hydrolapathum* and *Senecio paludosus*. At Fogdarp, where the shore may be less steep and stony, the area between high and low water is often provided with a zone of *C. gracilis* or *elata*, the outermost tussocks of which even in summer stand in the water (figure 31). At Fulltofta the amphibious zone is composed of a relatively wide *C. gracilis* fen, which towards the alder wood is replaced by a *Phalaris* border.

On the somewhat more shelving shores occasionally three zones may be distinguished, *e.g.*, at Fulltofta. From the alder wood a meadow zone (*C. fusca*) extends to a sparsely grown zone with *Caltha palustris, Hydrocotyle vulgaris, Lysimachia thyrsiflora, Phalaris arundinacea* and *Scirpus palustris*, which lakewards passes into a thin *Sc. palustris* zone, with an understorey consisting of a *Littorella* sward and *Ranunculus Fl.* ssp. *reptans*. At Nunnäs the meadow community passes through a small wave-cut edge into the wetter *Scirpus palustris* zone with *Ranunculus Fl.* ssp. *reptans*. The grazing at Fulltofta as well as at Nunnäs is very intensive.

Thick reedswamps hardly exist. The only ones are found near the outflow, sometimes at the Bosjökloster shore and in Fulltofta bay. In

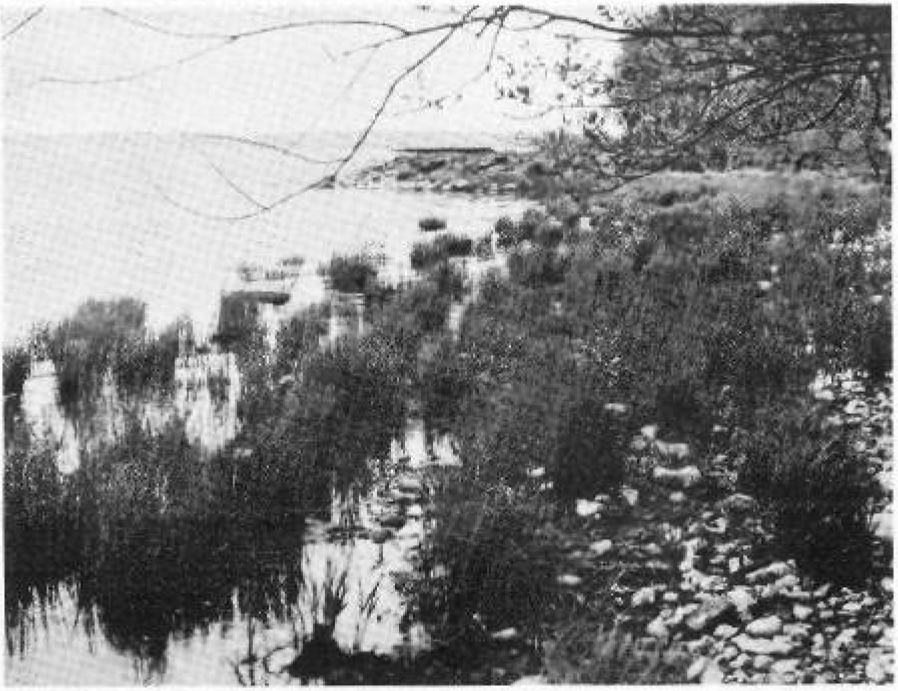

Fig. 31. Eastern Ringsjön at Fogdarp. The stony shore is covered with *Carex elata* and *gracilis*. Photo by the author. 12.5.1949.

all these cases *Phragmites* is the constituent of the reeds. *Typha angustifolia* reeds are not observed and *Scirpus lacustris* occurs only in very small patches. The remaining reed clumps are either very small or so thin, that they can be called »pekas» according to LILLIEROTH (1950) (figure 32). Stands of *Glyceria maxima* are to be found in Fulltofta bay. *Scirpus palustris* forms more or less thick low reeds at many places, with an understorey of *Littorella uniflora*, *Polygonum amphibium*, *Potamogeton gramineus*, *P. nitens*, *Ranunculus Fl.* ssp. *reptans*, *Scirpus acicularis* and others. *Equisetum fluviatile* occurs only to a very insignificant extent, *e.g.*, in Fulltofta bay outside the high reeds. *Butomus umbellatus* grows in small clumps as in Western Ringsjön. As distinguished from most of the other lakes studied *Sagittaria sagittifolia* is a component of the vegetation in shallow water at some localities.

Water-lilies seem to be absent. *Potamogeton natans* and *Polygonum amphibium* occupy habitats of similar type as in Western Ringsjön.

The rosette plants have a large horizontal distribution, vertically they

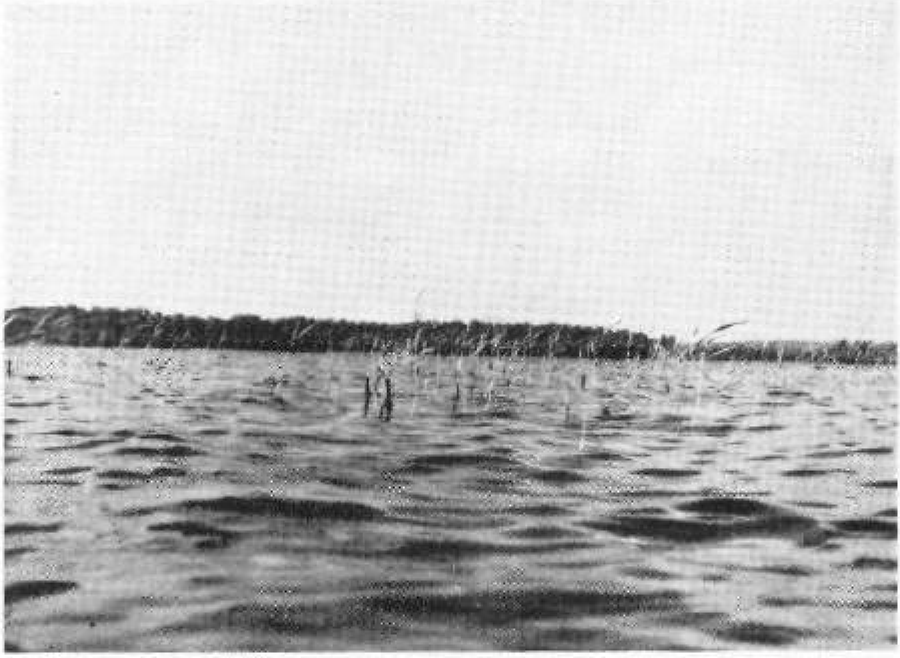

Fig. 32. Eastern Ringsjön at Nunnäs. Thin *Phragmites* reed covers large areas of the water surface. Photo by the author. 13.6.1950.

form only narrow belts. The *Littorella* mat may be 40 to 50 m. broad on very shoaling sheltered bottom, *e.g.*, at Fulltofta, but it seldom advances to a greater depth than half a metre. *Ranunculus Fl.* ssp. *reptans* is frequent on the shores near the low water-line. The same applies to *Scirpus acicularis*, but it usually extends into considerably deeper water. Intermixed with the isoetids in the shallow water are found the following elodeids: charads, *Myriophyllum alterniflorum*, *Potamogeton filiformis*, *P. gramineus*, *P. nitens*, *P. panormitanus*, *P. perfoliatus*, and *Ranunculus peltatus*. Several of them forms as dense mats as *Littorella*, *e.g.*, *P. filiformis*, *Ranunculus peltatus* and *Myriophyllum alterniflorum*.

Outside the shallow shore belt the vegetation is relatively scanty. The bottom declines abruptly and is often covered with stones, which probably contributes to the poor development of the vegetation. In the more shoaling bays there are meadows of *P. pectinatus* and *P. perfoliatus*. These species grow on both muddy and minerogenous bottom. *P. perfoliatus* is the only plant, that is found outside the steep stony shores, *e.g.*, at Bosjökloster. *Ranunculus peltatus* can also extend rather deeply (about 2 m.). *Elodea canadensis*, which immigrated to Fulltofta about 15 years ago (private communication) has a varying distribution year by year. It is spread along all the shores.

No samples of gyttja (fine detritus gyttjas) have proved to be rich in lime. Samples from 15 m. depth contain a relative abundance of mineral grains. The iron content is rather high and the sediment limit runs deeply (LUNDH 1951).

Sätoftasjön (Figure 30.).

Sätoftasjön, which is much smaller than the other parts, forms, so to speak, a northern isolated part of Eastern Ringsjön. In the time before the lowering the connexion between the lakes was much broader than now. The narrow point (Munkavägen), nowadays dividing them, did not exist previously. Now the part of the channel passable by larger row-boats is very narrow. The gut is namely to a large extent filled up with big stones.

The shores in the eastern and western parts are shallow and composed of sand. The northern shore is more stony, likewise the southern one. The wide open shores are everywhere grazed. In the amphibious vegetation two or three zones might be distinguished. Distally there is a meadow community. Next comes a belt, where the vegetation may possibly be divided into two zones. At Häggenäs for example the upper zone is covered with predominating *Hydrocotyle*, the lower one with predominating *Equisetum arvense*. On the western side of the lake the *Carex gracilis* communities reach down to the water's edge. On the northern shore, where the ground rapidly ascends, there is sometimes an amphibious *Carex* zone (chiefly *C. gracilis*), landwards intermingled with *Calamagrostis canescens*. Not infrequently there is a great number of herbids included in this zone, *e.g.*, *Eupatorium cannabinum*, *Lycopus europaeus* and *Lysimachia vulgaris*. East of Sätoftabaden a *Carex elata* fen extends to the thick reed.

The thickest and broadest reedswamps of whole Ringsjön are to be found in Sätoftasjön. Sheltered by the forest the shore east of Bosjökloster is lined by very broad *Phragmites* reeds, just north of the channel. Along the northern side the *Phragmites* reeds are also abundant. At the mouth of the river from Höör a »growing up» takes place with high herb-rich *Phragmites* reeds and stands of *Glyceria maxima* and *Equisetum fluviatile*. In the neighbourhood the outlet from Kvesarumssjön also debouches. Outside there reeds of *Phragmites* and *Scirpus* *lacustris* are plentifully developed. Only some parts of the western shore are completely free from reeds. *Scirpus palustris* is common at open shores.

Water-lily vegetation is practically absent. *Nuphar luteum* is only registered outside the mouth of the river from Höör. *Polygonum amphibium* and *Potamogeton natans* often grow close to the shore in *Scirpus palustris* reeds.

The wide sandy bays exhibit a poor bottom vegetation. Isoetids are mostly absent. They are replaced by charads, *Myriophyllum alterniflorum, Potamogeton nitens* and *P. perfoliatus. Littorella* swards are, however, to be found at other localities, *e.g.*, along the shore of Munkavägen and on the northern shore of the lake. The same is true of *Scirpus acicularis* and *Ranunculus Fl.* ssp. *reptans*. Among the *Littorella* rosettes *Isoetes lacustris* occurs at Munkavägen in a depth of 50 to 60 cm. (measured August 1950). To what depth it extends is unknown. Probably it occupies a narrow zone, as the bottom descends steeply. Another *Isoetes* locality is known but has not been studied by the author (Lundh 1951). At those habitats preferred by *Littorella* the following elodeids are very often found: *Myriophyllum alterniflorum, Potamogeton gramineus, P. nitens* and *Ranunculus peltatus.*

The western part of the lake bottom is shelving and covered with a rich submerged vegetation out to a depth of about 2 to 2.5 m. This depth is not obtained until a distance of 300 m. from the shore. A profile across this vegetation showed a *Chara aspera* zone of 5 to 10 m. in breadth close to the shore-line. Then *Ch. fragilis, Elodea canadensis, Myriophyllum alterniflorum, Najas flexilis* and *Potamogeton panormitanus* increased in abundance farther out in the lake. At a depth of 1.40 m. *C. stelligera* was also encountered. *P. panormitanus* was the most apparent dominant, which often filled up the dredge. In addition to the species mentioned *Callitriche hermaphroditica* and *P. perfoliatus* were also observed in the profile. *Lemna trisulca* has also been observed in this part of the lake out to a depth of between 1 and 2 m. When the mud begins (in the profile at a depth of about 2 m.), the vegetation rapidly diminishes in abundance.

In the northwestern part the sediments (fine detritus gyttjas), when dried, were rust-coloured. The humus content seems to be highest in the neighbourhood of Sätoftabaden, where the rivers debouch. On the whole Sätoftasjön has the sediments richest in humus compared with the other parts of Ringsjön. In the northwestern part limy sediments have been found.

Fig. 33. The lake Dagstorpssjön. Scale 1 : 50 000.

Lake Dagstorpssjön (Figure 33.).

Dagstorpssjön is a long and narrow lake, surrounded by beautiful leafy woods, which have not yet been cut down to make way for summer cottages. Open shore is only to be found in the northeastern corner. On the whole the region around the lake is very little cultivated.

The water surface can be regulated by a dam in the outlet. The author has been unable to obtain information on possible lowerings of the lake.

The shores are steep and rich in stones and boulders. Therefore the amphibious zone becomes short and indistinct. The shrubby vegetation nearly touches the water-line. Fens occur only exceptionally, *e.g.*, in the bay below Stänkelstorp (*Carex elata* and *C. rostrata*). The stony zone between high and low water is relatively sparsely covered with *Alisma Plantago-aquatica, Carex Pseudocyperus, Cicuta virosa, Glyceria fluitans, Juncus articulatus, Lysimachia vulgaris, Lythrum Salicaria, Mentha* sp., *Scirpus palustris* and others. The vegetation is especially scanty on the southern shore. It is here characterized by chiefly *Carex gracilis* and *Glyceria fluitans*, but also more of the species already mentioned may be components.

The reedswamps compared with the three following lakes are small. They occupy generally only minute areas in the small creeks, which are numerous due to the irregular shore-line. The largest clumps grow

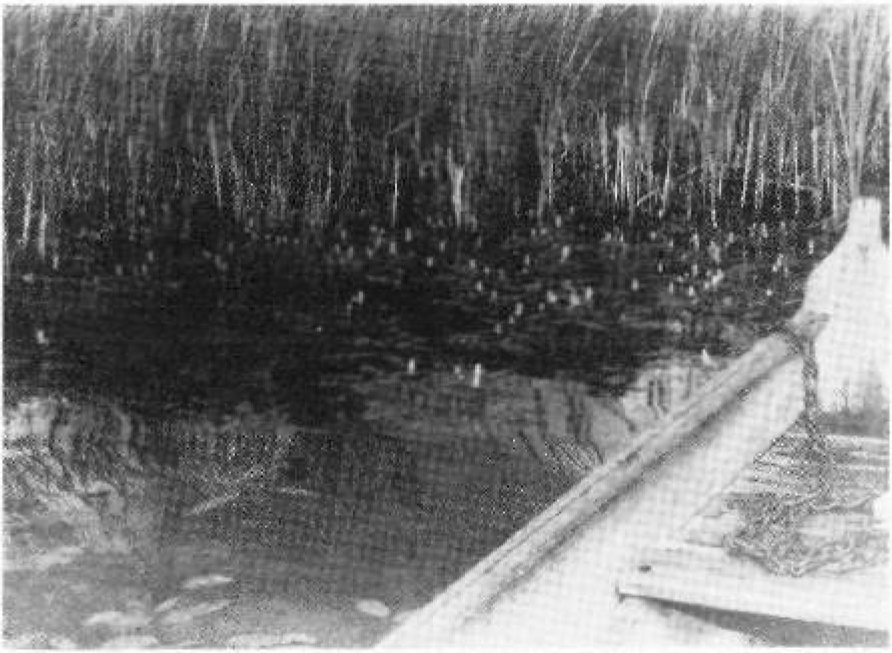

Fig. 34. Growth of *Polygonum amphibium* intermixed with *Potamogeton natans* outside the *Typha angustifolia* reed in the northern part of Dagstorpssjön. Photo by A. ALMESTRAND. 29.7.1949.

in the northeastern corner and consist of *Typha angustifolia* and *Phragmites communis*. *Typha angustifolia* and *Scirpus lacustris* occupy, moreover, about equally large areas in the creeks. Low reeds of *Scirpus palustris* appear at some shallow places. *Equisetum fluviatile* is often found in the bays together with high reeds. Small patches of *C. rostrata* reeds are observed now and then.

In most of the creeks both *Nuphar luteum* and *Nymphaea alba* are present outside the reed, often accompanied by *Potamogeton natans*. *Polygonum amphibium* occurs in rather small stands, distributed all over the lake, but seldom together with water-lilies (figure 34).

The shores are not so constituted, that an abundant occurrence of isoetids is to be expected. On sandy shores, however, *Scirpus acicularis* and sometimes *Juncus bulbosus* may occur. Hitherto *Littorella uniflora*, *Isoetes lacustris*, *I. echinosporum* and *Lobelia Dortmanna* have not been recorded from the lake.

The lake bottom very often descends steeply. Thus areas suitable for higher vegetation are not extensive. However, this fact probably cannot fully explain the poor development of the submerged vegetation. Only three elodeids are to be mentioned. *P. crispus* has been observed several times drifting but never attached. *Ranunculus peltatus* forms patches in shallow water. From the literature (NEUMAN 1896 p. 289) an occurrence of *P. gramineus*×*lucens* is known, but the plant has not been refound by the author.

The gyttjas resemble those described in the three following lakes.

Lake Kvesarumssjön (Figure 35.).

Kvesarumssjön as well as Dagstorpssjön and the two following lakes are not lowland lakes, but situated on the woody ridge Linderödsåsen. The lake borders to the south on a small coherent cultivated area, but otherwise mixed forests rich in birch reach down to the shores.

As early as in the Eighteen Seventies a drainage of the outlet, which runs southwards to Ringsjön, was carried out in order to drain the surrounding grounds. Now the ditch is so small, that sometimes the water runs backwards in winter when the snow thaws. Kvesarumssjön has often an abnormally high water-level. In August 1949 one could almost speak of an inundation, caused by the rich summer precipitation.

The shores are gravelly and stony. Along the eastern shore a *Carex elata* border runs inside the reed. At the western shore the short amphibious vegetation is composed of a mixture of herbids and graminids, *e.g.*, *Alisma Plantago-aquatica*, *Carex elata*, *C. Pseudocyperus*, *Iris Pseudacorus*, *Juncus articulatus*, *Lycopus europaeus*, *Lysimachia thyrsiflora*, *L. vulgaris*, *Lythrum Salicaria*, *Mentha* sp., *Phalaris arundinacea* and *Scirpus palustris*.

Reeds are to be found almost around the entire lake. The broadest ones are situated in the southern and northern ends, where also Verlandung is apparent. The narrow reeds along the eastern shore to a great extent composed of *Scirpus lacustris*. At the southern shore *Phragmites* is dominant. *Typha angustifolia* is relatively local. In the reeds of the Verlandung zones *Typha latifolia* and *Equisetum fluviatile* are also included. Besides apparently plenty of *Glyceria maxima* occurs, especially in the southwestern end. On the other hand, the abundance of herbs, characteristic for the reeds of the Verlandung zones in the lowland lakes, is lacking. Where the high reeds are not developed, *Scirpus palustris* or *C. rostrata* are to be found.

Nuphar luteum as well as *Nymphaea alba* are included in the belts

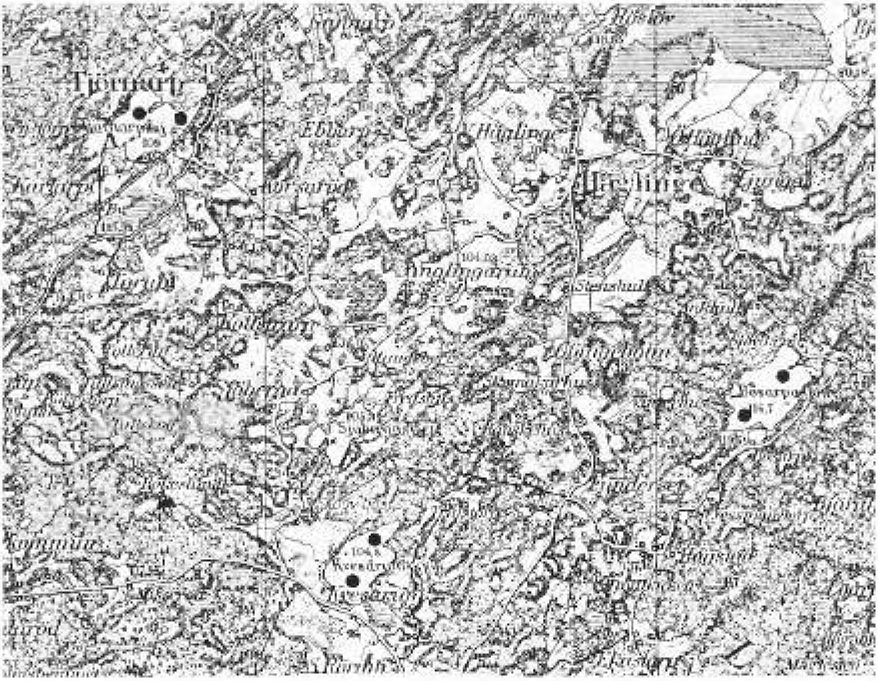

Fig. 35. The lakes Kvesarumssjön, Tjörnarpssjön and Bosarpssjön. Scale 1 : 100 000.

of water-lilies, which are plentifully developed in the northern and southern ends outside the Verlandung reeds. *Potamogeton natans* grows at the same habitats. *Polygonum amphibium* seems to be absent. *Hydrocharis Morsus-ranae* is recorded from three localities, two of which belong to the zones, where »growing up» is found.

On the coarse-grainy, stony shores, isoetids are often intermixed with the aforementioned high-growing herbs, where the amphibious zone is sufficiently broad. This applies to *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis*. These extend barely down into the aquatic zone (the sublitoral). Somewhat deeper, *i.e.*, just below the water-line (July—August 1948) *Chara aspera* and *Ch. fragilis* may grow, if the bottom is shoaling. Notable is the fact that neither *Littorella* nor *Isoetes* has been found. A contributing cause of this may be, that the bottom is generally rather steep and covered with sediments fairly near the water surface. The comparatively shallow lake is markedly poor in submerged plants. Outside the shallow minerogenous shores no higher plants have been observed at all. *Potamogeton perfoliatus* is found at two localities in the northern part, where it grows in shallow water (depth 2 to 5 dm.) together with charads. *Nitella* sp. is met with at the eastern shore in shallow water. It might be noted here that some branches of drifting *Potamogeton pectinatus* have been found once. They were rather wilted, however, and it is possible that they had been brought to the lake by fishing-tackle from another lake.

The organic sediments, which on account of the insignificant area of the lake and its sheltered position are to be found already at a small depth, consist of fine detritus gyttjas with a rather considerable amount of diatoms. They are fairly poor in mineral grains (chiefly mjäla). The humus content, judging from the alkali extract, is relatively high. The iron content is moderate.

Lake Tjörnarpssjön (Figure 35.).

Tjörnarpssjön is located at a village around a station and is very frequented by tourists. Summer houses are situated around the entire lake. Close to the shores runs a border of alders except for the part adjacent to the railway.

Exact information on human intervention is not available. Judging from the old geological map (kbl. »Linderöd» published 1879), however, a new outlet has been excavated since 1879 in the north connecting the lake with a tributary to Finjasjön. Previously the outlet was situated at the southeastern shore near the railway.

The amphibious zone is generally characterized by a *Carex elata* border, which lakewards is mostly replaced by a reed community, but sometimes directly touches the water. If the terrain allows, the *C. elata* zone is succeeded by a *Molinia coerulea* zone landwards. On very stony shores there occur only isolated tussocks of *C. elata*. On the island the *C. elata* margin extends into the water and is landwards lined by a *Calamagrostis canescens - Phalaris arundinacea* zone. Of the species included in the *C. elata* community the following may be mentioned: *Alisma Plantago-aquatica, Cicuta virosa, Juncus articulatus, Lycopus europaeus, Lysimachia thyrsiflora, Lythrum Salicaria, Potentilla palustris.* In the south near the railway, fen grounds with *C. elata* and *C. lasiocarpa* touch the water surface (around the old outlet).

The lake has a long lobated shore line, to a large extent lined by reeds. *Scirpus lacustris* is predominating, but both *Phragmites* and *Typha angustifolia* are also common components. The species often form mixed stands. The »growing up» is most marked in the southwestern bay, where fens edge the shore line. *Equisetum fluviatile* grows here outside the broad high reed. Thick *Equisetum* reed is also to be found at a locality on the western shore. *Typha latifolia* is local.

The numerous bays provide sheltered habitats for floating leaf vegetation. Water-lilies are spread in different parts of the lake, but the biggest carpets of *Nuphar luteum* and *Nymphaea alba* are to be found in the southwestern bay with Verlandung and in the bay on the other side of the point. *Potamogeton natans* is more widespread than the water-lilies. *Polygonum amphibium* is recorded from one locality but *Hydrocharis* from none.

No isoetids have been observed by the author, but according to the register of »Skånes Flora» *Scirpus acicularis* grows at the lake.

The most common elodeid is *Myriophyllum alterniflorum*, which has an abundant distribution. *Potamogeton perfoliatus* is known from three localities. *P. crispus* is found drifting. *Utricularia vulgaris* grows in the Verlandung zone to the southwest among the water-lilies. No other elodeid has been observed.

The gyttjas agree in general respects with those in Kvesarumssjön.

Lake Bosarpssjön (Figure 35.).

The area of Bosarpssjön is somewhat larger than that of Kvesarumssjön, but its shape is similar to that of the latter. In both there are small islets and shoals. The shores of Bosarpssjön, however, are at several places more shelving. Forests surround the main part of the lake. The leafy woods consist chiefly of beeches, but oaks and birches also occur. They give a more luxuriant appearance than those around Kvesarumssjön. The meadow in the southeastern corner contains among others also *Trollius europaeus*. Close to the lake grows an alder border.

The extension of the interferences by man undertaken at Bosarpssjön is not known by the author. According to documents from 1919—20 in Lantmäterikontoret in Kristianstad the outlet has once been moved. Previously it ran east of the present one. Probably this change also caused a lowering of the water-level. Judging from the map it seems to have amounted to about 20 m. horizontally at the brook outlet on the eastern shore (HOBROK 1919—20).

The lake is subjected to an important regulation of the water-level, as the mill in the outflow uses the water for power. In the autumn of 1949 the water-level had been lowered very radically, at least 80 to 90 cm. This arrangement gave a picture of the lake, divergent from that previously obtained. At a visit in September 1950 the same low water-level was established. Judging from the vegetation these conditions had been prevalent for a long time (perhaps from the previous autumn).

The description below treats the vegetation in the period 1947—49, when the lake, at least in spring and summer, had a higher water-level than at present. The flood in spring was generally very strong (in 1950 the water surface only reached up to the beginning of the *Littorella* zone, *i.e.*, did not even cover the normal aquatic zone).

The shore is enormously stony and rich in boulders. Characteristic for large parts of the shore is a border of *Carex gracilis*. Sometimes it extends directly into the water, sometimes it is replaced by high reed or low reed. On the western side *C. gracilis* is very often absent, and the *Littorella* zone, which forms the uppermost part of the aquatic zone, is directly succeeded by the *Molinia coerulea* zone. If the *C. gracilis* border is developed, it passes landwards into a *Molinia* zone.

The broadest reedswamps, which actually are not especially abundant, are to be found in the southern end. *Typha angustifolia* is the main component, but *Scirpus lacustris* is also included. The western shore is provided with a connected reed belt in the southern part, containing chiefly *Scirpus lacustris*. At the remaining shores larger or smaller patches of *Sc. lacustris* or *T. angustifolia* occur, except on the northern side, where the reeds consist mainly of *Phragmites*. Along the eastern shore *Carex gracilis*, edged by a zone of *Sc. palustris*, reaches down to the water-line. Low reeds of *Sc. palustris* are relatively common. *Equisetum fluviatile* grows for example in the southern end and along the eastern shore in small clumps.

The best conditions for the development of a floating leaf vegetation seem to be found in the southern end. Here large covers of *Nuphar luteum* and *Nymphaea alba* occur. Otherwise water-lilies are only encountered at a few localities, *e.g.*, in the northwestern corner and at Sjörup. *Polygonum amphibium*, contrary to *Potamogeton natans*, is recorded from several places. Bosarpssjön is one of the lakes studied which has the greatest occurrence of the former. *Hydrocharis* has not yet been observed.

The isoetids are not quantitatively well represented. They are restricted to a small area on both sides of the summer low water-line. *Littorella uniflora* grows at Sjörup and also along the northern and western shores. To the northwest the *Littorella* sward was about 6 to 8 m. broad (in August 1949). At Sjörup, where the shore is open and

Fig. 36. From the northern shore of Bosarpssjön in September 1950. A considerable part of the normal lake bottom is laid bare, a result of the water regulation by the mill at the outflow. The bulk of the reedswamps stands above the water-line. Photo by the author, 2.9.1950.

rather shelving, *Scirpus acicularis* and *Juncus bulbosus* are also to be found. They have further been observed at two other localities. The *Isoetes* species are not known from the lake.

The bottom is very irregular. Sometimes it declines abruptly, sometimes shoals rise unexpectedly. In spite of the richness in shoals, which, as might be expected, would favour the submerged vegetation, the elodeids are not abundant in the lake. They occur only in shallow water and consist mainly of *Myriophyllum alterniflorum*. Besides, *Nitella* sp. is found at one locality.

After the latest lowering in 1949—50 the reedswamps stand at many places on bare laid shore. At such a locality, illustrated by figure 36, the zonation is otherwise as follows: Alder and birch → *Molinia* zone (3 to 4 m.) → *C. gracilis* zone (6 to 10 m.) → *Sc. palustris* zone with *Littorella* mat (2 m.) → sterile stony zone (6 m.) → the water surface (September 2 1950). Outside the *Littorella* mat, which already before the lowering could be distinctly observed, vegetation is on the whole absent. Only a stand of *Sc. acicularis* was noted, which was now low-growing and fertile.

The gyttjas resemble those of Kvesarumssjön, but are considerably richer in iron.

Lake Finjasjön (Figure 37.).

Finjasjön has only been subjected to sporadic examination on a few excursions in 1948—50. Only the eastern part has been visited, and thus this part is the one discussed below. In the north the shores are covered with willow bushes and alder trees close to the shore-line. At Tormestorp the shores are open and on the southern side pines and birches grow. At the southern corner are the shores grazed.

Lowering of the water surface has been carried out on at least two occasions, the first time before 1845 and the second time just before 1900 (Ewe 1887—90, Hobrok 1911).

At many places the shores are shelving and sandy. At Finjasjöbaden the reed (*Equisetum fluviatile*) is replaced landwards by a *Carex gracilis* fen, containing such species as *Alisma Plantago-aquatica, Cicuta virosa, Mentha aquatica, Rorippa amphibia, Sium latifolium* and others. On the point west of the mouth of the outflow from Tjörnarpssjön, the reed of *Scirpus palustris* is also succeeded by a *C. gracilis* border. The shore within this area is stony and with its black stones resembles Bosarpssjön greatly, especially at those places where the *C. gracilis* zone reaches down to the water-line.

The isoetid vegetation is abundantly developed. At Tormestorp *Littorella uniflora, Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis* are to be found, sometimes alternating with or intermingled in large mats of *Chara aspera. Isoetes lacustris* probably plays no dominant rôle in the submerged vegetation, but still its distribution is very little known.

Many elodeids are well developed. *Potamogeton perfoliatus* is common everywhere along the shores, and that is also applicable to *Myriophyllum alterniflorum*. None of the other lakes studied shows such a mass development of *Potamogeton pusillus* as Finjasjön. *Callitriche hermaphroditica* forms a prominent feature in the submerged vegetation. A drifting branch of *P. praelongus* has been observed. The distribution of *Najas flexilis* has previously been described by Hallberg (1940) and Weimarck (1944).

Lake-ore (coin ore) has been found. The organic sediments examined

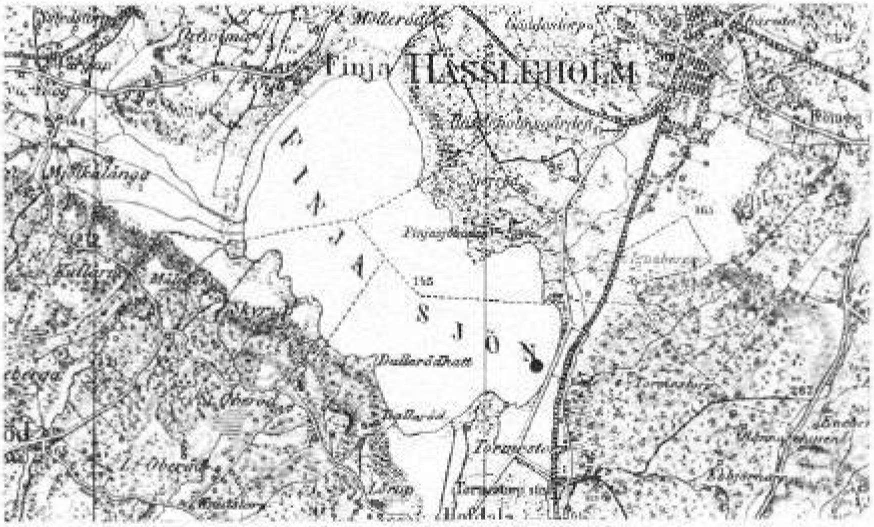

Fig. 37. The lake Finjasjön. Scale 1 : 100 000.

consist of very iron-rich detritus gyttjas, containing a great deal of mineral grains (chiefly mo). The humus content seems to be as high as in Kvesarumssjön. Some dy clods have been observed.

Lake Araslövssjön and Lake Hammarsjön (Figure 38.).

The river Helgeå runs through these two lakes, producing different environmental conditions than in the adjacent lakes as regards the quality of the water. The lake water mainly consists of river water, which on account of the extensive drainage area of the Helgeå has largely been transported from geological different regions and, therefore, ought to diverge considerably from the water of the local rivers.

The studies of the author has, as a matter of fact, principally included the vast fens surrounding the lakes. No systematic investigation of the remaining aquatic vegetation has been performed. Both lakes have, however, been subjected to exhaustive botanic studies by Telegrafkommissarie TH. LANGE (Araslövssjön and Hammarsjön) and fil. mag. G. WIDEHOLT-LILLIEROTH (Hammarsjön, *cf.* p. 119).

The lakes are very shallow in comparison to their areas and largely grown together by enormous reedswamps. They are rather impassable

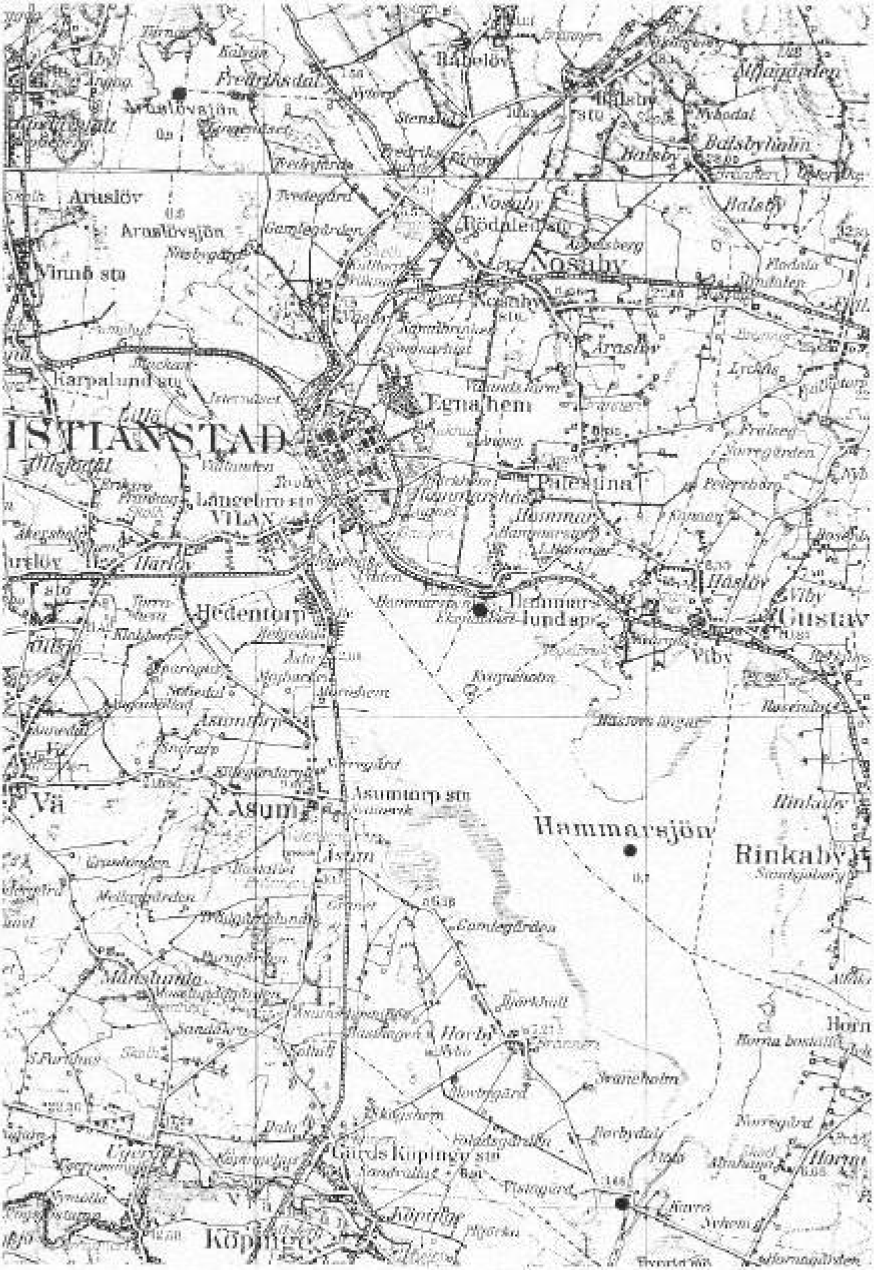

Fig. 38. The lakes Araslövssjön and Hammarsjön. Scale 1 : 100 000.

by a motorboat. In winter the surrounding fens are greatly overflowed. The floating leaf vegetation is also abundant.

Though the author has not obtained a distinct idea of the quantitative composition of the vegetation, the lakes have, nevertheless, been included in the survey (table 6), because they have been rather thoroughly studied from a floristic point of view. A purely qualitative description of the vegetation can always be of great value.

Lake Råbelövssjön (Figure 39.)

Råbelövssjön is one of the largest lakes investigated. Its southern end belongs to the cultivated Kristianstad plain. In the west the woody Archaean eminence, Balsberget, borders on the lake. The northernmost part is wedged into Archaean bedrock. Here and there is edged by a margin of alders. At several places, especially on the western shore, the fruit-orchards occupy a still larger area.

According to the geological map and SUNDELIN (1922) the water-level has been lowered several times. In 1845 it was lowered 1.7 m., 1865 1.0 m., 1886 0.3 m. In 1914 a cleaning of the outflow was carried out. In 1845 the water-level was situated 5.6 m. above sea-level, and is now about 2.0 m.

The lake is regularly constructed (PERSSON 1932) with a very even bottom, which descends below the depth curve of 10 m. only within a small area to the south. The bottom declines relatively abruptly. At a distance of 20 m. from the shore-line depths of 1 to 2 m. have been measured (in 1946).

The shores are to a great extent provided with a reed border, even if it is mostly narrow. Compared with, for example, Yddingen and Krankesjön the reeds are very little apparent. They occupy the largest areas in the bays, preferably in the Österslöv bay and the Råbelöv bay. *Phragmites* is completely dominant. *Typha angustifolia* and *Scirpus lacustris* grow only in small patches. *Sc. Tabernaemontani* appears here and there, when other high reeds are not developed. *Equisetum fluviatile* forms, for example, in the bay at Råbelöv, low thick reeds outside the *Phragmites* belt. *Glyceria maxima* has not been observed as a reed-forming plant. *Butomus umbellatus* may be met with in small clumps around the entire lake. Quagmire-like reeds are relatively rare. A so-called Verlandung zone occurs in the south, at Helmershus and at several localities along the eastern shore.

Along great parts of the minerogenous shores there is a barricade of

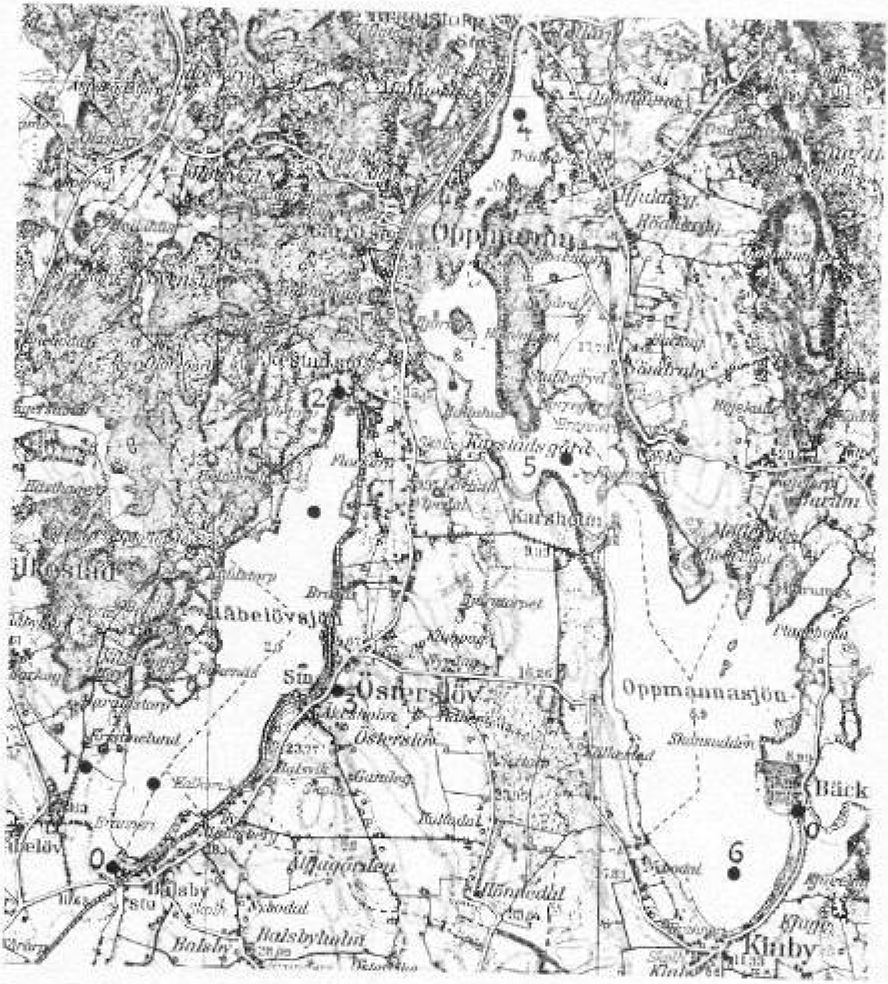

Fig. 39. The lakes Råbelövssjön and Oppmannasjön. Scale 1 : 100 000.

big boulders and stones, which is grown with a sparse vegetation. At the locality illustrated by the figure 40 it consists of *Phalaris arundinacea* and *Lysimachia thyrsiflora* and at Ekestad of *Epilobium hirsutum, Eupatorium, Filipendula Ulmaria, Lysimachia vulgaris, Myosotis palustris, Solanum Dulcamara* and *Valeriana officinalis* (figure 41, *cf.* also figure 42).

Very often the development of fen vegetation at the shore is favoured by ground-water supply from the slope above. The reeds are in such

Fig. 40. Råbelövssjön at Balsberget. The shore is rich in boulders and the narrow amphibious zone is covered chiefly with *Lysimachia thyrsiflora* and *Phalaris arundinacea*. Photo by the author. July 1946.

cases landwards replaced, *e.g.*, by a zone of *Carex paniculata* - tussocks (figure 43) containing the following characteristic species:

Agrostis stolonifera
Alisma Plantago-aquatica
Bidens cernua
Caltha palustris
Carex Pseudocyperus
— *rostrata*
Galium palustre
Hydrocharis Morsus-ranae
Iris Pseudacorus
Lemna minor
— *trisulca*
Lycopus europaeus
Lysimachia thyrsiflora
Lythrum Salicaria
Myosotis palustris
Peucedanum palustre
Poa trivialis
Rumex Hydrolapathum
Scirpus Tabernaemontani
Sium latifolium
Solanum Dulcamara
Sparganium ramosum
Stellaria palustris

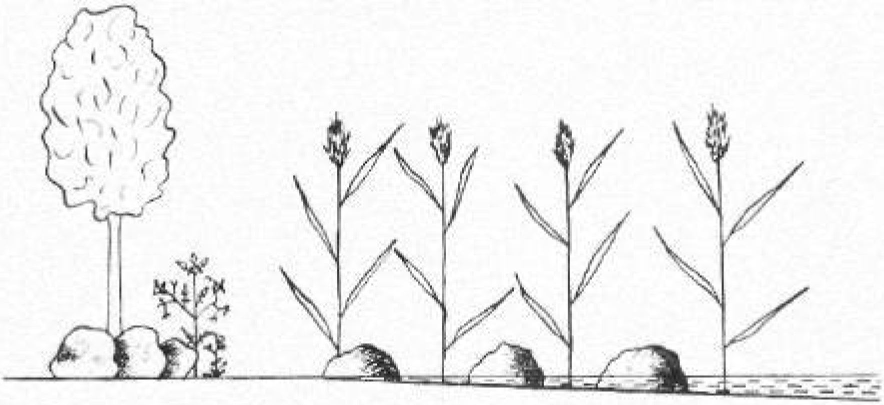

Fig. 41. Shore profile from Råbelövssjön at Ekestad. The amphibious vegetation forms a narrow zone between the big boulders. The most frequent species are *Epilobium hirsutum*, *Eupatorium cannabinum*, *Filipendula Ulmaria*, *Lysimachia vulgaris*, *Myosotis palustris*, *Solanum Dulcamara* and *Valeriana officinalis*.

Fig. 42. Råbelövssjön at the eastern side south of Ekestad. At some places big boulders (erratic blocks) reduce the extension of the amphibious vegetation. Photo by the author. July 1946.

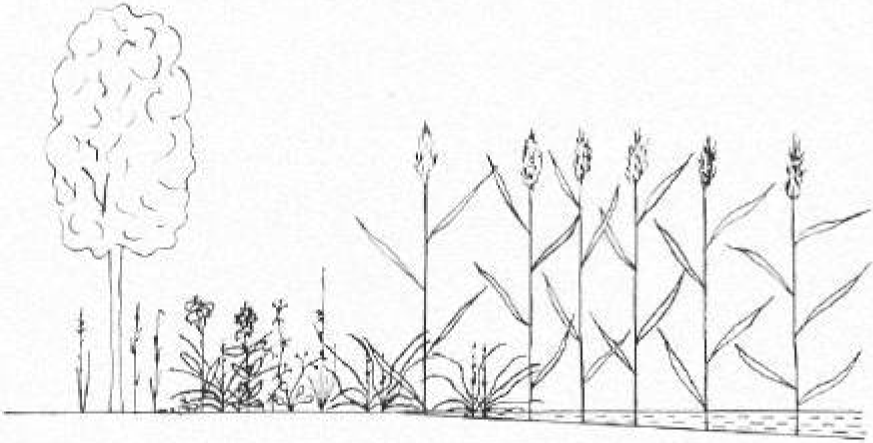

Fig. 43. Shore profile from Råbelövssjön at Brusås (eastern shore), showing a Verlandung zone. The tussocks of *Carex paniculata* advance into the reedswamp (*Phragmites*).

Fig. 44. Shore profile from Råbelövssjön at Tommarp (western shore). The thick high *Phragmites* reed, which in its inner edge is rich in herbs, is landwards replaced by a *C. paniculata* fen, which passes into a *Filipendula Ulmaria* zone. Within the reed the water surface is covered with *Hydrocharis* and lemnids.

More or less extensive Magnocaricion fens inside the reeds are characteristic for many localities, *e.g.*, in Österslöv (*C. paniculata*), Balsby (*C. paniculata* and *acutiformis*) and Råbelöv (*C. elata, paniculata* and *acutiformis*). A zonation, that is not established at any of the remaining lakes, is outlined on figure 44 and is to be studied especially at the western shore of Råbelövssjön. The *Filipendula Ulmaria* community

Fig. 45. P 8 from the Ekestad bay (July 1946). The reed: *Scirpus lacustris*. The entire bay is full of *Ceratophyllum demersum* and *Chara stelligera* meadows. At the western shore there occurs a small belt of *Nuphar luteum*. The greatest measured depth is 2.60 m.

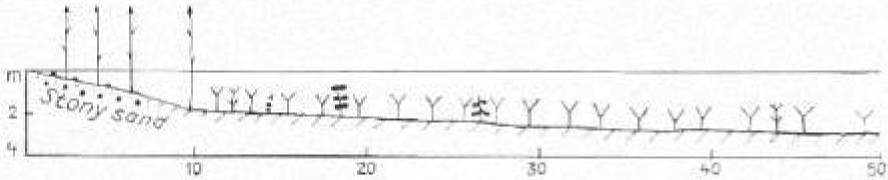

Fig. 46. P 11 from the western shore about 300 m. northeast of Knutstorp (July 1946). The reed: *Phragmites*. The submerged vegetation is dominated by *Chara stelligera*. The higher plants extend to a depth of about 3 m.

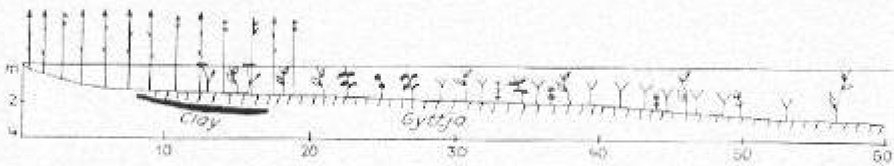

Fig. 47. P 10 b situated just south of Helmershus (July 1946). The reed: a mixture of *Phragmites* and *Scirpus lacustris*. The floating leaf plants consist of *Nuphar luteum*. Several elodeids are represented. The higher vegetation ceases at a depth of about 3 m.

contains many luxuriant herbs and presents a very fine view. The following species are the vascular plants most often noted in the community:

Herbids	Graminids
Cirsium palustre	*Agrostis stolonifera* s. lat.
Eupatorium cannabinum	*Carex acutiformis*
Filipendula Ulmaria	— *disticha*
Galium uliginosum	*Phalaris arundinacea*
Lathyrus pratensis	*Phragmites communis*
Lysimachia vulgaris	
Lythrum Salicaria	

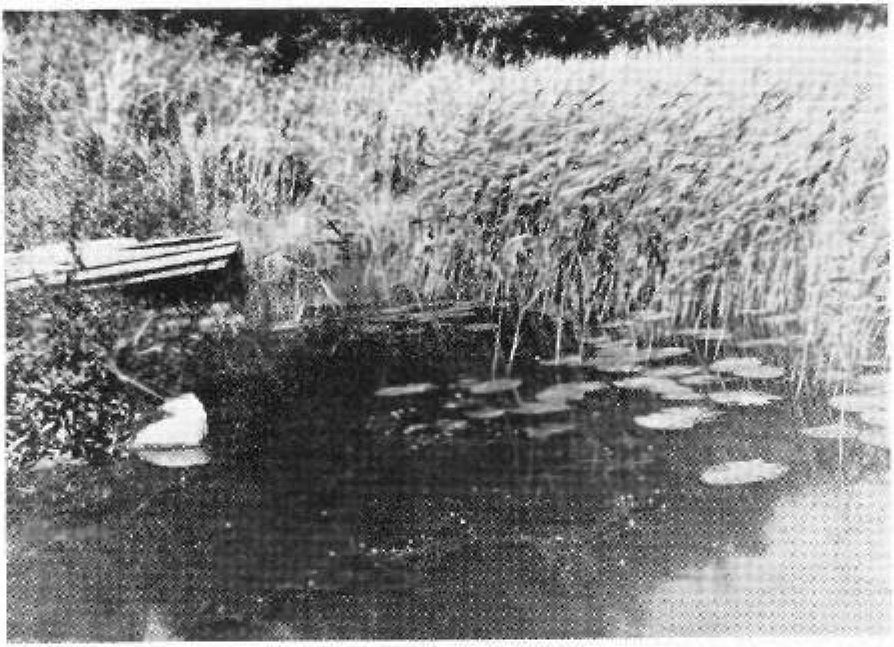

Fig. 48. Flowering *Ranunculus circinatus* in the bay south of Helmershus in Råbelövssjön (western shore). The reed in the background consists of *Phragmites*. Photo by the author. July 1946.

The nymphaeid layer is very little developed. In calm bays sometimes small borders of *Nuphar luteum* occur, often together with *Potamogeton natans*. *Polygonum amphibium* has only a very insignificant distribution. *Hydrocharis Morsus-ranae* belongs as usual to the reed communities.

Isoetids are scarcely represented. *Scirpus acicularis* is recorded from sandy bottom at a few places in different parts of the lake. *Littorella* and *Lobelia* were observed by LANGE in the Nineteen Twenties, but have not been refound by the author. Charads, *Potamogeton filiformis* and *P. perfoliatus* often occupy the shallow areas with a depth of less than 1 m.

The submerged vegetation is well developed, even outside the shallow zone. Three species can form pure dense stands: *Ceratophyllum demersum*, *Chara stelligera* and *Elodea canadensis*. *Ceratophyllum*, which very often reaches up to the water surface, was observed in 1946 in dense meadows in the northern bay at Ekestad (figure 45) and in the bay about 300 m. northeast of Knutstorp. *Chara stelligera* exhibited coherent clumps at several localities, *e.g.*, in the Ekestad bay and Tommarp (figure 46). *Elodea* was registered from numerous places. Except for the species mentioned above many others also seem to have a great distribution. Mostly the elodeids grow together without anyone predominating (figure 47). All together 14 submerged vascular plants have been recorded. *P. lucens* occupies an apparently large area, but also *P. crispus, P. Friesii, P. pectinatus, P. perfoliatus* and *Ranunculus circinatus* (figure 48) are frequent components. *P. praelongus* has been found at one locality. *P. panormitanus* and *P. pusillus* have been encountered mainly in connexion with the profiles but never in large amounts. *Zannichellia palustris* has been collected by the dredge at three localities in the southern part and besides observed in shallow water southwest of Bokenäs (attached specimens). *Myriophyllum spicatum* was found in 1946 only at one locality, a shoal out in the lake. Later on it has been noted from the shore at Balsvik. Råbelövssjön has most of the submerged plants in common with Krankesjön (in 1944).

The bottom samples, which have been collected in connexion with the profiles, have been mixed with a good deal of minerogenous material, although the gyttja element has been considerable. Coarse detritus gyttja and clayey gyttja have been examined. Very often the gyttja includes lime. The samples collected on other occasions (at Ekestad in deeper water) consist of limy, very mineral-rich (clay to fine mo) fine detritus gyttjas with varying amount of coarse detritus. The iron content is relatively small.

Oppmannasjön (Figure 39.).

Oppmannasjön is too large to be treated as one unit and it is also morphologically divided into several smaller parts: 1. northern part (the Arkelstorp part, A.), connected with the remaining lake by a narrow channel, 2. the middle part (the Norregård part, N.) cut off from the southern part by two projecting points at Karsholm and 3. the wide southern part (the Kiaby part, K.). A. and N. are rather similar. They are long and narrow with lobated shore-lines and several islets and shoals. The surroundings descend abruptly into the lake. Such a shape favours the development of local environments. The shores are covered with trees and sometimes coherent leafy woods, especially on the western side. K. extends far down into the plain. It is much broader than the other parts and has shelving shores, which are built up of sand and clay to the south. The western shore is open up to Karsholm. On the eastern side towards Bäckaskog there are small groves of birch and spruce.

Already from the different values of the transparency and lake colour (*cf.* pp. 24 and 27) it is evident that local conditions prevail in different parts of the lake. In the field studies consideration has also been given to this three-section, but time has not allowed a penetrating examination of each part. In the survey (table 6) Oppmannasjön is included as one unit. The Arkelstorp part is the one most slightly investigated.

Oppmannasjön was lowered in 1886 according to the description of the geological map by digging a new outlet south of the castle Bäckaskog. The lake Ivösjön had recently (in 1873—74) been subjected to a lowering, which made that of Oppmannasjön possible. The water-level was lowered about 2.4 m. A relatively large area was obtained by the lowering, especially in the southern part, where a land strip, 100 to 400 m. broad, was formed. Previously the water reached close to the road according to a land-surveying map, drawn in 1887—90. The land increase was smallest in the Arkelstorp part. The narrow channel with the Verlandung reeds was formed after the lowering, which also gave rise to new islets and to the growing together of other islands with the mainland.

No detailed studies of the distribution of the reedswamps have been performed. K. compared with the other parts has only small reeds. It is also most exposed and its sandy, sometimes clayey bottom perhaps provides no suitable substratum. On the southern side a great part of the reeds is composed of *Scirpus Tabernaemontani* and *Sc. palustris.* In the bay at Barum the reeds have a stronger development. In the northern part of the lake (A.) the reedswamps are enormously high and abundant. *Phragmites* as well as *Typha angustifolia* and *Scirpus lacustris* are components, even if *Phragmites* is mostly dominant. *Butomus umbellatus* is to be found in small growths now and then. Here a rapid Verlandung takes place, *e.g.*, in the northern end and in the channel (figure 49). The high reeds often consist of communities rich in herbs. Also *Typha latifolia* may sometimes be reed-forming. Outside the high reeds dense borders of *Equisetum fluviatile* are formed, which lakewards are succeeded by nymphaeid layers.

The nymphaeids, isoetids and elodeids recorded are distributed in the following manner:

A: *Hydrocharis Morsus-ranae, Nuphar luteum, Polygonum amphibium, Potamogeton natans—Elodea canadensis, Myriophyllum spicatum, Ranunculus circinatus.*

Fig. 49. The narrow channel east of Gärrö in Oppmannasjön. At its western side vast Verlandung reedswamps are developed. The abundant *Phragmites* belt is succeeded toward the lake by a sometimes thick *Equisetum fluviatile* zone, containing many herbs, *e.g.*, *Carex Pseudocyperus*, *Cicuta virosa*, *Epilobium palustre*, *Lycopus europaeus*, *Solanum Dulcamara* and *Typha latifolia*. *Riccia fluitans* is also found at this locality. The open water surface is to a large extent covered with water-lilies (*Nuphar*). Photo by A. ALMESTRAND. 25.7.1947.

N: *Scirpus acicularis*—*Nuphar luteum*—*Myriophyllum spicatum*, *Potamogeton crispus*, *P. lucens*, *P. perfoliatus*.

K: *Echinodorus ranunculoides*, *Ranunculus Fl.* ssp. *reptans*, *Scirpus acicularis*—*Polygonum amphibium*, *Potamogeton natans*—*Myriophyllum spicatum*, *Potamogeton crispus*, *P. filiformis*, *P. Friesii*, *P. gramineus*, *P. lucens*, *P. pectinatus*, *P. perfoliatus*, *Zannichellia palustris*.

The floating leaf species have the widest distribution in the northern part. *Hydrocharis* belongs to the reed communities. In the southern part *Polygonum amphibium* and *Potamogeton natans* grow intermingled with thin reeds in shallow water.

The isoetids are quantitatively best developed in the Kiaby part. Both

Ranunculus Fl. ssp. *reptans* and *Scirpus acicularis* occupy vast areas. *Echinodorus* is probably more local. It was found in the dry summer of 1947 on a dry-laid, clayey and sandy shore east of Kälkestad. In the shallow water grow also the elodeids *Potamogeton gramineus*, *P. filiformis* and *Zannichellia palustris* and charads. *Scirpus acicularis* is noted from Norregård. Otherwise the isoetids seem to be relatively rare in the northern parts of the lake.

Already from a glance at the list of species given above a variation in the composition of species in the different parts may be established. The northern part of the lake lacks isoetids but contains all of the recorded floating leaf plants. In the southern part it is quite the contrary. The study of the quantitative distribution of the species only confirms what is apparent from the list. The fact is naturally connected with the varying morphological and geological nature of the different parts.

The submerged vegetation is not especially richly developed, except on the shallowest sections of the bottom. A. is probably richest in vegetation. Farthest to the north large areas are covered with *Myriophyllum spicatum*. *Elodea* is also common, and an important occurrence of *Ranunculus circinatus* has been recorded. In N. *M. spicatum* is also predominant, but *P. lucens* and *perfoliatus* are found at several localities. *P. crispus* has only been observed uprooted.

K. is characterized by its charad vegetation, which in 1947 exhibited an abundant development. The shoaling, sandy and clayey bottom is on the whole poorly covered. The most common species are as in N. *Myriophyllum spicatum* (most widespread), *P. lucens* and *P. perfoliatus*. As is already clear from the list of species, *Myriophyllum spicatum* occurs plentifully in all parts. The plant is also, on the whole, the most frequent among the typical lowland lake species.

On account of the imperfect investigation it is impossible to give such a reliable survey of the vegetation as in the remaining investigated lakes.

Only a few sediment samples have been collected, partly from N., partly from K. The former part is rather shallow, with a depth not exceeding 3 m. The sedimentation is rich. The samples from a depth of nearly 3 m. may be designated as fine detritus gyttjas with a moderate element of coarse detritus. The iron content was moderate and there was no liberation of carbon dioxide with hydrochloric acid. In the southern end gyttjas were not obtained until a considerable distance from land. The samples collected in a depth of 2 to 2.5 m. may almost be regarded as muddy, clayey sand with high lime and iron content. A sample from the Barum bay at a depth of 8 to 9 m. may be denoted as a clayey, fine detritus gyttja with a low lime content and a moderate iron content.

Lake Levrasjön (Figure 50.).

Levrasjön, situated east of Ivösjön, is the most transparent of the lakes studied. It is smaller than Råbelövssjön, but their vegetation has many features in common. Levrasjön is like Råbelövssjön located in a densely populated district. The large factory Iföverken at Bromölla is the main cause of the extensive settlement. Only in the northern part does a beech forest abut on the lake, but an alder border lines a large part of the shores. In the west there are vast fen grounds, inundated in winter.

According to a private communication Levrasjön is said to have previously lacked an outlet. Information from Kommunalkontoret in Bromölla indicates that the communication can be true. That part of the present outlet, which is situated between the road and Levrasjön, was apparently excavated in the first half of the Nineteenth Century. According to the description of the geological map (De Geer 1889) the surface has been lowered at least about 0.3 m.

On the eastern side the ground slopes down very abruptly, and springs give rise to fen vegetation. The region has been closely investigated by Fil. lic. O. Andersson.

The periodically inundated part of the shore is made up of sand or somewhat coarser material, often stony, and is covered with a luxuriant vegetation, consisting of *e.g.*, *Carex elata*, *C. Pseudocyperus*, *Epilobium palustre*, *Eupatorium cannabinum*, *Lycopus europaeus* and *Solanum Dulcamara*. On the western shore the reeds are landwards replaced by Magnocaricion fens. *Cladium Mariscus* is known from the shore vegetation.

The reedswamps are very dense and rather broad at the western shore. On the eastern shore, however, they are narrow and scanty. Everywhere *Phragmites* is dominant. Both *Scirpus lacustris* and *Typha angustifolia* have a very limited distribution. Levrasjön has a very exposed position and, as westerly winds are the prevailing ones in Scania, it is natural that the reeds have an insignificant extension at the eastern shore. Furthermore the shore-line here is even and lacks sheltered coves. *Scirpus Tabernaemontani* forms reeds mainly at the eastern shore. Low reeds of *Scirpus palustris* have been observed at a few places, *e.g.*, in the southern end.

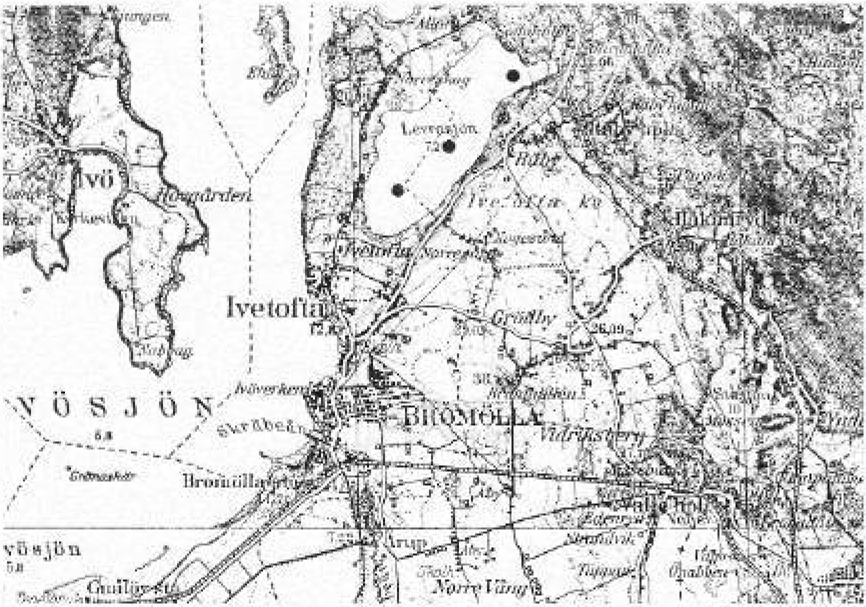

Fig. 50. The lakes Levrasjön and Siesjön. Scale 1 : 100 000.

The floating leaf vegetation is as expected very insignificantly developed, as sheltered habitats are rare. Only one water-lily locality (*Nuphar luteum*) has been recorded, in the northeastern bay. *Polygonum amphibium* is registered from one locality. The author has not observed *Potamogeton natans* and *Hydrocharis Morsus-ranae*. The latter, however, according to the register of Skånes Flora, has been found once in the lake.

No isoetids are common. A minute occurrence of *Ranunculus Fl.* ssp. *reptans* has been noted on the eastern shore. In place of the isoetids charads and *Potamogeton filiformis* grow in the shallow water. A *Ch. aspera* mat can be observed out to a depth of about 1.5 m.

The lake is very rich in submerged plants. No species, however, predominates completely, but several seem to be equally frequent. Most of them are not restricted to a small part of the lake but may be collected almost everywhere. This is true of, for example, *Ceratophyllum demersum, Chara stelligera, Elodea canadensis, Fontinalis antipyretica, Myriophyllum spicatum, Potamogeton crispus, P. Friesii,* and *P. pectinatus.* More difficult to find in the open lake is *P. pusillus*, which has been met with at two localities. *P. lucens* grows in some small stands. *P. gra-*

mineus occurs at a few places, especially in the southern end in rather shallow water. Furthermore, it may be mentioned that *P. nitens* is registered from some localities along the eastern shore, from Råby to the southern end. At one locality a plant is found, which seems to be identical with *P. Torssandri* (*gramineus*×*lucens*×*perfoliatus*). *Utricularia vulgaris* is collected from rather deep water at the northern side, notably not in connexion with Verlandung zones, as is usually the case. *Lemna trisulca* occurs out to a depth of 6.5 m. A dominating element of the submerged vegetation is the charophytes. *Ch. stelligera* as well as *Ch. fragilis* and also others are included in the vegetation in deeper water on sedimentary bottom.

All sediment samples have been very rich in lime. Those, which have been taken from a depth of 15 to 18 m. may almost be designated as muddy mo to mjäla. The iron content is very high. Lake-marl is to be found at several localities. On the eastern shore, where most of the profiles have been laid, the bottom at a depth of 2 m. descends abruptly. The gyttja sediments are not to be found until below this slope. As the bottom of Levrasjön is very symmetric, the bottom conditions ought to be similar in the entire lake. The inclination is, however, less in the southern and northern ends.

Lake Siesjön (Figure 50.).

Siesjön, which contrary to the other lakes in the Kristianstad region is very small, is situated on the boundary to Blekinge. The lake is located nearest the coast, but nevertheless very high above sea-level. The steep slopes on the western side provide a good shelter against the winds. The eastern side is covered with beech forest and the western one with shrubbery of alder and willow.

A lowering of the water-level has been contemplated. Around the lake there are very extensive fens and reedswamps, which might indicate a previous lowering of the water-level.

The open minerogenous shores are strongly grazed. Clay is to be found now and then. At the eastern shore, where the wood abuts on the lake, a border of *Carex gracilis* (often containing *C. elata* and *C. vesicaria*) forms the transition to dry vegetation. At the western shore springs ooze out of the slopes and give rise to fen vegetation and a thick precipitation of lime.

Along the western shore the *Phragmites* reeds are predominating, often intermixed with *Scirpus lacustris*. Otherwise *Scirpus lacustris* is the most common reed component. *Typha angustifolia* constitutes growths here and there. Along the western shore there are dense but sometimes rather narrow reeds, in the southern end there are broader ones. Well-marked Verlandung zones are frequent along the western side and in the south. Here *Sparganium ramosum* forms clumps. At one locality *Menyanthes trifoliata* reaches out to the water surface intermingled with scanty reeds of *Carex lasiocarpa, C. rostrata, Equisetum fluviatile, Phragmites communis* and *Scirpus lacustris*. In the Verlandung reeds several other herbs may be included, *e.g.*, *Carex Pseudocyperus, Epilobium palustre, Lysimachia thyrsiflora, Ranunculus Lingua* and *Sium latifolium*. The reeds along the eastern shore are less dense and extensive (mostly *Scirpus lacustris*). *Equisetum fluviatile* occurs in small patches outside the high reeds. On the very stony eastern shore scanty straws of *Scirpus palustris* may grow inside the high reeds and also elsewhere.

The belts of water-lilies are, as might be expected, very strongly developed. Only the most exposed eastern shore completely lacks stands of water-lilies. Especially in the south large covers of yellow and white water-lilies are widely spread. *Nuphar* is more common than *Nymphaea*. *Potamogeton natans* is widespread in the entire lake, probably due to the well-developed reeds, which towards the shore shut off a calm body of water. *Polygonum amphibium* forms relatively large stands along the western shore. Remarkable is that *Hydrocharis* has not been recorded in the lake.

Scirpus acicularis is the only isoetid observed in the lake by the author. It may be found in very shallow places near the water-line. Very often it grows together with charads, *Potamogeton gramineus* and sometimes *P. Torssandri*.

The lake has no great depth, and at several places there are vast shoals. The submerged vegetation is often very abundant, *e.g.*, in the northern part, where large meadows of *Ceratophyllum demersum* and *Myriophyllum spicatum* are distributed. The latter is also common on a large shoal in the southern end. *Potamogeton lucens* forms only small patches, but is known from several localities. *P. praelongus* has been observed on the shoal mentioned above, and *P. crispus* grows at a few localities (besides, it is often found drifting). *Ranunculus circinatus* seems to be most richly developed in the northern end, but is also observed elsewhere. *P. obtusifolius* grows in the southern end in calm water inside the reed and, furthermore, at the western side close to the reed together with *Utricularia vulgaris* in a *Ceratophyllum* meadow.

The sediments of Siesjön (fine detritus gyttjas) are apparently not limy but relatively rich in iron. Coarse detritus is always a moderate element. At sheltered places the gyttja is to be found already in the dense reed close to the shore-line.

Lake Västersjön and Lake Rösjön (Figure 51.).

Västersjön and Rösjön were included in the investigation in order to obtain material for comparison from a lake type, corresponding to the *Lobelia-Isoetes* lakes described from Småland and other places. The lakes are situated close together on the ridge Hallandsåsen, the northernmost of the horsts which cross Scania from northwest to southeast. Thus, the lakes belong to an Archaean region, separated from the Sydsvenska Högland by faults. The position along a fault line ought to give rise to a big water depth. They have, on the whole, an other physiognomy than the other lakes studied.

The slopes along the northern shores are covered with beech forests, if they have not been displaced by planted coniferous trees. On the southern side the pine is more common.

The water-level changes very widely. At some excursions it was exceptionally high (*e.g.*, August 13 1949), at others exceptionally low (*e.g.*, November 12 1949 and September 16 1950). In the dry year 1947 the water surface sank rapidly already in the beginning of the summer (between May 14 and June 30). The outflow from Rösjön is regulated by a number of mills and power works (Utredning 1. 1949), and a still more radical regulation is planned. The vegetation zones in shallow water become in this way more irregularly inundated than is normal.

Stony, steep shores are characteristic. They are covered with a sparse vegetation of *Glyceria fluitans*, *Juncus articulatus*, *Lycopus europaeus*, *Lysimachia thyrsiflora*, *L. vulgaris*, *Lythrum Salicaria*, *Phalaris arundinacea* and others. Tussocks of *Molinia* forms the border towards land. Sometimes *Myrica Gale* grows close to the water's edge, *e.g.*, in a fen at the western end of Västersjön. The shore is sandy on the isthmus between the two lakes, which is built up of sand deposits. Mire grounds sometimes reach down to the water-line, mainly at Västersjön.

The reeds diverge considerably as to density as well as to breadth from those of the other lakes examined. They are generally only of importance in the bays and are also here comparatively scanty. In the eastern part of Västersjön there are relatively vast reeds. *Phragmites*, *Scirpus lacustris* and *Typha angustifolia* are all reed components, but

Fig. 51. The lakes Västersjön and Rösjön. Scale 1 : 100 000.

the first-mentioned is generally dominant. Thick low reedswamps of *Scirpus palustris* are to be found at the western parts of the southern shore at Västersjön. At the same localities and also elsewhere low reeds composed of *Carex lasiocarpa, C. rostrata* and *Equisetum fluviatile* occur.

In Rösjön almost no high reeds are developed. Only small sparse patches of *Scirpus lacustris* occur. *Sc. palustris* reedswamps on the other hand grow at several localities, likewise *Carex lasiocarpa* and *Equisetum fluviatile* stands. At the western end *Phalaris* is reed-forming at one place.

The shores are sometimes fenny, and here Verlandung takes place, *e.g.*, on the northern side, where the water-lily belt with sparse *Scirpus lacustris* is landwards replaced by a denser *Sc. lacustris* zone, in which a number of herbs are included, *e.g., Alisma Plantago-aquatica* (frequent), *Cicuta virosa, Equisetum fluviatile, Glyceria fluitans, Iris Pseudacorus, Nuphar luteum, Nymphaea alba* and *Sparganium ramosum*. This zone passes into a fen vegetation.

As distinguished from the other lakes the water vegetation in Västersjön and Rösjön is predominated by isoetids. Dense swards of *Littorella uniflora* are distributed in shallow water and in the amphibious zone. They are considerably more extensive than in any of the other lakes. *Ranunculus Fl.* ssp. *reptans* and *Scirpus acicularis* occur at similar habitats but not to the same extent. *Juncus bulbosus* (the land form), already reported from some other lakes, is common. *Pilularia globulifera* is certainly more widespread than is apparent from the number of localities now known. The fern grows very often in rather deep water (at a depth of 50 cm. in Västersjön on August 27 1949). The isoetids are therefore best studied, when the water-level is low. *Subularia aquatica* is recorded from a few localities in Rösjön and one in Västersjön (found by Professor H. Weimarck), but is certainly much more frequent. At least at one habitat it grows together with *Isoetes echinospora*. The *Lobelia-Isoetes* mats, which are characteristic for the so-called *Isoetes-Lobelia* lakes, are well developed.

The floating leaf vegetation is most abundant in Rösjön, which is smaller and has a more lobated shore-line. Yellow water-lilies and white ones grow often in the small sheltered creeks. Of the small-leafed species is especially *Polygonum amphibium* widely distributed, a feature which to a certain extent reminds one of Bosarpssjön. In Västersjön the water-lily localities seem to be fewer in number. The only large occurrence is situated in the western part, where both *Nuphar* and *Nymphaea* grow. The small-leafed species are also recorded only from a small number of localities.

The elodeid vegetation is poor. From the two lakes together the following species have been observed: *Juncus bulbosus* var. *fluitans*, *Myriophyllum alterniflorum*, *Nitella opaca*, *Potamogeton obtusifolius*, *P. perfoliatus*, *P. praelongus*, *P. pusillus*, *Utricularia vulgaris* and *Utricularia* sp. *Myriophyllum* and *Juncus bulbosus* are common. *P. perfoliatus* grows in some scattered stands. *P. praelongus* and *P. obtusifolius* have hitherto only been noted from one locality in Rösjön and *P. pusillus* from one in Västersjön. *Nitella* sp., which seems to have a rather great distribution in Västersjön, has not yet been observed in Rösjön. Water-mosses play a more important rôle than in the other studied lakes.

There are no reasons for assuming that these lakes differ appreciably from other *Isoetes-Lobelia* lakes with respect to the macrophytic vegetation, which have previously been exhaustively studied in Dalarna (Samuelsson 1925) and Småland (Naumann-Blomgren 1925, Thunmark 1931, Lillieroth 1938 and others). Consequently the author's investigation has not been made so carefully as has been the case with the other lakes.

Iron sediments have been known for a long time from the lakes (Thunmark 1937). The organic sediments have, as in Finjasjön, a high content of iron and humus. They must be denoted as fine detritus gyttjas with precipitation of dy and a considerable amount of mineral grains (chiefly mo). The dominant fossils consist of diatoms.

B. Distribution of the species in the lakes.

Isoetids, nymphaeids, lemnids and elodeids.

Table 6 illustrates the distribution of the eulimnic species, which are classified in some of the following groups: isoetids, nymphaeids, lemnids or elodeids. All species, which have been observed by the author, are marked with 1. The remaining findings, recorded after 1935, are marked with *1*. The findings, recorded before 1935, are marked with +. Among the last-mentioned some information from Araslövssjön, Hammarsjön and Råbelövssjön is of relatively late date. It originates from Telegrafkommissarie TH. LANGE's studies of the flora of the Kristianstad area in the Nineteen Twenties.

Critical *Potamogeton* species have been examined and partly identified by Lektor O. PALMGREN. Almost all *Potamogeton* hybrids have been identified by him.

Information concerning species, which can easily be wrongly determined, has only been used, when verifying specimens have been available for examination. Nor have records with vague descriptions of the locality been included in the table.

The author has visited all the lakes described. Araslövssjön, Hammarsjön and Finjasjön have, however, been studied only a few times in connexion with investigations of the algal flora or the Magnocaricion fens. The macrophyte flora of these lakes is rather well known, which is connected with the investigation of the flora of Scania (inventeringen av Skånes Flora). Araslövssjön has been studied by TH. LANGE, Hammarsjön by TH. LANGE and Fil. mag. G. WIDEHOLT-LILLIEROTH and Finjasjön (partly) by Professor H. WEIMARCK.

Information of the flora of the investigated lakes has been published by *e.g.*, ANDERSSON (1948, Ringsjön, Västersjön and Rösjön), HALLBERG (1940, Finjasjön and Ringsjön), HANSEN (1949 a and b, Björkesåkrasjön and Häckebergasjön), NEUMAN (1896, Dagstorpssjön), RUFELT (1949, Ringsjön), SIMMONS (1933, Ringsjön), TRYBOM (1893, Ringsjön), THUNMARK (1945, Häckebergasjön), WEIMARCK (1940 and 1944, Ellestasjön, Snogeholmssjön and Finjasjön) and WIDEHOLT (1948, Hammarsjön).

Furthermore the register of Skånes Flora contains several records not yet published and reported among others by Fil. lic. O. ANDERSSON (Levrasjön and Oppmannasjön), Fil. kand. J. ERICSON (Tjörnarpssjön), Fil. kand. K. H. MATTISSON (Björkesåkrasjön, Börringesjön and Havgårdssjön), Fil. mag. G. OLSSON (Dagstorpssjön and Ringsjön) and Fil. kand. B. RUFELT (Ringsjön).

Table 6. Survey of the higher aquatic plants in the lakes (except helophytes, mosses and algae).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			19	20	21	22	23	24	25	26	27	28	29	30	31
	Ydd.	Fjäll.	Börr.	Hav.	Björk.	Häck.	Svan.	Krag.	Ell.	Snog.	Söborg.	Sö.	Helje.	Vo.	Krk.	Gyll.	Tun.	W.	E.	Sä.	Dag.	Kves.	Tjörn.	Bos.	Fløja.	Aras.	Ham.	Råb.	Opp.	Levra.	Sle.	Vä.	Rö.
Isoetids																																	
Echinodorus ranunculoides	—	—	1	—	—	—	—	—	1	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	1	—	—	—	—
Isoetes echinospora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	1
— lacustris	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	1	1
Juncus bulbosus (the land form)	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	+	—	—	1	—	—	1	—	—	—	—	—	—	—	1	1
Littorella uniflora	—	1	—	—	—	+	—	1	1	+	—	+	—	—	—	—	—	1	1	1	—	—	—	1	1	+	*1*	+	—	—	—	1	1
Lobelia Dortmanna	—	1	—	+	—	—	—	—	—	—	—	—	—	+	—	—	—	+	—	—	—	—	—	—	—	+	*1*	+	—	—	—	1	1
Pilularia globulifera	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Ranunculus Flammula ssp. reptans	—	1	1	—	—	—	—	1	1	1	—	1	—	1	1	—	—	1	1	1	—	1	—	—	1	—	1	—	1	1	—	1	1
Scirpus acicularis	—	1	1	1	—	—	—	1	1	1	—	1	—	1	1	—	1	1	1	1	1	1	*1*	1	1	—	1	1	1	—	1	1	1
Subularia aquatica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	1
Nymphaeids																																	
Hydrocharis Morsus-ranae	1	1	1	—	1	1	1	1	1	—	1	1	—	—	1	—	—	—	—	—	—	1	—	—	—	—	*1*	1	1	+	—	—	—
Nuphar luteum	1	1	1	1	—	1	1	1	1	1	1	1	—	—	1	1	—	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nymphaea alba	1	1	1	—	—	1	1	1	1	—	1	—	—	—	—	1	1	—	—	—	1	1	1	1	—	1	1	—	+	—	1	1	1
Polygonum amphibium	1	1	1	1	—	1	1	1	1	1	—	1	—	1	—	1	1	1	1	1	1	—	1	1	1	1	—	1	1	1	1	1	1
Potamogeton natans	1	1	1	1	1	1	1	1	1	1	1	1	—	—	1	1	1	1	1	1	1	1	1	1	—	1	*1*	1	1	—	1	1	1
Stratiotes Aloides	+	1	1	—	1	1	—	—	1	—	1	1	—	—	1	—	—	+	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—
Lemnids																																	
Lemna minor	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	—	1	—	1	—	—	1	1	—	1	—	1	1	1	1	1	—	—
— trisulca	1	—	1	1	1	1	1	1	1	1	—	1	—	—	—	—	1	—	—	1	—	—	—	—	1	—	—	1	1	1	—	—	—
Spirodela polyrrhiza	—	—	1	1	1	1	1	—	—	1	—	1	—	1	1	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Elodeids																																	
Callitriche hermaphroditica	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	1	—	—	—	—	+	—	—	—
Ceratophyllum demersum	—	—	1	—	—	1	1	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	1	1	—	1	1	—	—

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			19	20	21	22	23	24	25	26	27	28	29	30	31
Elodea canadensis	—	—	—	—	—	—	—	—	—	1	—	1	1	—	1	—	—	1	1	1	—	—	—	—	—	+	*1*	1	1	1	—	—	—
Myriophyllum alterniflorum	—	1	—	+	—	—	—	—	—	+	—	—	—	—	—	—	1	1	1	1	—	—	1	1	1	+	1	—	—	—	—	1	1
— spicatum	1	1	1	1	1	1	1	1	1	1	—	1	—	1	1	1	1	1	—	—	—	—	—	—	—	—	+	1	1	1	1	—	—
— verticillatum	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	*1*	+	—	—	—	—	—
Najas flexilis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—
Potamogeton crispus	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	—	1	—	1	1	—	1	—	—	+	+	1	1	1	1	—	—
— filiformis	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	—	—	—	—	—	—	—	1	1	1	—	—	—
— Friesii	—	—	—	1	1	—	—	—	—	1	—	1	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—
— (probably) Friesii × panormitanus	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— gramineus	1	1	1	—	1	—	—	1	1	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	1	—	1	1	1	—	—
— gram. × lucens	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	+	—	—	—	—	—	—
— gram. × lucens × perfoliatus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—
— gram × perfoliatus	—	1	1	—	—	—	—	1	—	—	—	1	—	1	—	—	—	1	1	1	—	—	—	—	—	—	—	—	—	1	—	—	—
— lucens	1	—	1	1	—	—	—	1	1	1	1	1	1	—	1	1	—	1	—	+	—	—	—	—	—	+	*1*	1	1	1	1	—	—
— lucens × perfoliatus	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— obtusifolius	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	*1*	—	—	+	1	—	1
— panormitanus	—	—	—	—	1	—	—	—	—	—	—	—	1	—	1	—	—	1	1	1	—	—	—	—	—	—	—	1	—	—	—	—	—
— pectinatus	1	—	1	1	1	—	1	1	—	1	—	1	1	1	1	1	—	1	1	1	—	—	—	—	—	—	1	1	1	1	—	—	—
— perfoliatus	—	1	1	1	1	—	1	1	—	1	—	1	1	1	1	1	1	1	1	1	—	1	1	—	1	—	1	1	1	1	—	1	1
— praelongus	1	—	+	1	—	—	—	1	1	*1*	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	1	—	1
— pusillus	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	1	—	1	—	1	—
— rutilus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
— zosterifolius	—	1	—	—	—	—	—	+	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	+	*1*	—	—	—	—	—	—
Ranunculus circinatus	+	1	1	1	—	—	1	1	—	—	—	1	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—
— peltatus	1	—	1	1	—	1	—	—	—	—	—	—	—	1	1	—	1	1	1	1	1	1	—	1	1	—	*1*	—	—	—	—	—	—
— trichophyllus	—	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—
Zannichellia palustris	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—
Utricularia vulgaris	1	1	—	1	—	1	1	—	*1*	—	1	1	—	—	—	—	1	—	—	—	—	—	1	—	—	+	*1*	1	—	1	1	1	—

Table 7. Survey of the best studied helophytes in the lakes.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			19	20	21	22	23	24	25	26	27			28	29	30	31
																		W.	E.	Sä.									A.	N.	K.				
Graminids																																			
Carex acutiformis	1	1	1	1	—	—	—	1	—	1	1	1	1	1	1	—	1	—	—	1	—	—	1	—	—	—	—	1	1	—	—	—	—	—	—
— appropinquata	1	—	1	—	1	—	—	—	1	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	1	1	—	—
— paniculata	1	1	1	—	—	—	1	1	1	1	1	—	1	1	1	1	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	1	—	—
— Pseudocyperus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	—	—	1	1	—	—	—	—	—	1	1	—	1	1	1	—	—
— riparia	1	—	1	1	1	r	—	1	1	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
— vesicaria	—	1	1	—	1	1	—	1	1	1	—	—	—	1	—	—	1	1	—	1	1	—	—	1	1	1	—	1	—	—	—	—	1	—	—
Glyceria maxima	1	—	1	1	—	1	1	—	—	—	1	1	—	1	1	1	1	1	1	1	—	1	—	—	—	1	—	1	1	—	—	—	—	—	—
Scirpus maritimus	1	—	1	—	—	—	—	—	—	1	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— Tabernaemontani	1	1	1	—	1	—	—	1	—	1	—	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	1	—	—	—
Calamagrostis canescens	1	1	1	1	—	1	1	1	1	1	—	1	—	—	1	—	1	1	1	1	—	1	1	1	1	1	1	1	—	—	—	1	1	1	—
Carex elata	1	1	1	—	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	—	1	1	1	—	1
— gracilis	1	1	1	1	1	1	1	1	1	1	—	1	—	1	1	1	1	1	1	1	1	1	—	1	1	1	1	—	—	—	1	—	1	—	1
— lasiocarpa	1	1	—	—	1	—	—	1	1	—	—	—	—	—	1	1	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	1	1
— rostrata	1	1	1	1	1	—	1	1	1	1	1	1	1	—	1	1	1	—	—	—	1	1	1	—	—	1	—	1	1	—	1	1	1	1	1
Equisetum fluviatile	1	1	1	1	1	1	1	1	1	1	1	1	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Glyceria fluitans	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	1	1	1	—	1	—	—	—	—	—	—	—	—	1	1
Juncus articulatus	1	1	1	1	—	—	—	1	1	1	—	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	—	1	—	—	1	1	1	1	1
Phalaris arundinacea	1	1	1	1	—	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	—	—	1	—	1	—	1
Phragmites communis ...	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Scirpus lacustris	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
— palustris	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1
Typha angustifolia	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	—	—	—	—	1	1	1	1	1	1	—	1	1	1	1	1	1	1	—
— latifolia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1	—	1	—	—	—	1	1	1	1	—	1	1	1	—	1
Herbids																																			
Acorus Calamus	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	1	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Bidens cernua	1	1	1	1	1	1	—	—	1	—	—	1	1	1	1	—	—	—	—	1	—	—	—	—	—	—	—	1	1	—	1	1	—	—	—

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 W.	18 E.	18 Sa.	19	20	21	22	23	24	25	26	27 A.	27 N.	27 K.	28	29	30	31
Butomus umbellatus	—	—	1	1	—	1	—	1	1	1	—	1	—	—	1	1	—	1	1	—	—	—	—	—	1	1	—	1	1	—	—	—	—	—	—
Calystegia sepium	1	—	1	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	1	—	—	1	—	—
Epilobium hirsutum	—	1	1	1	—	—	1	—	1	1	—	1	1	1	1	1	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—
— parviflorum	1	—	1	1	1	—	—	1	1	—	—	1	1	1	1	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	1	1	1	—	—
Eupatorium cannabinum	1	1	1	1	1	—	—	1	1	1	1	1	1	1	1	1	—	1	1	1	—	1	—	—	—	1	—	1	—	1	1	1	1	—	—
Hippuris vulgaris	1	1	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—
Oenanthe aquatica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—
Ranunculus Lingua	1	1	1	—	1	1	1	1	1	1	1	—	1	1	1	1	1	—	—	—	—	—	—	—	—	1	1	1	1	—	1	1	1	—	—
Rorippa amphibia	1	1	1	—	—	1	1	1	1	1	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	1	1	—	1	—	1	—	1	—	—
Rumex Hydrolapathum ..	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	—	—	1	1	—	—	—	—	—	1	1	1	1	1	1	—	1	—	—
Sagittaria sagittifolia	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—
Senecio palustris	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—
Sium latifolium	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	—	—	—	1	1	1	1	1	1	—	1	1	1	—	—
Solanum Dulcamara	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	—	1	—	1	1	1	1	1	1	—	—
Alisma Plantago-aquatica	1	1	1	1	—	1	1	1	1	1	1	1	—	1	1	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bidens tripartita	1	1	1	1	—	1	—	1	1	1	—	1	—	1	1	—	—	—	—	1	1	—	—	—	1	—	1	1	—	—	1	1	1	1	—
Cicuta virosa	1	—	1	1	—	1	1	—	1	1	1	1	1	—	1	—	—	—	—	1	1	—	1	—	1	1	1	—	1	1	1	1	—	—	1
Iris Pseudacorus	1	1	1	1	1	—	1	1	1	1	—	1	—	1	1	1	1	1	1	—	1	1	1	1	—	1	1	1	1	—	—	—	1	—	1
Lycopus europaeus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	—	1	—
Lysimachia thyrsiflora ..	1	1	1	1	1	—	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1
— vulgaris	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1
Lythrum Salicaria	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Menyanthes trifoliata	—	1	—	1	—	—	1	1	1	—	1	—	—	—	1	1	1	1	1	—	—	—	—	1	—	—	1	—	—	—	—	—	1	1	1
Peucedanum palustre ...	1	1	1	—	1	—	1	—	1	1	1	—	—	—	1	1	1	1	1	—	—	1	1	—	—	1	1	1	—	—	—	1	1	1	1
Potentilla palustris	1	1	—	—	1	—	1	1	1	—	1	—	1	—	1	1	1	—	—	—	1	1	1	1	1	1	—	1	—	—	—	—	1	1	—
Ranunculus Flammula ..	—	1	1	—	—	—	—	—	1	1	—	—	—	1	1	—	1	—	—	—	1	1	1	1	—	—	—	1	—	—	1	—	1	—	1
Scutellaria galericulata ..	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	—	1	1	—	1	1	1	—	—	1	1	1	—	—	—	1	1	1	1
Sparganium ramosum ...	1	1	1	1	1	1	1	1	1	1	1	1	—	1	1	1	1	1	1	1	1	1	—	—	1	—	1	1	1	—	1	—	1	—	1
— simplex	—	1	1	—	—	—	1	—	1	—	—	—	—	—	—	—	1	—	—	—	1	—	—	1	1	—	1	—	—	—	—	—	1	1	—

The bottom plants, not reachable by hand from the boat, have been collected mainly by dredge, sometimes by grapnel and hayrake. The vegetation has furthermore been studied, as far as possible, *in situ* by water-telescope.

The nomenclature follows Hylander 1941.

Helophytes.

Table 7 gives a list of the helophytes best investigated. It has been completed by records from the register of Skånes Flora. Findings recorded before 1920 have not been included. Ringsjön and Oppmannasjön have been divided into three parts. The helophytes have been brought together in a separate list, as they have not been subjected to the same close study as the other water plants. Those species are most thoroughly recorded, which mainly occupy areas in the vicinity of the water-line. No division of the species according to the occurrence in the amphibious zone (eulitoral) or both in the amphibious zone and the aquatic zone (eulitoral and sublitoral) has been performed, as a distinct delimitation is difficult to carry out. It is, however, relatively easy to distinguish those species, which extend into rather deep water, that is, are able to grow at localities always covered with a considerable water layer. The following species seem to belong to this group: *Butomus umbellatus, Equisetum fluviatile, Glyceria fluitans, Phragmites communis, Sagittaria sagittifolia, Scirpus lacustris, Sparganium ramosum* and *Sp. simplex*. The following species prefer the driest part of the amphibious zone: *Calamagrostis canescens, Calystegia sepium, Eupatorium cannabinum* and *Peucedanum palustre*.

A division into graminids and herbids has been made. Furthermore, those species have been brought together, which have a ubiquitous distribution in the area.

Among the herbids it may be noted that *Sagittaria* has a small distribution, both as regards the number of the lakes, where it is found, and the size of the clumps, which it forms. Nowhere have so large occurrences been observed as those described by Lillieroth (1950) from W. Sorrödssjön. *Acorus* grows very seldom in the investigated lakes. Noticeable is also, that *Oenanthe aquatica*, which occurs in several lakes in Middle Sweden, is here almost absent. Apart from Tunbyholmssjön, where the author has observed it, findings are reported only from Araslövssjön, Hammarsjön, Häckebergasjön and Råbelövssjön

Fig. 52. Oppmannasjön at Arkelstorp, western shore. *Butomus umbellatus* forms here isolated clumps at some distance from the shore. Photo by A. ALMESTRAND, 25.7.1947.

(according to the register of Skånes Flora). These localities are unknown to the author, and as far as Häckebergasjön is concerned also very old. *Butomus umbellatus* generally forms small stands (figure 52). Frequently it grows in sterile clumps at a depth of at least 0.5 m. It is, however, easily recognizable by its leaves with the triangular section. It may also grow in the reed communities, but it is not especially common.

Charophytes and mosses.

Table 8 shows the findings of charophytes in the lakes. The records come exclusively from the investigations of the author, as no charophytes have been delivered to the herbariums of the Botanical Museum, Lund or the National Museum, Stockholm from these lakes during the

Table 8. Survey of the charophytes and some common water mosses in the lakes.

	Ydd.	Fjäll.	Börr.	Hav.	Björk.	Häck.	Svan.	Krag.	Ell.	Snog.	Söborg.	Sö.	Helje.	Vo.	Krk.	Gyll.	Tun.	W. Ri.	E. Ri.	Sä.	Dag.	Kves.	Tjörn.	Ros.	Fl.	Råb.	Opp.	Levra.	Ste.	Vä.	Rö.
Charophyta																															
Chara aspera Willd.	1	1	1	1	1	—	—	1	1	—	—	—	1	1	1	1	—	1	1	1	—	1	—	—	1	1	1	1	1	—	—
— contraria A. Br.	1	—	1	1	1	—	—	1	1	—	—	1	1	1	1	—	—	1	—	—	—	—	—	—	—	1	1	1	1	—	—
— fragilis Desv.	1	1	1	1	1	—	1	1	1	—	—	—	1	1	1	1	1	1	1	1	—	1	—	—	1	1	1	1	1	1	—
— hispida Wallr.	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
— rudis A. Br.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—
— stelligera Bauer	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	1	—	—	—	—	—	1	—	1	—	—	—
— tomentosa L.	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—
Nitella opaca	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— sp. (the Flexiles-group)	—	—	—	—	—	—	1	—	—	—	—	—	1	—	1	—	—	1	—	1	—	1	—	1	1	—	—	1	—	1	—
Bryophyta																															
Fontinalis antipyretica	—	1	1	—	—	—	1	1	—	—	1	—	—	—	1	1	1	1	1	—	—	—	—	1	—	1	—	1	—	1	1
Riccia fluitans	1	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Ricciocarpus natans	1	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

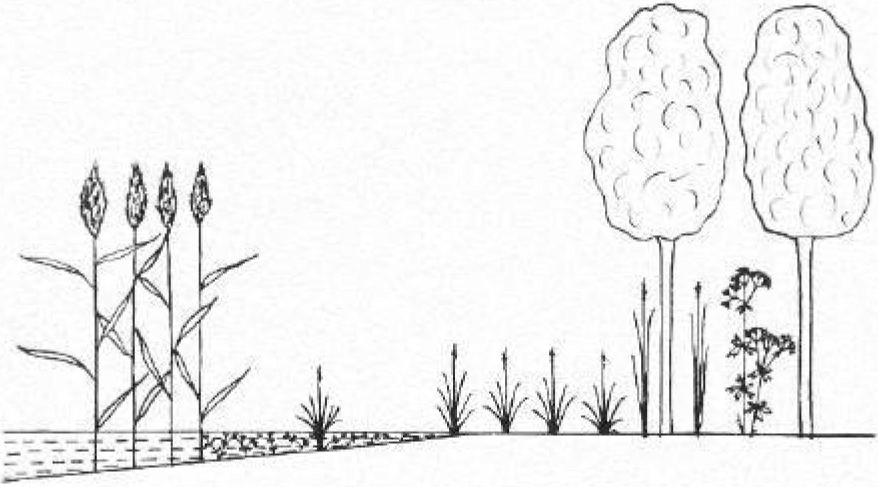

Fig. 53. Shore profile from the southern shore of Yddingen. A typical habitat for *Chara hispida*, which grows in thick mats in the calm water inside the *Phragmites* reed. The amphibious zone consists in its outer part of *Carex elata* - tussocks and in its inner part of *Calamagrostis canescens* stands, which landwards are edged by *Eupatorium* or *Phalaris*.

last years. The nomenclature refers to LEVRING & HASSLOW 1937. The material collected in 1945—47 has been examined by Kyrkoherde O. J. HASSLOW. Some critical material has also been examined by Over-assistent S. OLSEN.

Otherwise the determination method recommended by OLSEN (1944 p. 13) has been employed. This method has proved extremely effective and makes the identification of even strongly encrusted specimens possible. Sterile individuals belonging to the *Flexiles*-group of *Nitella sensu* MIGULA have been entered as *Nitella* sp. As far as *Chara fragilis* is concerned the author follows HASSLOW (1931) and OLSEN (1944).

For the determination the following literature has been used: ALLEN (1950), GROVES and BULLOCK-WEBSTER (1920), HASSLOW (1931), MIGULA (in PASCHER 1925 and RABENHORST 1897) and OLSEN (1944).

Charophytes constitute a prominent element in the vegetation of several lakes investigated. The genus *Chara* is both qualitatively and quantitatively more abundant than *Nitella* with a few exceptions (*e.g.*, Tunbyholmssjön and Västersjön). Other genera have not been recorded. *Nitellopsis obtusata* has been entered as *Chara stelligera*.

Lake Yddingen.

The charophytes are entirely restricted to the bottom near the shore. Open minerogenous parts of this are mostly covered with *Chara* mats, containing *Ch. aspera, fragilis* and *contraria*. Furthermore, charads are highly characteristic for calm bodies of water, separated from the open lake by thick reeds (figure 53). Here *Ch. hispida* is dominant.

Lake Fjällfotasjön.

Only *Ch. aspera* and *fragilis* have been observed. As in Yddingen they do not grow on muddy bottom, but are confined to the shallow minerogenous zone out to a depth of about 40 to 50 cm. (in 1947). The algae have a fresh green colour and are free from strong incrustation.

Lake Börringesjön.

The charads are absent in deeper water but are richly developed in shallow water. Open minerogenous bottom is covered with thick mats, preferably consisting of *Ch. aspera* and *contraria*. *Ch. hispida* and *fragilis* are also included but in scattered groups. At sheltered places, *e.g.*, inside thick reeds, the charads are plentifully represented. The same species are to be found, though *Ch. aspera* is less predominating.

It is difficult to establish the exact effect of the lowering on the growth of the *Chara* species. However, they seem to have adapted themselves rather easily to the new conditions, as they still occupy a considerable area.

Lake Havgårdssjön.

The *Chara* vegetation is rather abundant, but only few species are recorded. The minerogenous bottom is often covered with a dense mat of *Ch. aspera* and *contraria*. Sometimes *Ch. fragilis* is also intermingled. On muddy bottom together with higher aquatic plants *Ch. fragilis* is to be found in longish specimens with extended branchlets. It is the typical appearance of *fragilis*, occurring in deep water.

No large *Chara* species have been observed.

Lake Björkesåkrasjön.

In Björkesåkrasjön, as previously in Krankesjön, the charad vegetation is visible from a boat even far from the shore. Both lakes are very shallow. Particularly in the northern part of the lake the *Chara* meadows are well developed. They consist of three species, *viz.*, *Ch. hispida, fragilis* and *contraria*. At Hjortalöpet the shallow bottom is covered with a *Ch. aspera* mat. Suitable habitats for this species are otherwise absent. The greatest part of the lake bottom is muddy and near the shore-line grown with dense reedswamps.

Lake Häckebergasjön and Lake Svaneholmssjön.

No charophytes have been observed by the author in Häckebergasjön. In Svaneholmssjön a small locality for *Ch. fragilis* is found at the bathing-place, which forms the only open shore with firm bottom around the lake. *Nitella* sp. is encountered in the bay west of the castle.

Lake Krageholmssjön.

This lake contains a more insignificant charad vegetation than might have been expected. It is limited horizontally as well as vertically and may form a short, very little connected zone out to a depth of some decimetres. Only *Ch. aspera, contraria* and *fragilis* are known.

Lake Ellestasjön.

As in the preceding lake the charophytes only inhabit an insignificant territory. They are confined to the area close to the water-line and exhibit no connected mats. *Ch. fragilis* and *aspera* are the most common species. At one locality to the southwest *Ch. tomentosa* and *contraria* were observed in 1947, but only in small patches. Later on they have not been refound.

Lake Snogeholmssjön, Lake Sövdeborgssjön and Lake Sövdesjön.

In the two first-mentioned lakes no charad localities have been recorded. In Sövdesjön one locality for *Ch. contraria* is found. The absence of *Characeae* is especially noticeable as regards Sövdesjön, the sandy bottom of which seems to offer suitable habitats. To what extent the lake lowering in the Nineteen Thirties might have contributed to the disappearance of a former *Chara* vegetation is now impossible to establish. Judging from the conditions known from Krankesjön and Börringesjön a moderate lowering of the water surface would not seem to bring about a displacement of the charads, even if they grow in shallow water.

Lake Heljesjön.

As already mentioned, Heljesjön still contains a beautiful charophyte vegetation (p. 69). The *Ch. aspera* carpet growing in shallow water was almost completely laid bare by the lowering in the spring of 1949 and has not quite recovered since that time. *Ch. fragilis* and *contraria* were also included in these mats. On deeper, sedimentary bottom well developed *Ch. rudis* meadows are spread, especially in the western part of the lake. *Ch. tomentosa* is still rather abundant (in the autumn 1949) and forms reddish meadows at several places mainly in the western part. In the deep water vegetation the following charophyte species are to be found: *Ch. fragilis* and *Nitella* sp. (belonging to the *Flexiles*-group). The latter seems to occupy an especially vast area.

Lake Vombsjön.

At the southern side of the lake where sandy shores prevail, one can find vast dense carpets of charads, dominated apparently by *Ch. contraria*. Also *Ch. aspera* and *fragilis* may be intermingled. These mats are easily laid bare by only an insignificant lowering of the water surface, and in autumn they are generally dry. On the northern shore the *Chara* occurrences are very local. No large *Chara* species, for example, *hispida*, have been observed, although they are to be expected.

Lake Krankesjön.

The charophyte vegetation from the year 1944 has previously been discussed (p. 76 *et seq.*). From 1948 the charads began to redevelope in shallow water. It has been possible to collect most of the species from 1944 (*Ch. aspera, contraria, fragilis, rudis, tomentosa*). Only *Ch. stelligera* and *Nitella* sp. are absent. On the other hand, the vast *Chara* meadows out in the lake have disappeared and have been replaced by vascular plants (chiefly *Potamogeton crispus*). It remains to be seen whether the old *Chara* vegetation will arise anew. Spores of the disappeared species are possibly present on the bottom and under favourable conditions such a redevelopment is possible.

Lake Gyllebosjön.

Gyllebosjön has with respect to its position a surprisingly rich *Chara* vegetation. Along the southeastern shore a more or less dense mat of charads extends as an understorey in a *Carex lasiocarpa* zone (*Ch. aspera, fragilis* and *hispida*). The two latter species are also found in the neighbourhood of the hospital, where two shorter parts of the shore are kept free from high plants because they are used as bathing-place or watering-place. *Ch. fragilis* has the largest distribution. It occurs in small patches here and there along all the shores, and is also a component of the submerged vegetation out in the lake, *e.g.*, at the shoal already mentioned (p. 81). In the Magnocaricion fens around the outflow there are pools entirely filled up with *Chara* species, mainly *hispida* and *fragilis*.

Lake Tunbyholmssjön.

Tunbyholmssjön as Svaneholmssjön seems to lack other *Chara* species than *fragilis*, which is also local. Hitherto it has been observed only at the short gravelly shore strip, which is employed as bathing-place, southeast of the castle. On muddy bottom out in the lake grow considerable quantities of *Nitella opaca*.

Lake Ringsjön.

Of the three parts of Ringsjön the western one has the richest *Characeae* vegetation, qualitatively as well as quantitatively. *Ch. aspera, contraria, fragilis, rudis, stelligera* and *Nitella* sp. are known from here. The distribution of *Ch. stelligera* has been dealt with in another paper (LUNDH 1951). In contrast to the character of other habitats in Scania it grows here even on firm, not muddy, substratum. While *Ch. hispida* has only been found in a few specimens, the three first-mentioned species occupy an outstanding place in the submerged vegetation of the lake. As the minerogenous shores are very shoaling, *Ch. aspera-contraria* mats inhabit large areas. *Ch. fragilis* also extends on muddy bottom and forms here vast green meadows. *Nitella* sp. is collected in different parts of the lake. It grows in very shallow water, *e.g.*, at Boo, as well as in somewhat deeper water (1 to 2 m.), *e.g.*, at Lillö.

In Eastern Ringsjön the charads seem to be restricted to the minerogenous shallow bottom, which in the bays consists of sand and otherwise of coarser material. They may form mats, *e.g.*, at Klinta and in the bay at Fulltofta, but this is rather rare. Usually they grow intermingled with vascular plants, *e.g.*, *Potamogeton filiformis* and *Littorella uniflora*. Hitherto two species have been observed, *viz.*, *Ch. aspera* and *fragilis*.

Sätoftasjön, which has shoaling shores similar to those in Western Ringsjön, contains at least in the western part a rich *Chara* vegetation. Out to a depth of about 2 to 3 dm. there is a more or less coherent *Ch. aspera* carpet. Outside *Ch. fragilis* is to be found, at first in single individuals, then in steadily increasing amounts. At a depth of about 1.5 m. *Ch. stelligera* is met with. The bottom is still minerogenous (sandy). The alga is not observed in large coherent quantities. *Ch. fragilis*, on the other hand, gives rise to vast meadows. On muddy bottom the vegetation grows thin rather rapidly. Along the eastern shore occur only scattered findings of *Ch. aspera* and *fragilis*, chiefly in the bay at Häggenäs. *Nitella* sp. has been collected at some places on minerogenous bottom, which at Munkagången is very stony.

Lake Kvesarumssjön.

The *Chara* vegetation belongs to the minerogenous bottom, nearest the shore. The two species present are *Ch. aspera* and *fragilis*. They form only small isolated stands. A sterile *Nitella* (belonging to the *Flexiles*-group) has been found near the shore on a locality with silty bottom. Naturally this species can be expected to have a wider distribution.

Lake Bosarpssjön, Lake Tjörnarpssjön and Lake Dagstorpssjön.

In Bosarpssjön a charophyte vegetation seems to be absent, with the exception of one *Nitella* species, which is hitherto known from a locality in the southern end with silty bottom. In Tjörnarpssjön and Dagstorpssjön the author has not registered any charads at all. It is, however, possible, that both *Ch. fragilis* and *aspera* may grow in very isolated stands in all the three lakes. The absence of a marked *Chara* vegetation may probably be due to the scarcity of suitable habitats on the steep stony bottom.

Lake Finjasjön.

Finjasjön with its large surface and general shape gives quite another impression than the four small lakes mentioned above. It possesses also a quantitatively better developed *Chara* vegetation. The species found are, however, the same as in Kvesarumssjön, *viz.*, *Ch. aspera* and *fragilis*. They may, especially *aspera*, form dense mats on shallow minerogenous bottom. In deeper water a *Nitella* species (the *Flexiles*-group) has been observed on a bottom mixed with mud.

Lake Råbelövssjön.

As the shores are seldom shelving and usually fringed by a closed reed belt, no rich development of charads is to be expected in the form of mats in shallow water. Where the bottom is rather slightly inclined and dense high reeds are absent, the typical species *Ch. aspera, contraria* and *fragilis* may grow. They occupy, however, only an insignificant area. The two latter extend to deeper sedimentary bottom, and especially *Ch. fragilis* is often found here intermingled with the higher plants out to a depth of about 3 m., but never in large quantities. *Ch. contraria* has not been collected in any profile, and therefore exact figures of depth can not be given. The species is found at least at a depth of 2 m., but only in single individuals. Several findings of *Ch. tomentosa* were made in the southern half of the lake, where it seems to prefer a depth of about 1 to 2 m., the area, within which the sediment limit is generally situated. The distribution of *Ch. stelligera* has previously been dealt with (Lundh 1947). It is encountered at a depth between 1.5 m. and 3 m., and thus it is to be found as far as the deepest higher vegetation may extend.

Lake Oppmannasjön.

Only the southern part, called the Kiaby part, exhibits a considerable *Chara* vegetation. The year 1947, when the water-level was extremely low, was apparently favourable for the charads. The shoaling, insignificantly water-covered sandy shore was at many places grown with thick *Chara* mats, *e.g.*, at Kiaby and at the western side east of Kälkestad. The predominating species were *Ch. aspera, contraria* and *tomentosa*. Later on such a mass development has not been refound, but the species are present in small scattered patches. In 1949 a rich occurrence of *Ch. contraria* and *tomentosa* was recorded at a stone shoal near Bäckaskog. On the adjacent stony shore grew a dense mat of *Ch. aspera, contraria* and *tomentosa*. From the bay Barumviken, which is unsatisfactorily studied, only one *Chara* locality is known (*Ch. contraria*). In the remaining parts of the lake the charophytes seem to play an unimportant rôle. No findings have been made here.

Lake Levrasjön.

Levrasjön has an abundant charophyte vegetation. The number of species amounts to 6. In shallow water *Ch. aspera* inhabits vast areas, very often intermixed with *Ch. contraria* or *fragilis*. On the eastern shore, which is very shelving, this mat extends to about 50 m. in breadth. At profile 6, laid southeast of the northernmost sample station (figure 50), it can be observed that outside the *Ch. aspera-contraria* mat a *Ch. rudis* zone is developed, which lakewards passes into an *Elodea* meadow. The bottom descends here abruptly already at a distance of 10 to 20 m. from land. *Ch. aspera* may extend to a depth of about 2 m. but is always confined to the minerogenous bottom (also lake-marl). *Ch. contraria* has on the whole a distribution similar to *Ch. aspera*.

The vegetation reaches down to a relatively great depth, and, therefore, it is necessary here to use a dredge or a similar device in order to obtain an idea of its composition. *Ch. fragilis* and *tomentosa* may grow in deeper water than the aforementioned species. The former has been recorded from a depth of 8 to 9 m. The latter is found in the profiles out to a depth of 2 to 2.5 m. It does not seem to occur on pure mud. It seldom forms pure stands but is intermingled with other higher plants or charads. *Ch. stelligera* is observed at several localities from the northeastern bay to the southern end of the lake. Sometimes the dredge was filled with such specimens, but apparently it does not, as a rule, form coherent meadows. According to the profiles it extends to a depth of at least 4.5 m. All the charads, but especially those growing on lake-marl, are greatly encrusted, sometimes past recognition.

Lake Siesjön.

The richest *Chara* locality, a sheltered cove, is situated in the northern end, where several species have been observed: *Ch. fragilis, contraria* and *hispida*. The area is, however, rather limited. The algae grow only close to the water-line on the clayey bottom.

In calm water inside the reed zone there often occur mats of charads, mainly composed of *Ch. aspera*, sometimes intermingled with *fragilis* and *contraria*, *e.g.*, at the eastern and southeastern shore. No charads are included in the vegetation outside the shallow zone, which is completely dominated by vascular plants.

Lake Västersjön and Lake Rösjön.

These two lakes, as already mentioned, have not been studied so intensively as the remaining lakes as concerns the quantitative distribution of the plants. For this reason the spread of *Ch. fragilis*, which species has been collected in Västersjön, is not known in detail. It is notable that the alga seems to be absent at the usually typical habitats, namely the shallow zone near the water-line. *Nitella* sp. (eventually *opaca* according to O. J. HASSLOW) is a characteristic constituent of the submerged vegetation. The author has not found any charophyte localities in Rösjön, but probably such are present.

In table 8 also the most common water mosses are included. Mosses constitute only an insignificant element of the bottom vegetation outside the eulitoral zone. *Fontinalis antipyretica* is the most frequent species. This moss is generally to be found in shallow water near the water-line. In Råbelövssjön and Levrasjön, however, it occurs also in deep water. In the former it grows at a depth exceeding 2.5 m. and in the latter the greatest measured depth amounts to 6.5 m. In the profiles from these two lakes *Fontinalis* was often observed in the outermost part of the higher vegetation. The moss grows both on minerogenous and organogenous bottom (gyttja). Carpets of *Fontinalis* have been found, for example, in Levrasjön and Krageholmssjön. Very often it is washed up on shore in large quantities in spring, *e.g.*, in Råbelövssjön, Sövdeborgssjön and Gyllebosjön. In Ringsjön *Fontinalis* is most widespread in Eastern Ringsjön. It is to be noted that the moss is not found here in deep water as in Råbelövssjön and Levrasjön. In the remaining lakes, from which findings have been recorded, the species has a more or less restricted distribution except in Västersjön (eventually Rösjön), where several localities have been registered from different parts of the shore. It grows here near the summer water-line, and sometimes it is completely laid bare in the event of pronounced low water.

Irrespective of *Fontinalis* the submerged moss vegetation is best developed in Västersjön. The material collected here has been determined by Fil. dr H. PERSSON, who has also communicated some features of the distribution of these species in Scania. The two mosses, found in the dredge, are *Fontinalis hypnoides* Hn and *Drepanocladus tenuinervis* H. Perss. in herb. They have been collected in different parts of the lake and probably have a vast extension. As no profiles have been laid in the lake, it is impossible to express an opinion of the distribution of the mosses in relation to the other submerged plants. The former species is known in Scania from Stenshuvud and Värsjön, the latter, which is to be regarded as a true lake bottom species, is very little known from South Sweden.

In Tjörnarpssjön *Fissidens Julianus* (Sav.) Schp. has been observed. It is probably the fourth finding in the province. The moss grows richly at least at one habitat with stony bottom in the southern part of the lake.

The typical lowland lakes seldom contain any important moss vegetation. In Levrasjön mats of a moss, which was macroscopically determined as *Drepanocladus* sp., were observed on lake-marl in the northern part as well as at the western shore in the summer of 1947. In Råbelövssjön sometimes moss fragments could be found in the dredge. A sample determined by H. PERSSON, appeared to be *Amblystegium riparium* (Hedw.) Br. & Sch., a shore moss, which frequently occurs on the shores of the investigated lakes.

In addition to the submerged mosses discussed above two species are to be found in some lakes, which, when floating, can be considered rather as lemnids, *viz.*, *Riccia fluitans* and *Ricciocarpus natans*. The former has been observed almost constantly within the reed communities. Probably it is more common than the list shows (table 8). It often occurs at localities, difficult to get at. The locality found in Yddingen was discovered by Fil. dr S. LILLIEROTH. *Ricciocarpus* is notably unfrequent. Nowhere have so large quantities been observed as in, for example, Tåkern. In April 1949 it formed a green cover inside the reeds at the eastern side of Krankesjön. Since 1929 it has been registered from a fen east of the lake (LOHAMMAR 1940). In May the same year it had almost entirely disappeared. The same was the case in Häckebergasjön, where it in April grew together with *Lemna minor* and *L. trisulca* in reed remains in the northern part of the lake. In Yddingen it was found in October 1949 by S. LILLIEROTH in the vast reed zone of the southwestern part. Since 1927 the moss has been known from the adjacent locality St. Roslätt. Apparently the moss has spread from the old localities into the lakes Krankesjön and Yddingen. Also Häckebergasjön may be a new locality, as the species is likely expanding (LOHAMMAR 1940).

The lists of species are not claimed to be complete. Species may, for example, be overlooked on account of their minute distribution and also by the fact already discussed, that the submerged water plants seem to be very sporadic in their occurrences. Finally mistakes can be made in connexion with the registration.

References.

ALLEN, G. O. 1950. British Stoneworts (Charophyta). — The Haslemere Natural History Society. Haslemere Educational Museum, Surrey, Arbroath.

ALM, G. 1920. En jämförande undersökning över de biologiska orsakerna till Börringe- och Havgårdssjöarnas olika fiskavkastning. — Skrifter utg. av Södra Sveriges Fiskeriförening. N:o 3. Lund.

ALMESTRAND, A. 1951. Studies on the vegetation and hydrochemistry of Scanian lakes. II. Ion determinations in lake waters. — Bot. Not. Suppl. Vol. 2: 3. Lund.

ALMQUIST, E. 1929. Upplands vegetation och flora. — Acta Phytogeogr. Suec. Bd I. Uppsala.

ANDERSSON, A. 1948. Näringstillgång och planktonutveckling i några skånska sjöar. — Vattenhygien. Årg. 4. p. 9. Stockholm.

ANDERSSON, I. 1947. Skånes Historia. Till Saxo och Skånelagen. Stockholm.

ARRHENIUS, O. 1934. Fosfathalten i skånska jordar. — Sverig. Geol. Undersökn. Ser. C. N:o 383. Stockholm. English summary. (The phosphate content in Scanian soils.)

— 1950. Markreaktionen hos sydsvenska jordar. — Socker. Vol. 6. No. 4. p. 63. Malmö. English summary. (Soil acidity in Southern Sweden.)

BERGSTEDT, J. A. 1887—90. Handlingar angående värdering och delning av de landvinningar som uppkommit genom sänkning av Oppmannasjön o.s.v., upprättade 1887—90. (Unpublished.) Lantmäterikontoret i Kristianstad.

BERGSTEN, K. E. 1945. Skånes klimat. — Svensk Geogr. Årsb. p. 31. Lund.

BLOMGREN, N. och NAUMANN, E. 1925. Untersuchungen über die höhere Vegetation des Sees Stråken bei Aneboda. — K. Fysiogr. Sällsk. Handl. N.F. Bd 36. Nr 6. Lund.

DAVIDSSON, H. 1925. En skånsk rullstensås. — Svensk Geogr. Årsb. p. 86. Lund.

DE GEER, G. 1887. Kartbladet Lund. — Sverig. Geol. Undersökn. Ser. Aa. N:o 92. Stockholm.

— 1889. Kartbladet Bäckaskog. — Ibid. N:o 103.

— 1889. Kartbladet Karlshamn. Skånedelen. — Ibid. N:o 106.

DU RIETZ, G. E. 1930. Vegetationsforschung auf soziationsanalytischer Grundlage. — Abderhalden, Handb. biol. ArbMeth. 11: 5. p. 293. Berlin & Wien.

— 1940. Das limnologisch-thalassologische Vegetationsstufensystem. — Verh. int. Ver. theor. angew. Limnol. Bd IX. p. 102. Stuttgart.

— 1950. Phytogeographical Excursion to the Maritime Birch Forest Zone and the Maritime Forest Limit in the Outermost Archipelago of Stockholm. July 13, 1950. — Seventh Int. Bot. Congress. Stockholm. Excursion guides. B 1.

DU RIETZ, G. E., HANNERZ, A. G., LOHAMMAR, G., SANTESSON, R. und WAERN, M. 1939. Zur Kenntnis der Vegetation des Sees Tåkern. — Acta Phytogeogr. Suec. Bd XII. Uppsala.

EHNBOM, K. 1941. Statsunderstödda torrläggningar och nyodlingen i Malmöhus län åren 1880—1935. — Svensk Geogr. Årsb. p. 22. Lund. German summary.

EKSTRÖM, G. 1940. The cultivated moraine soils in Scania. — Soil Research. Vol. VII. No. 1/2. p. 40. Berlin.

— 1950. Skånes åkerjordsområden. — Socker. Vol. 6. No. 3. p. 53. Malmö. English summary. (Regions of Cultivated Soils in Scania. Map of Surface-Soils.)

EWE, E. W. 1887—90. Karta över förslag till Finjasjöns sänkning upprättad 1887—90. (Unpublished.). Lantmäterikontoret i Kristianstad.

FOREL, F. A. 1901. Handbuch der Seenkunde. Allgemeine Limnologie. pp. 1—249. Stuttgart.

FRÖDIN, J. 1910—12. Djupkarta över västra Ringsjön. (Unpublished.)

GROVES, J. and BULLOCK-WEBSTER, G. R. 1920. The British Charophyta. Vol. I—II. — The Ray Society. London.

HALLBERG, J. 1940. Utbredningen i Skåne av Najas flexilis (Willd.) Rostk. et Schmith. — Bot. Not. p. 413. Lund.

HANSEN, S. 1949 a. Cladium Mariscus i Skåne. — Bot. Not. p. 127. Lund.

— 1949 b. Anmärkningsvärda växtfynd i Genarps socken i Skåne. — Bot. Not. p. 447. Lund.

HANSTRÖM, B. 1945. Regleringen av Kävlingeån i Skåne och dess konsekvenser ur naturskyddssynpunkter. — Sveriges Natur. p. 9. Stockholm.

HASSLOW, O. J. 1931. Sveriges Characeer. — Bot. Not. p. 63. Lund.

HOBROK, O. 1911. Karta över landvinningarna vid Finjasjön. (Unpublished.) Lantmäterikontoret i Kristianstad.

— 1919—20. Handlingar rörande verkställd utstakning av rågångar i Bosarpssjön uti Häglinge socken o.s.v. (Unpublished.) Lantmäterikontoret i Kristianstad.

HOLST, N. O. 1892. Kartbladet Simrishamn. — Sverig. Geol. Undersökn. Ser. Aa. N:o 109. Stockholm.

— 1911. Kartbladet Börringe Kloster. Ibid. N:o 138.

HORN AF RANTZIEN, H. 1950. Limnological Excursion to Lake Vitträsk, Runmarö, in the Stockholm Archipelago. July 13, 1950. — Seventh Int. Bot. Congress. Stockholm. Excursion guides. B 4.

— 1951. Macrophyte Vegetation in Lakes and Temporary Pools of the Alvar of Öland, South Sweden. I. The Alvar and its Amphibious Vegetation. — Svensk Bot. Tidskr. Bd 45. p. 72. Uppsala.

HUMMEL, D. 1877. Kartbladet Båstad. — Sverig. Geol. Undersökn. Ser. Aa. N:o 60. Stockholm.

HYLANDER, N. 1941. Förteckning över Skandinaviens växter utgiven av Lunds Bot. Förening. 1. Kärlväxter. 3:dje uppl. Lund.

HÅRD AV SEGERSTAD, F. 1924. Sydsvenska florans växtgeografiska huvudgrupper. Malmö.

JUDAY, C. and BIRGE, E. A. 1933. The Transparency, the Color and the Specific Conductance of the Lake Waters of Northeastern Wisconsin. — Transact. Wisc. Acad. Vol. XXVIII. Madison.

KARLSSON, V. 1879. Kartbladet Linderöd. — Sverig. Geol. Undersökn. Ser. Aa. N:o 68. Stockholm.

KELLEY, W. P. 1942. Modern clay researches in relation to agriculture. — Journ. Geol. Vol. L. Nr 3. p. 307. Chicago.

LEVRING, T. and HASSLOW, O. J. 1937. Förteckning över Skandinaviens växter utgiven av Lunds Bot. Förening. 3. Alger. 2:dra uppl. Lund.

LILLIEROTH, S. 1938. Die höhere Vegetation des Sees Lammen bei Aneboda. — K. Fysiogr. Sällsk. Handl. N.F. Bd 36. Nr 14. Lund.

— 1943. Om den recenta utbredningen av Najas flexilis och Potamogeton rutilus i Skåne. — Bot. Not. p. 151. Lund.

— 1950. Über Folgen kulturbedingter Wasserstandsenkungen für Makrophyten- und Planktongemeinschaften in seichten Seen des südschwedischen Oligotrophiegebietes. — Acta Limn. 3. Lund.

LINDSTRÖM, A. 1877. Kartbladet Hessleholm. — Sverig. Geol. Undersökn. Ser. Aa. N:o 61. Stockholm.

— 1898. Kartbladet Örkelljunga. — Ibid. N:o 114.

LINNAEUS, C. 1751. Skånska Resa. Stockholm.

LINNERMARK, N. 1942. Ringsjötraktens issjösystem och isavsmältning. — Medd. Lunds Geol.-Min. Inst. N:o 96. Lunds Geol. Fältklubb 1892—1942. Lund.

— 1945. Den skånska jorden och kulturlandskapet. — Medd. Lunds Univ. Geogr. Inst. N:o 227. Svensk Geogr. Årsb. Lund.

LOHAMMAR, G. 1938. Wasserchemie und höhere Vegetation schwedischer Seen. — Symb. Bot. Upsal. III: 1. Uppsala.

— 1940. Ricciocarpus natans' (L.) Corda nuvarande nordeuropeiska utbredning. — Svensk Bot. Tidskr. Bd 34, p. 464. Uppsala.

LUNDEGREN, A. 1934. Kristianstadsområdets kritbildningar. — Geol. För. Förh. Bd 56. p. 125. Stockholm.

LUNDEGÅRDH, H. 1950. Lärobok i växtfysiologi. Stockholm.

LUNDH, A. 1947. Chara stelligera Bauer åter funnen i Råbelövssjön och Levrasjön. — Bot. Not. p. 81. Lund.

— 1951. Some aspects of the higher aquatic vegetation in the lake Ringsjön in Scania. — Bot. Not. p. 22. Lund.

LUNDQVIST, G. 1925. Utvecklingshistoriska insjöstudier i Sydsverige. — Sverig. Geol. Undersökn. Ser. C. N:o 330. Stockholm.

— 1927. Bodenablagerungen und Entwicklungstypen der Seen. — Die Binnengewässer. Bd II. Stuttgart.

— 1936. Sjöarnas transparens, färg och areal. — Sverig. Geol. Undersökn. Ser. C. N:o 397. Stockholm.

— 1940. Zur Mikroskopie der Binnenseesedimente. — Verh. int. Ver. theor. angew. Limnol. Bd IX. p. 111. Stuttgart.

— 1942. Sjösediment och deras bildningsmiljö. — Sverig. Geol. Undersökn. Ser. C. N:o 446. Stockholm.

MARISTO, L. 1941. Die Seetypen Finnlands. — Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo. Tom. 15. N:o 5. Helsingfors.

MIGULA, W. 1897. Die Characeen Deutschlands, Oesterreichs und der Schweiz. — Rabenhorsts Kryptogamenflora von Deutschland, Oesterreichs und der Schweiz. — Zweite Aufl. Fünfter Band. Leipzig.

— 1925. Charophyta. — PASCHER, A. Süsswasserflora Deutschlands, Österreich und der Schweiz. Heft 11. Jena.

MOHRÉN, E. 1941. Eslövstraktens geologiska byggnad och utveckling. — Eslövs Sparbanks Minnesskrift. Eslöv.

MUNTHE, H. and others. 1920. Kartbladet Sövdeborg. — Sverig. Geol. Undersökn. Ser. Aa. N:o 142. Stockholm.
NATHORST, A. G. 1882. Kartbladet Kristianstad. — Ibid. N:o 85.
— 1885. Kartbladet Trolleholm. — Ibid. N:o 87.
NELSON, H. 1935. Skånes landformsområden. — Geografdagarna i Lund 1935. p. 3. Lund.
— 1945. Skåne. En geografisk skiss. — S.T.F. Resehandbok. p. 9. Stockholm.
NEUMAN, L. M. 1896. Studier öfver Skånes och Hallands Flora. III. — Bot. Not. p. 279. Lund.
NILSSON, O. 1900. Segeåns reglering. (Unpublished.) Lantmäterikontoret i Malmö.
NORDQVIST, H. 1937. Fiskeresultat från Börringeområdets sjöar. — Skrifter utg. av Södra Sveriges Fiskeriförening. N:o 1. Lund.
OLSEN, S. 1944. Danish Charophyta. — Kongel. Danske Vidensk. Selsk. Biol. Skr. Bind. III. Nr 1. Köpenhamn.
PEARSALL, W. H. 1921. The aquatic vegetation of the English Lakes. — Journ. Ecol. Vol. VIII. p. 163. Cambridge.
PERSSON, M. 1932. Morfologiska studier inom nordöstra Skånes sjöområde. — Svensk Geogr. Årsb. p. 7. Lund. French summary.
RUFELT, H. 1949. Om flora och vegetation i Stehags socken. — Bot. Not. p. 109. Lund.
SAHLSTRÖM, K. E. 1945. Sveriges lodade sjöar. — Sverig. Geol. Undersökn. Rapporter och meddelanden i stencil. Nr 2. Stockholm. (Stenciled.)
SAMUELSSON, G. 1925. Untersuchungen über die höhere Wasserflora von Dalarne. — Svenska Växtsociol. Sällsk. Handl. Bd IX. Uppsala.
— 1934. Die Verbreitung der höheren Wasserpflanzen in Nordeuropa. — Acta Phytogeogr. Suec. Bd VI. Uppsala.
SANDEGREN, R. 1941. Om den forna och nutida förekomsten av Najas flexilis i Sverige. — Bot. Not. p. 59. Lund.
SIMMONS, H. G. 1933. Några skånska växtlokaler. — Bot. Not. p. 349. Lund.
Skrivelse den 21 okt. 1949 till drätselkammaren från vattenverket angående åtgärder för tillgodoseendet av vattenbehovet i Hälsingborg under tiden 1955—1980. Hälsingborg. 1950.
SUNDELIN, U. 1922. Råbelövssjöns och Nosabykärrets senkvartära historia och de där gjorda stenåldersfynden. — Geol. För. Förh. Bd 44. p. 553. Stockholm.
THUNMARK, S. 1931. Der See Fiolen und seine Vegetation. — Acta Phytogeogr. Suec. Bd II. Uppsala.
— 1937. Über die regionale Limnologie von Südschweden. — Sverig. Geol. Undersökn. Ser. C. N:o 410. Stockholm.
— 1938. Om sjöarna i Långasjö socken i Kronobergs län. — Hembygdsboken Långasjö. Försök till en sockenbeskrivning. p. 1. Emmaboda.
— 1945. Zur Soziologie des Süsswasserplanktons. — Folia Limn. Scand. No. 3. Lund.
— 1948. Sjöar och myrar i Lenhovda socken. — Lenhovda. En värendssocken berättar. p. 665. Moheda.
— 1950. Om sjösänkningseffekter. (Preliminary manuscript.)
TRYBOM, F. 1893. Ringsjön i Malmöhus län, dess naturförhållanden och fiske. — Medd. Kongl. Landtbruksstyr. N:r 13. (N:r 4 år 1893.) Stockholm.
TULLBERG, S. A. 1882. Kartbladet Övedskloster. — Sverig. Geol. Undersökn. Ser. Aa N:o 86. Stockholm.

Utredning angående vattenförsörjningens ordnande för Hälsingborg och Landskrona. Bd 1—2. Hälsingborg. 1949.

WALDHEIM, S. 1947. Kleinmoosgesellschaften und Bodenverhältnisse in Schonen. — Bot. Not. Suppl. Vol. 1: 1. Lund.

WALLÉN, C. C. 1945. Klimatstudier i svenska sockerbetsdistrikt med särskild hänsyn till Skåne. — Socker. Vol. 1. No. 9. p. 209. Malmö. English summary.

WEIMARCK, H. 1940. Om floran i Sjöbotrakten. — Bot. Not. p. 173. Lund.

— 1942. Lokala kalkförekomster och näringsfordrande arters utbredning i trakten av Vittsjö och Bjärnum. — Svensk Geogr. Årsbok. p. 108. Lund.

— 1944. Flora och vegetation i Nävlingeåsområdet. — Bot. Not. p. 1. Lund.

WELCH, P. S. 1935. Limnology. New York and London.

WENNBERG, G. 1943. Eisströme über Schonen während der letzten Eiszeit. — K. Fysiogr. Sällsk. Handl. N.F. Bd 54. Nr 3. Lund.

— 1949. Differentialrörelser i inlandsisen. — Medd. Lunds Geol.-Min. Inst. N:r 114. Lund.

WENT, F. W. 1949. Ecology of desert plants. II. The effect of rain and temperature on germination and growth. — Ecology. Vol. 30. p. 1. Lancaster.

WENT, F. W. and WESTERGAARD, M. 1949. Ecology of desert plants. III. Development of plants in the Death Valley National Monument, California. — Ibid. Vol. 30. p. 26.

WIDEHOLT, G. 1948. Floran i Fjälkinge, Gustaf Adolf och Rinkaby socknar. — Bot. Not. p. 93. Lund.

ÅBERG, B. und RODHE, W. 1942. Über die Milieufaktoren in einigen südschwedischen Seen. — Symb. Bot. Upsal. V: 3. Uppsala.

ÅGREN, G. 1926. Skånes jordbruksområden. — Svensk Geogr. Årsb. p. 5. Lund.

Ångström, A. 1938. Lufttemperatur och temperaturanomaler i Sverige 1901—1930. — Medd. Stat. Metr.-Hydr. Anstalt. Bd 7. N:o 2. Stockholm.

Årsbok 28—30. 1947—49. I. Månadsöversikt över väderlek och vattentillgång. — Sverig. Meteorolog. o. Hydrolog. Inst. Stockholm.

— 28—29. 1948—49. II. Meteorologi. 1. Nederbörden i Sverige. (Precipitation in Sweden.) — Sverig. Meteorolog. o. Hydrolog. Inst. Stockholm.

II

ION DETERMINATIONS IN LAKE WATERS

BY

ARTUR ALMESTRAND

Introduction.

In connexion with the investigation of the aquatic vegetation in several lowland lakes in Scania performed by ASTA LUNDH (1951), the author on several occasions collected water samples both from the lakes and their tributaries in order to determine the concentrations of a number of common ions.

The main part of the analytical work was carried out in the summers of 1946 and 1947, but some supplementary analyses were made in the summer of 1948. As the investigation closely accompanied that performed by LUNDH in her study of the same lakes during the same periods the reader is referred to her description of the development of the investigation (LUNDH 1951 pp. 7 and 9).

The analyses were performed in 1946 in the laboratory of the purification plant for sewage of Lund at Källby, in 1947 at the soil laboratory of the Botanical Museum in Lund and in 1948 mainly at Källby.

The investigations have been partly financed by grants from the Royal Physiographical Society of Lund, The Royal Academy of Science of Sweden and the National Council for Research Work.

When the collecting of the samples was commenced in the spring of 1946, the aim of the investigation was to obtain information of the characteristic features of the concentrations of electrolytes in the waters of Scanian lakes and, moreover, to study whether there was any correlation between the concentrations of ions and the distribution of the higher aquatic plants. Naturally it is impossible, even if such a correlation were discovered, to discuss the growth requirements of the plants.

There are very few investigations on the water chemistry of Scanian lakes, but some authors have made determinations of the general limnological factors. Thus THUNMARK (1945 b) has published some determinations of colour, potassium permanganate-consumption, hydrogen ion concentration, total hardness and specific conductivity from Häckebergasjön. LILLIEROTH (1949 and 1950) has reported the same analyses

Table 1. Survey of the localities for the water samples.

Lake	Map Figure no. (in Lundh 1951)	Maximum number of localities	Name of the tributaries	Notation on the map.
1. Yddingen	9	3	—	1, 2, 3, 4
2. Fjällfotasjön	9	4	—	—
3. Börringesjön	9	4	—	—
4. Havgårdssjön	9	2	—	—
5. Björkesåkrasjön ..	14	2	—	—
6. Häckebergasjön ..	14	3	—	—
7. Svaneholmssjön ..	14	3	—	—
8. Krageholmssjön ..	16	3	Vistorpsbäcken	1
9. Ellestasjön	16	3	Ebbetorpsbäcken Snogarpsbäcken	2 3
10. Snogeholmssjön ..	16	3	Outflow from Ellestasjön Assmåsabäcken	4 5
11. Sövdeborgssjön ..	16	1	—	—
12. Sövdesjön	16	3	Outflow from Snogeholmssjön Fribultsbäcken	6 7
13. Heljesjön	21	1	—	—
14. Vombsjön	21	3	Täpperödsbäcken Övedsbäcken Björkaån	7 8 9
15. Krankesjön	21	5	Sjötorpsbäcken Silvåkrabäcken	5 6
16. Gyllebosjön	29	2	—	—
17. Tunbyholmssjön ..	29	2	—	—
18. Western Ringsjön	30	1	—	—
Eastern Ringsjön	30	1	—	—
19. Dagstorpssjön	33	1	—	—
20. Kvesarumssjön ...	35	2	—	—
21. Tjörnarpssjön ...	35	2	—	—
22. Bosarpssjön	35	2	—	—
23. Finjasjön	37	1	—	—
24. Araslövssjön	38	1	—	—
25. Hammarsjön	38	3	—	—
26. Råbelövssjön	39	3	Råbelövsbäcken Ekestadsbäcken Österlövsbäcken	1 2 3
27. Oppmannasjön ...	39	3	—	—
28. Levrasjön	50	3	—	—
29. Siesjön	50	2	—	—
30. Västersjön	51	3	—	—
31. Rösjön	51	3	Lärkesholmsån	1

from some lakes in the north-western part of the province but has added determinations of potassium, nitrogen and phosphate. ANDERSSON (1948) published some ion determinations from four Scanian lakes as a part of the present investigation.

More extensive ion determinations from Swedish lakes have been carried out by LOHAMMAR (1938) and his large material has subsequently been treated by IVERSEN and OLSEN (1943) and RODHE (1949). LOHAMMAR's investigation also included the lowland lakes of Uppland, the vegetation of which seems to be very similar to that of Scanian lakes. THUNMARK (1948) has published some results from lake investigations in Södermanland and Småland but of the ions only chloride is discussed. Very detailed studies on the concentrations of cations and sulphate and chloride have been performed by WITTING (1947, 1948 and 1949) in Swedish mire-waters.

In Denmark IVERSEN (1929) has published some studies on the relations between the hydrogen ion concentration and the occurrence of water plants. NYGAARD (1938) made rather close investigations on the hydrochemistry of Danish ponds and lakes, also including the seasonal variations in the contents of nitrogen and phosphorus but he did not discuss the plants. OLSEN (1950 a and b) has recently carried out an investigation in order to find correlations between some ions and the distribution of water plants and divided them into groups according to the concentrations of ions.

This paper is not intended to give a comprehensive solution of the problem of the relationships between ion content and the distribution of plants, nor a limnological classification of the lakes, but to contribute to the always actual discussion of the causes of the differences between the vegetation of various lakes. Very often the total content of electrolytes, *i.e.*, the specific conductivity is regarded as a measure of the nutrients, in spite of the fact that the proportions of the components can vary considerably in different cases. It has been impossible to publish the whole extensive material, which contains about 4800 determinations from lake waters and 1500 values from waters from tributaries, and only surveys are given here. Naturally this material can be treated in many other ways than has been done here and there are also many examples in the literature of a much smaller material which has been studied more closely and from which more far-reaching conclusions have been drawn.

General remarks.

As the lakes studied here are the same as those which have been discussed by LUNDH (1951), no general descriptions or maps of the lakes are given in this report. Such information is to be found in her work, where also the localities for the collecting of the water samples are given for both the lakes and the tributaries. Moreover the hydro-

Table 2. Survey of the number of the water analyses of the investigated lakes.

Lake	1946	1947	1948	Total
1. Yddingen	12	8	2	22
2. Fjällfotasjön	6	8	2	16
3. Börringesjön	8	8	2	18
4. Havgårdssjön	2	4	2	8
5. Björkesåkrasjön	—	4	—	4
6. Häckebergasjön	—	3	1	4
7. Svaneholmssjön	1	4	2	7
8. Krageholmssjön	4	6	2	12
9. Ellastasjön	4	6	2	12
10. Snogeholmssjön	6	6	2	14
11. Sövdeborgssjön	—	1	2	3
12. Sövdesjön	6	6	2	14
13. Heljesjön	—	2	2	4
14. Vombsjön	11	7	3	21
15. Krankesjön	15	6	2	23
16. Gyllebosjön	—	4	2	6
17. Tunbyholmssjön	—	4	2	6
18. Western Ringsjön	—	2	1	3
Eastern Ringsjön	—	1	1	2
19. Dagstorpssjön	—	1	2	3
20. Kvesarumssjön	—	2	2	4
21. Tjörnarpssjön	—	2	2	4
22. Bosarpssjön	—	2	2	4
23. Finjasjön	—	—	1	1
24. Araslövssjön	1	—	—	1
25. Hammarsjön	1	2	—	3
26. Råbelövssjön	20	—	1	21
27. Oppmannasjön	—	4	3	7
28. Levrasjön	2	6	2	10
29. Siesjön	—	4	2	6
30. Västersjön	—	5	3	8
31. Rösjön	—	5	3	8

Table 3. Survey of the number of water analyses from the tributaries.

Tributary	Corresponding lake	No. on the map	Map fig. no.	1946	1947	1948	Total
Brook 1	Yddingen	1	9	4	1	—	5
Brook 2	»	2	9	3	—	—	3
Brook 3	»	3	9	1	—	—	1
Brook 4	»	4	9	3	1	4	4
Vistorpsbäcken	Krageholmssjön	1	16	3	1	—	4
Ebbetorpsbäcken	Ellestasjön	2	16	2	1	—	3
Snogarpsbäcken	»	3	16	2	—	—	2
Outflow from Ellestasjön	Snogeholmssjön	4	16	3	2	—	5
Assmåsabäcken	»	5	16	3	1	—	4
Outflow from Sövdeborgssjön	Sövdesjön	6	16	2	—	—	2
Frihultsbäcken	»	7	16	2	1	—	3
Täpperödsbäcken	Vombsjön	7	21	4	1	—	5
Övedsbäcken	»	8	21	4	1	—	5
Björkaån	»	9	21	4	2	—	6
Sjötorpsbäcken	Krankesjön	5	21	3	1	—	4
Silvåkrabäcken	»	6	21	4	1	—	5
Råbelövsbäcken	Råbelövssjön	1	39	7	—	—	7
Ekestadsbäcken	»	2	39	7	—	—	7
Österslövsbäcken	»	3	39	7	—	—	7
Lärkesholmsån	Rösjön	1	51	—	1	—	1

logical conditions of the years of the investigation are not discussed here (*cf.* LUNDH 1951 p. 30 *et seq.*).

Naturally the localities in the lakes have not always had exactly the same position, nor has the same number of samples been collected at all visits to the lakes. The localities in the outflows and in the tributaries have always had the same position.

Table 1 is a survey of all stations for sample collecting. Altogether 31 lakes have been studied. The number of stations has varied from one to five according to the area of the lake.

Table 2 gives a survey of the total number of analyses series from the lakes for the different years of the investigation and thus shows its development.

Table 3 illustrates the number of analyses from the tributaries. As is evident the number was greater in 1946 than in 1947, because most of the brooks were completely dried up in the summer of 1947, a year very deficient in precipitation (*cf.* LUNDH 1951 p. 35).

Methods.

The water samples were collected in the surface water down to 0.5 m. Common one litre bottles with cork stoppers were employed. Samples for determinations of oxygen and carbon dioxide were collected in bottles with glass stoppers but these analyses will not be discussed here.

For most of the chemical analyses the methods described in »Anvisningar för Bakteriologiska och Fysikalisk-kemiska Vattenanalyser» have been used and references are given below to this publication. As this book is written in Swedish and the author has made some modifications of the methods brief summaries are given below.

Hydrogen ion concentration. The pH was determined in some analyses in the spring of 1946 colorimetrically by using a Hellige comparator and phenol red, pH range 6.8—8.4, as the indicator. Generally, however, the determinations were made by a Radiometer potentiometer. The pH was always determined the same day as the samples were collected and as soon as possible thereafter. Some experiments employing a portable pH-meter in field failed as the apparatus did not stand the transportation on a motor cycle.

Potassium permanganate-consumption, mg. $KMnO_4$ per litre. The analysis was made in the following manner. To 100 ml. of the water sample 1 ml. of concentrated H_2SO_4 and 10 ml. of 0.1 N $KMnO_4$-solution were added in a wide test tube. This was then placed in a water bath for 20 minutes and then 10 ml. of 0.1 N $Na_2C_2O_4$-solution were added and the $KMnO_4$-consumption was determined by titration with 0.1 N $KMnO_4$-solution.

Specific (electrical) conductivity ($\varkappa_{18} \cdot 10^6$) was determined by a conductivity apparatus, made by Trüb Täuber & Co, Zürich and a dip electrode, type Philips, with a cell constant of about 0.66. The electrode was kept in 96 per cent alcohol.

Total solids, mg. per litre. 100 or 200 ml. of a thoroughly shaken sample were evaporated to dryness on a water bath in a tared crucible of porcelain (platinum or quarz crucibles were not available). Since the amount of total solids in waters rich in plankton generally could be regarded as large, in such cases only 100 ml. were used. After evaporating the crucibles were dried at 100 to 105 °C for three hours. The increase in weight was taken as the total solids.

Non-volatile solids, mg. per litre. The dried residue from the preceding analysis was ignited in an electric oven at 600 to 650 °C. The difference in weight between the crucible after ignition and the empty crucible is the non-volatile solids.

Total hardness, German degrees, °DH, was determined by titration with a soap solution according to KLUT (1927 pp. 111 to 113).

Calcium, mg. per litre. The method is given on pp. 68 to 69. Calcium was precipitated with ammonium oxalate, and after dissolving the precipitate in sulphuric acid, the free oxalic acid was titrated with 0.05 N $KMnO_4$-solution. Generally 250 ml. of water were used for these analyses.

Magnesium, mg. per litre, was determined by the method given on pp. 69 to 70, in the filtrate from the calcium analysis when the calcium oxalate was separated. Magnesium was precipitated with ammonium phosphate and then determined gravimetrically in the ignited precipitate. The values are rounded off to 0.5 mg. per litre.

Iron, mg. per litre. During 1946 iron was determined by the method given on pp. 70 to 71, by colouring with potassium thiocyanate and colorimetric determination. From 1947 the analyses were performed according to SAYWELL and CUNNINGHAM (1937) with o-phenantroline. 100 ml. of water were evaporated to dryness and then the residue was dissolved in hydrochloric acid. After addition of hydroxylamine and o-phenantroline the colour was measured in a photocolorimeter.

Potassium, mg. per litre. The determinations were performed by Lantbrukskemiska Kontrollstationen in Kristianstad by using a flame photometer after the precipitation of the calcium by a mixture of sal-ammoniac and oxalic acid.

Chlorides, mg. per litre, were determined according to the method given on pp. 78 and 79 by titration according to MOHR with a silver nitrate solution, of which one ml. corresponded to one mg. chlorine. In the calculations the results have been corrected for the quantities of silver nitrate necessary to colour the potassium chromate according to OHLMÜLLER-SPITTA (1931 p. 70).

Sulphate, mg. per litre. The method is to be found on pp. 79 and

80. The sample volume was generally 250 ml. After precipitation with barium chloride the determinations were made gravimetrically.

N i t r a t e, mg. per litre. In 1946 the method including colour development with brucine sulphate, given on pp. 80 to 82 was used, but it proved to be somewhat unsatisfactory. From 1947 the analyses were performed according to the method with phenole disulphonic acid, *cf.* BURSTRÖM (1942). 100 or 200 ml. of water were evaporated to dryness after the addition of potassium hydroxide. The residue was treated with hydrogen peroxide and the phenol disulphonic acid and ammonia were added. The colour was measured in a photocolorimeter.

S i l i c o n d i o x i d e, mg. per litre, in water soluble silica, was determined according to WERESCAGIN (1931 p. 183). The colorimetric determination was made in a common Lunzer colorimeter with tubes of 30 cm. in height.

P h o s p o r u s, γ P per litre. Some results from 1946 obtained with the method given by LOHAMMAR (1938) seemed to be unsatisfactory, as the blue colour was not stable and therefore they are not included here. From the autumn of 1946 the method of SCHEEL (1936) has been used. 500 ml. of water were evaporated to dryness and then the residue oxidized with hydrogen peroxide in order to destroy organic material. In some cases it proved to be necessary to remove silica by evaporation with hydrochloric acid. The developed colour was determined in a photocolorimeter and the experiments were carried out by the Lantbrukskemiska Kontrollstationen in Kristianstad.

B i c a r b o n a t e, mg. HCO_3 per litre, was determined according to the method given on p. 78 by titration with hydrochloric acid and methyl orange as the indicator.

C o l o u r, given as mg. Pt per litre, was determined according to the method given on p. 58, which is the general method given by HAZEN (1892). A Lunzer colorimeter with 30 cm. tubes was employed.

Results.

A survey of all analyses from the lakes is given in table 4 and from all tributaries in table 5. The discussion below is mainly founded upon these surveys. Both maximum and minimum values and the averages are presented. In those cases where only one determination has been made it is given as the average.

Hydrogen ion concentration. Since the variation of the pH due to the photosynthesis of the plankton organisms is affected by *e.g.*, weather and plankton content, no averages have been calculated. The method given by IVERSEN (1929) for determining the maximal pH variation of a water has not been employed, but since the determinations have been carried out on various occasions, it is likely that the extreme values are also represented. The pH in all lakes lay above the neutral point, with a few exceptions as regards Västersjön and Rösjön. It is apparent that the pH varies in about the same manner in all the lakes, even if the general electrolyte content is different as well as the vegetation. Any significant differences did not seem to occur. Thus it is impossible to establish a correlation between pH and the qualitative composition of the lake vegetation as has been made by IVERSEN (1929) for some waters in Denmark. In spite of the fact that the vegetation of such lakes in Scania as for example Yddingen and Rösjön has entirely different character, the reactions of the waters are rather similar. This seems to indicate that a factor other than pH regulates the distribution of the plants.

Potassium permanganate-consumption. The $KMnO_4$-consumption is commonly employed for the estimation of the content of such factors as humus, organic substances in plankton, detritus and so on. It generally varies in such a manner that brown and turbid lakes have a relatively large consumption, for example Börringesjön and Krankesjön, while lakes with transparent, uncoloured water have low values, for example Heljesjön and Levrasjön. No apparent correlation between the qualitative composition of the vegetation and the $KMnO_4$-consumption naturally can be found. In turbid lakes, however, the quantitative development of the vegetation seems to be less than in transparent lakes, a fact already observed by IVERSEN (1929). Thus Levrasjön and Heljesjön have a very rich bottom vegetation. This also holds true for Råbelövssjön and Western Ringsjön. Turbid lakes on the other hand, for example Fjällfotasjön and Börringesjön, have very insignificant submerged vegetation. No determinations of the light intensities on the bottoms have been performed by the author, but ÅBERG and RODHE (1942) established a high extinction in the lake Växjösjön, which probably has the same richness in plankton as the most plankton-rich Scanian lakes, *e.g.*, Vombsjön and Sövdesjön. These authors, however, have not studied the distribution of plants in relation to light.

In connexion with the $KMnO_4$-consumption the water colour will also be discussed. Levrasjön has the least colour of all the lakes, not exceeding 8 mg. Pt per litre, followed by Havgårdssjön, Heljesjön, Gyllebosjön and Råbelövssjön, all with richly developed bottom vegetation. On the other hand, the brownest waters are to be found in Fjällfotasjön, Kvesarumssjön, Tjörnarpssjön and Araslövssjön. These conditions are related to the supply of water to the lakes (*cf.* LUNDH 1951). The remaining lakes are more or less randomly distributed between these two groups. It is apparent that all combinations between the salt concentration and the humus content can exist. On the whole it is possible just by measuring the lake colour (*cf.* LUNDH 1951, table 3 p. 24) to obtain an idea of the relative content of humus, even if there are exceptions.

Specific conductivity. This factor is used as a measure of the total salt content and in limnological literature it is very often regarded as identical with the content of nutrients. As already mentioned it is a very complex property which is not as significant as is generally considered. In the lakes studied here the conductivity of the hydrogen ions might be disregarded as the pH is above 7. According to RODHE (1949) the following ions mainly constitute the specific conductivity in lake waters: Ca, Mg, Na, K, Cl, SO_4 and HCO_3.

A survey of the values is given in the diagram in figure 1, which shows that if the lakes are arranged according to increasing specific conductivity a relative smooth curve is obtained from Västersjön to Yddingen. According to this curve the lakes cannot be divided in well delimited classes as far as this factor is concerned. The main part of the lakes had a specific conductivity between 200 and 300. Only four exceeded this value and those are situated on the southwestern plain and the Kristian-

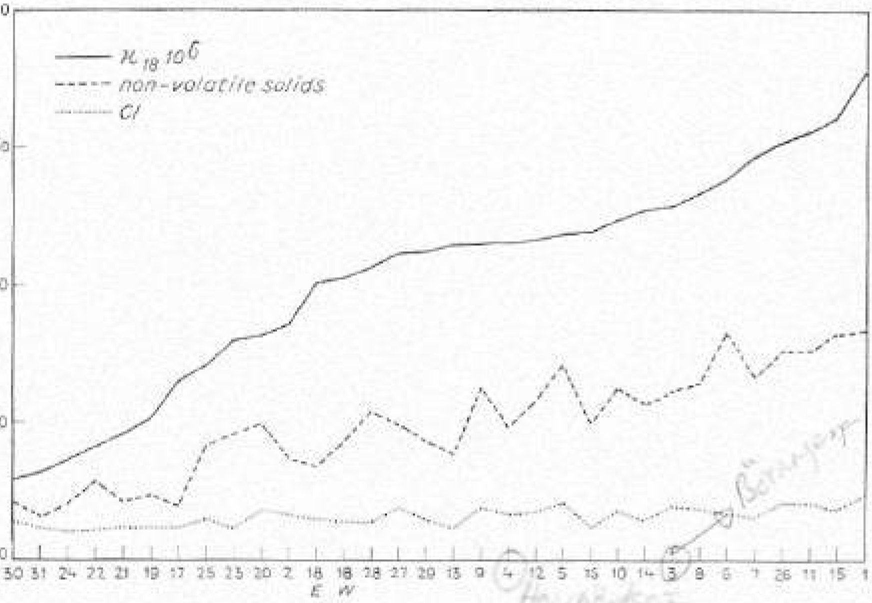

Fig. 1. The variation of the specific conductivity, non-volatile solids (mg. per litre) and chloride (mg. per litre) in the lakes arranged according to increasing specific conductivity. The lakes are represented by number (cf. table 1) instead of names.

stad plain. The remaining lowland lakes belonged to the group 200 to 300. The group between 100 and 200 contained two lakes on the ridge Linderödsåsen (Dagstorpssjön and Kvesarumssjön), Tunbyholmssjön, Fjällfotasjön and Hammarsjön. The group below 100 included two lakes on Linderödsåsen (Tjörnarpssjön and Bosarpssjön), Araslövssjön, Västersjön and Rösjön. The two last-mentioned have apparently abberant vegetation in comparison to all the remaining lakes. The lake Araslövssjön is supplied with water from the Småländska Högland and thus is relatively deficient in electrolytes (*cf*. ÅBERG and RODHE 1942).

Total solids. The content of total solids is likewise a complex factor, which contains *i.a.* salts, clay particles, dry substances from algae and humic substances. Thus it differs in many ways according to the local variations of these factors.

Non-volatile solids. The amount of non-volatile solids followed in general features the specific conductivity, but it deviated somewhat, depending upon, for example, the content of clay particles.

In the studies of the cations there is a gap in the analyses as no determinations of sodium have been performed at all, because this ion is not regarded as an essential nutrient. However, this ion naturally may be present in relatively large quantities (*cf.* LOHAMMAR's analyses from the lowland lakes in Uppland, 1938).

Calcium and bicarbonate. Figure 2 illustrates the variations in the calcium and bicarbonate contents in the lakes, which are arranged in the same order as in figure 1. It is very apparent that these qualities vary in the same manner as the specific conductivity, and that these two ions are quantitatively predominating. The amount of calcium was generally equivalent to that of HCO_3 (figure 2). The quotient $\frac{Ca}{HCO_3}$ varies mostly between 0.7 and 1.3. Some marked exceptions were found in Tjörnarpssjön and Araslövssjön with 0.5 and Hammarsjön, Västersjön and Rösjön with about 2. Probably the aberrations were partly due to the fact that the method for determinations is not quite accurate for small quantities of HCO_3 (*cf.* STEEMANN-NIELSEN 1944).

As regards the calcium content of different lakes it may be noted that Vombsjön and Krankesjön, which are situated in sandy areas with acid leached grounds were rich in calcium. Gyllebosjön, which lies in a district generally regarded as deficient in this substance, had also a high concentration. The same held true for Kvesarumssjön, which in comparison to the other lakes on Linderödsåsen was rich in calcium.

Magnesium. Compared with calcium the quantities of magnesium and also of potassium are small. The former varies between 9.5 (Yddingen) and 1.0 (Araslövssjön). Thus the concentration was highest in the real lowland lakes and lowest in the water from the Småländska Högland.

Iron. This element showed an irregular variation both within a lake and between different lakes. The most prominent aberrations were found between Araslövssjön-Hammarsjön and the remaining lakes, thus demonstrating a difference between the lakes. The same was also applicable to a certain extent as regards magnesium, but here Hammarsjön was richer.

Potassium. The variation was comparatively slight between 1.1 and 6.0 mg. per litre. As regards the soils surrounding the lakes LUNDH (1951) has found that no regional differences can be established. It seems to be very striking that Heljesjön, which according to the usual terminology must be regarded as a typical eutrophic lake, had an average potassium content of only 1.5 mg. per litre, which is about the same concentration as that of Västersjön and Rösjön, both with a divergent vegetation.

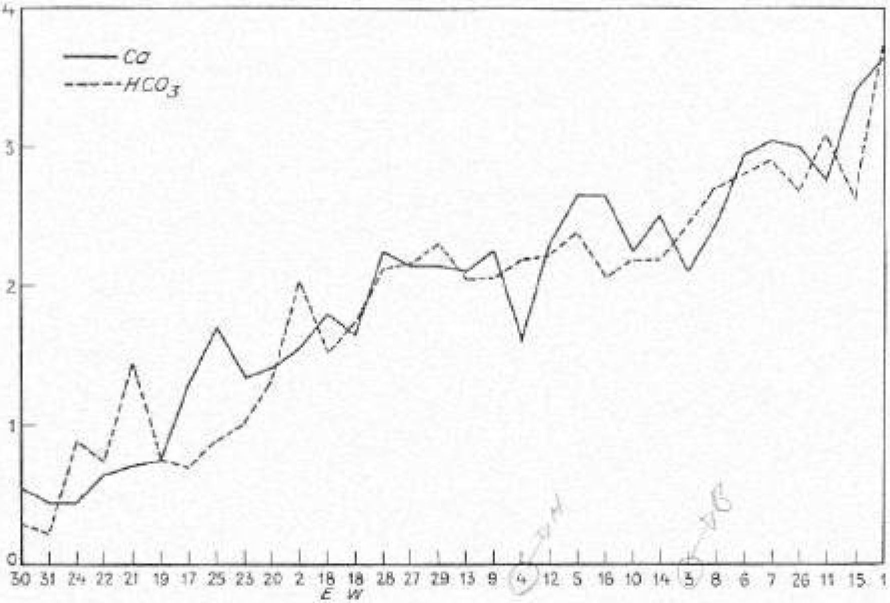

Fig. 2. The variation of calcium and bicarbonate (mEq. per litre) in the lakes arranged according to increasing specific conductivity.

Chloride. The chloride generally follows the variation of the specific conductivity. The quotient of the lakes richest and those poorest in this element is about 2. No lake showed such a high content as has been found in the polluted Scanian rivers (*cf.* ANDERSSON and LUNDH, 1948), which is due to the fact that the degree of contamination by sewage is lower in the lakes. THUNMARK's investigations in the so-called nutrient-rich lakes in Södermanland established that these lakes have the same chloride content as the lakes on Linderödsåsen and somewhat lower values than Västersjön and Rösjön on Hallandsåsen, though containing a vegetation of the same species as the pronounced Scanian lowland lakes. Perhaps the Scanian lakes have throughout a higher concentration of chloride because of their situation near the Swedish west-coast. Such a relation has been observed by WITTING (1948) in mire-waters as regards sodium and magnesium. The lakes in Uppland richest in chlorides had about the same concentrations as the richest lakes in Scania, probably due to their position in areas previously transgressed by the sea.

Sulphate. Among the anions this ion showed the most apparent variation in addition to bicarbonate. The concentration was highest in the most typical lakes on the plains with the highest specific conductivity, namely Yddingen, Krankesjön and Råbelövssjön, but also Vombsjön and Gyllebosjön were included in this group with average concentrations varying between 37 and 44 mg. per litre. The content was lowest in Araslövssjön, Västersjön and Rösjön, which, as already mentioned, have a deviating vegetation. Sövdeborgssjön is uncertain as only one determination is available.

Nitrate. The nitrate concentration was low in comparison to the anions mentioned hitherto. Sometimes in spring, however, higher values have been found, perhaps due to effects from manuring the fields in winter and spring (*cf.* Yddingen, Börringesjön, Snogeholmssjön and Vombsjön). High values have also been found in spring in Ringsjön (according to a private communication from civil engineer ERIC BENGTSSON, Hälsingborg). During the summer the nitrate content does not generally exceed 1 mg. per litre and no significant differences seem to prevail.

Silicic acid. The concentration of soluble silicic acid was also relatively low and of about the same order of magnitude in all the lakes.

Phosphorus. Unfortunately comparatively few values are available and they often showed a strong variation even in the same lake. In the autumn of 1947 with an extremely low water-level prevailing, the phosphorus content in all the lakes was high, perhaps depending upon a leaching from the sediments near the shore and a concentration by evaporation of water. From the mean values it is impossible to obtain a clear picture of the variation in the phosphorus content in the different lakes. It seems, however, as if the most salt-rich lakes have the highest concentration, even if there are exceptions.

Lake	1. Yddingen	2. Fjällfotasjön	3. Börringesjön	4. Havgårdssjön	5. Björkesåkrasjön	6. Häckebergasjön	7. Svaneholmssjön	8. Krageholmssjön	9. Ellestasjön	10. Snogeholmssjön	11. Sövdeborgssjön
Number of analyses	22	16	18	8	4	4	7	12	12	14	3
pH	7.7—8.7	7.4—9.2	7.5—8.8	8.0—8.6	8.2—8.8	7.6—8.3	7.6—8.9	7.6—8.8	7.7—9.2	7.7—9.3	7.9—8.3
$KMnO_4$	98—164	147—234	87—204	42—204	139—149	111—145	89—117	49—88	79—135	78—122	54—95
	119	179	132	109	145	123	100	66	92	100	71
$\varkappa_{18} \cdot 10^6$	214—438	152—197	217—357	208—251	228—242	246—288	282—313	241—304	171—303	214—296	308—316
	355	171	257	230	237	277	294	266	230	247	311
Total solids	264—357	165—261	212—328	145—269	215—247	223—256	193—285	199—268	204—297	216—273	119—243
	317	201	242	187	232	241	245	232	236	234	181
Non-volatile solids	123—191	65—95	95—184	95—101	99—204	102—219	111—154	101—180	96—166	97—177	
	166	74	123	97	144	167	133	128	126	125	152
Total hardness °DH	6.7—12.9	3.5—5.9	3.7—9.0	3.4—7.3	6.5—7.4	5.9—10.2	6.8—9.6	5.6—10.9	4.0—8.7	5.6—9.6	6.3—8.0
	10.9	4.5	7.2	5.7	7.0	8.0	8.4	8.1	6.9	7.1	6.9
Ca	66—83	26—36	20—58	20—45	44—62	54—67	46—72	40—57	27—78	37—58	36—66
	73	31	43	32	53	59	61	49	45	45	55
Mg	4.0—9.5	3.5—5.5	1.0—8.5	4.5—8.0		2.5—4.0	4.0—5.5	2.5—6.0	1.5—6.0	3.5—6.0	
	7.5	4.8	6.0	6.8	4.5	3.2	4.6	4.9	4.7	5.0	2.5
Fe	0.0—0.37	0.0—0.50	0.0—0.73	0.0—0.16	0.01—0.60	0.25—0.92	0.0—0.40	0.0—0.37	0.0—0.26	0.0—0.35	0.10—0.17
	0.09	0.20	0.15		0.31	0.47		0.05	0.06	0.08	0.14
K	5.0—6.0	3.7—5.0	4.6—7.0	3.0—4.3	3.3—3.9	3.4—3.8	2.1—3.9	2.9—5.3	3.4—4.7	3.3—5.6	2.6—2.9
	5.5	4.4	5.2	3.7	3.7	3.6	3.2	4.2	4.3	4.4	2.8
Cl	17—31	14—22	17—24	13—18	19—25	16—19	13—20	15—26	15—22	15—23	21—22
	24	17	20	17	21	17	16	19	19	18	21
SO_4	37—67	14—34	18—38	10—22	15—17	11—41	17—25	24—38	23—44	20—33	
	44	19	25	15	16	20	20	29	30	24	7
NO_3	<1—6.0	0.3—1.7	trace—4.7	0.2—0.9	0.0—0.3	0.0—0.7	0.0—0.5	0.1—0.4	0.2—1.2	0.3—5.5	0.2—0.4
					0.2	0.4					0.3
SiO_2	0.1—3.6	0.1—1.6	0.0—3.8	0.0—3.4	1.2—3.2	0.2—2.6	0.2—4.2	0.0—4.0	0.0—3.4	0.0—3.2	0.1—2.2
	1.1	0.7	0.8	1.2	2.2	1.2	1.7	1.6	1.1	1.4	1.2
Soluble P	8—280	16—320	10—226	20—268	130—198	92—240	20—320	10—220	8—136	16—130	
	76	112	84		152	117	139	73	60	60	160
HCO_3	165—477	71—215	122—171	110—153	140—149	154—184	159—201	141—249	85—146	110—149	184—194
	227	124	149	132	145	171	177	165	125	133	188
Colour	30—80	60—160	28—68	10—30	50—80	50—65	30—50	18—35	30—63	16—97	16—22
	52	91	42	18	63	59	43	27	45	54	19

Table 4. Continued.

Lake	12. Sövdesjön	13. Heljesjön	14. Vombsjön	15. Krankesjön	16. Gyllebosjön	17. Tunbyholmssjön	18. Western Ringsjön	Eastern Ringsjön	19. Dagstorpssjön	20. Kvesarumssjön	21. Tjörnarpssjön
Number of analyses	14	4	21	23	6	6	3	2	3	4	4
pH	7.7—9.2	8.0—8.6	8.1—8.9	7.7—8.6	7.7—8.8	7.1—7.9	7.8—8.6	7.8—8.4	7.1—7.9	7.5—8.6	7.4—7.9
$KMnO_4$	67—120 89	23—59 40	40—105 55	61—104 82	32—57 49	41—82 66	40—50 45	48	60—63 62	95—139 125	74—177 123
$\varkappa_{18} \cdot 10^6$	196—282 233	170—288 229	221—298 254	266—388 322	206—275 238	102—165 131	202—207 205	202	95—110 103	152—182 163	85—102 91
Total solids	124—328 224	65—191 140	131—268 210	128—326 272	76—201 171	48—123 99	138—173 156	134	91	189	95—96 96
Non-volatile solids	52—173 116	30—108 78	20—167 114	131—209 164	46—140 99	31—49 40	68—103 86	68	48	96—101 99	36—49 43
Total hardness °DH	5.6—14.8 7.9	5.2—7.0 6.0	4.8—9.0 7.5	7.1—11.7 9.8	6.2—7.4 6.9	1.6—4.0 3.0	3.9—5.8 4.6	3.8	1.6—2.7 2.1	3.0—4.3 3.5	1.4—4.0 2.7
Ca	32—53 46	39—46 42	40—57 50	56—78 68	50—57 53	21—34 26	31—36 33	34—38 36	14—16 15	27—28 28	13—14 14
Mg	2.5—5.0 4.5	2.5—4.0 3.0	2.0—6.5 4.9	4.0—8.0 5.6	2.0—5.0 3.1	1.5—3.0 2.4	2.5	2.5	2.0—3.0 2.5	3.5—4.5 4.1	1.5—2.5 2.3
Fe	0.0—0.29 0.07	0.0—0.11 0.06	0.0—1.0	0.0—0.33	0.03—0.12 0.08	0.0—0.45 0.19	0.08—0.11 0.09	0.08—0.11 0.10	0.10—0.17 0.13	0.09—0.72 0.44	0.14—0.25 0.22
K	3.2—5.0 4.1	0.9—2.0 1.5	3.4—4.7 4.0	2.9—5.8 4.2	1.4—2.6 1.9	0.9—2.1 1.6	3.0—3.9 3.5	2.9—3.2 3.1	1.4—2.3 1.8	2.3—2.7 2.5	1.2—1.9 1.6
Cl	17—20 18	10—13 12	13—16 15	16—21 19	9—15 12	11—14 12	13—14 14	14—15 15	11—13 12	16—19 18	11—13 12
SO_4	19—32 26	19—21 20	31—66 41	30—82 48	31—53 37	11—37 21	17—37 27	35	12—17 15	21—31 27	11—17 13
NO_3	0.1—2.5	0.2—0.4 0.3	0.1—1.7	0.2—8.5	0.0—0.2	trace—0.1	<0.1—0.2	0.1—0.2 0.2	0.2—2.2 1.3	0.3—1.6 1.1	0.3—1.3 1.0
SiO_2	0.0—4.0 1.5	0.1—2.8 1.3	0.4—4.2 1.5	0.0—0.6 0.4	0.3—2.4 1.1	0.3—1.8 0.9	3.8	—	0.6—2.2 1.5	0.5—3.6 1.6	0.4—1.2 1.0
Soluble P	18—140 65	12—92 52	12—156 45	14—65 30	10—280	12—280	140	—	100	126—136 131	82—92 87
HCO_3	116—149 135	104—153 124	110—159 133	139—192 159	116—134 126	35—46 42	92—116 106	92	43—49 45	73—85 82	37—49 44

Lake	22. Bosarpssjön	23. Finjasjön	24. Araslövssjön	25. Hammarsjön	26. Råbelövssjön	27. Oppmannasjön	28. Levrasjön	29. Siesjön	30. Västersjön	31. Rösjön
Number of analyses	4	1	1	3	21	7	10	6	8	8
pH	7.1—8.1	8.8	7.1	7.2—7.8	7.0—8.5	8.1—9.5	8.0—8.7	7.0—8.4	6.9—8.7	7.0—8.5
$KMnO_4$	67—164			99—108	28—55	41—138	20—36	46—65	42—60	43—87
	129	51	95	103	45	83	28	57	52	63
$\varkappa_{18} \cdot 10^6$	78—91			119—164	264—354	146—252	192—228	195—247	54—66	57—69
	82	160	72	142	304	223	213	224	59	64
Total solids	92—279			124—170	209—266	177—277	154—259	174—186	60—169	58—71
	186	169	98	144	241	195	179	179	81	65
Non-volatile solids	57—59			53—128	121—196	75—112	86—139	85—88	18—108	20—52
	58	—	41	84	152	99	108	87	42	32
Total hardness °DH	1.4—3.2			1.7—4.4	8.1—10.8	4.0—7.0	4.7—7.6	4.6—7.1	0.6—1.4	0.7—2.0
	2.0	2.7	1.7	3.0	9.6	5.6	6.2	6.3	1.2	1.5
Ca	12—14			25—62	44—68	27—50	35—56	38—49	6—21	7—14
	13	27	8.7	34	60	43	45	43	11	9
Mg	1.5—2.5				1.0—6.5	4.0—5.0	2.5—4.0	2.5—9.0	2.5—3.0	1.5—3.0
	2.0	3.5	1.0	3.7	4.0	4.7	3.0	4.1	2.6	2.7
Fe	0.08—0.65			trace—1.2	0.0—0.16	0.04—0.20	0.0—0.17	0.05—0.31	0.0—0.38	0.0—0.55
	0.33	0.15	1.0		0.02	0.12	0.04	0.17	0.15	0.19
K	1.5—1.9			2.2—2.6	3.2—6.4	1.5—4.0	4.7—5.9	2.0—2.5	1.1—1.7	1.1—1.4
	1.7	2.5	2.3	2.4	5.4	3.1	5.3	2.2	1.4	1.3
Cl	10—11			14—17	19—24	16—21	11—16	13—17	13—18	11—13
	11	12	10	15	21	19	14	15	14	12
SO_4	10—15			14—27	34—44	15—23	15—30	14—34	7—9	5—12
	13	25	11	20	39	20	20	20	8	9
NO_3	0.2—1.5			trace—1.0	trace—1.5	0.2—0.9	0.1—0.2	0.2—1.8	0.2—0.6	0.0—0.7
	1.0	0.7	2.0			0.7	0.2	0.5	0.2	0.3
SiO_2	0.4—1.2				0.2—1.3	0.4—3.0	0.2—1.8	0.4—2.2		
	0.9	0.6	0.4	1.2	0.7	1.1	0.8	1.2	—	—
Soluble P	32—64			90—280	16—400	12—28	14—62	18—178	62—118	80—138
	48	—	55	203	100	17	27		91	100
HCO_3	37—61			45—73	146—185	85—140	116—146	128—159	17—20	14—30
	45	61	54	54	162	131	129	140	18	20
Colour	41—90			40—100	7—28	10—36	4—8	24—40	25—70	25—65
	66	40	180	68	19	18	6	28	53	47

Table 5. Survey of the water analyses of the tributaries.

Name of the tributary	—	—	—	—	Vistorps-bäcken	Ebbetorps-bäcken	Snogarps-bäcken	Outflow from Ellestasjön	Assmåsa-bäcken	Outflow from Snogeholms-sjön
Lake	Yddingen	Yddingen	Yddingen	Yddingen	Krage-holmssjön	Ellestasjön	Ellestasjön	Snogeholms-sjön	Snogeholms-sjön	Sövdesjön
No. on the map in LUNDH (1951)	1	2	3	4	1	2	3	4	5	6
Fig. in LUNDH (1951)	9	9	9	9	16	16	16	16	16	16
Number of analyses	5	3	1	4	4	3	2	5	4	2
pH	6.9—7.6	7.3—7.8	7.5	7.4—7.8	7.9—8.5	8.1—8.2	7.7	7.5—8.1	7.3—7.6	7.3
$KMnO_4$	85—234	103—157		132—173	33—72	34—60	120—146	74—110	98—171	88—101
	158	132	129	156	56	47	133	98	152	95
$\varkappa_{18} \cdot 10^6$	545—635	463—505		490—595	366—473	346—414	421—473	240—293	251—350	269—302
	582	490	522	527	408	389	447	265	306	286
Total solids	413—630	383—437		433—508	291—400	259—381	251—417	215—255	277—340	245—258
	513	406	401	466	347	334	334	234	313	252
Non-volatile solids ..	162—338	195—219		205—358	173—299	142—303	84—215	112—157	131—230	104—131
	259	209	199	260	229	231	150	134	190	118
Total hardness °DH	15.7—22.9	15.3—17.0		14.8—18.5	10.1—16.7	10.4—13.9	13.6—16.3	6.5—16.0	8.4—17.0	9.0—10.2
	18.2	16.1	14.7	16.8	13.4	12.7	15.0	9.7	11.3	9.6
Ca	53—142	51—100		100—122	75—99	66—86	54—99	33—57	52—73	54—59
	107	83	100	110	86	79	77	47	64	57
Mg	4.0—10.0	8.5—20.5		2.0—10.5	6.0—8.0	2.5—8.5	4.5—6.5	4.0—6.0	4.0—7.0	4.5—5.5
	7.8	12.8	7.5	6.1	6.6	5.8	5.5	5.2	6.0	5.0
Fe	0.0—1.3	0.0—0.2		0.0—0.62	0.0—0.50	trace—0.27	trace—0.10	0.0—0.36	0.0—0.48	0.4—0.5
		0.1	trace	0.35	0.19					0.5
K	3.9—7.5			1.1—5.5	2.9—6.3	4.3—5.5		3.6—5.4	1.8—4.1	
	6.0	4.0	—	3.5	4.1	4.9	8.0	4.7	2.2	4.3
Cl	21—40	19—34		18—45	16—22	17—19	21—21	14—18	19—29	
	31	25	24	33	19	18	21	16	22	22
SO_4	26—138	17—38		14—80	19—41	23—42	45—48	11—29	20—54	
	74	31	40	34	31	30	47	23	27	12
NO_3	<1—13.0	<1—5.0		<1—6.7	0.5—8.0	1.0—7.0	1.1—8.0	trace—9.0	trace—7.5	<1—5.0
			8.5		3.1	3.6	4.6			
SiO_2	0.2—2.4	0.0—1.2		0.2—1.6	0.2—3.8	0.0—5.0	0.0—1.6	0.0—4.0	0.1—4.6	0.8—2.4
	1.1	0.6	0.0	1.1	2.2	2.1	0.8	1.3	2.0	1.6
Soluble P	28—144			26—54	24—220	50—72		20—240	30—200	
		12	—	40	93	61	40	102	103	72
HCO_3	215—536	284—342		350—455	173—317	203—293	221—300	135—171	132—240	171—181
	349	311	284	410	243	257	261	152	184	178
Colour	110—280	65—110		95—170	20—44	37—50	115—117	40—95	100—290	60—120
	184	95	130	131	33	42	116	66	190	90

Table 5. Continued.

Name of the tributary	Frihults-bäcken	Täpperöds-bäcken	Öveds-bäcken	Björkaån	Sjötorps-bäcken	Silvåkra-bäcken	Råbelövs-bäcken	Ekestads-bäcken	Österslövs-bäcken	Lärkes-holmsån
Lake	Sövdesjön	Vombsjön	Vombsjön	Vombsjön	Kranke-sjön	Kranke-sjön	Råbelövs-sjön	Råbelövs-sjön	Råbelövs-sjön	Rösjön
No. on the map in LUNDH (1951)	7	7	8	9	5	6	1	2	3	1
Fig. in LUNDH (1951)	16	21	21	21	21	21	39	39	39	51
Number of analyses	3	5	5	6	4	5	7	7	7	1
pH	7.3—7.9	8.3—8.7	7.8—8.6	7.7—8.3	7.7—8.1	7.5—8.1	7.4—7.8	6.9—7.6	7.6—8.4	7.3
$KMnO_4$	32—62 51	54—92 66	21—121 64	23—66 38	40—118 72	41—75 54	83—145 120	88—153 122	31—76 51	36
$\varkappa_{18} \cdot 10^6$	268—298 283	348—412 383	300—394 346	313—359 335	368—443 408	392—425 409	285—394 370	184—368 293	465—600 542	100
Total solids	216—277 247	265—315 299	230—296 269	219—270 261	302—414 340	251—394 328	299—348 319	209—471 273	320—469 389	97
Non-volatile solids	107—160 137	156—202 178	148—192 157	133—176 156	179—232 208	144—236 194	177—211 197	103—185 152	193—292 246	42
Total hardness °DH	7.0—13.9 9.6	10.5—13.6 12.1	8.2—12.8 10.4	8.3—12.9 10.5	10.4—12.6 12.0	12.0—13.6 12.7	10.1—13.9 11.6	6.4—12.2 9.5	16.0—21.3 18.4	1.4
Ca	52—60 56	55—85 71	53—78 61	54—79 66	65—108 84	79—110 90	61—78 64	35—77 57	104—124 115	15
Mg	3.0—5.0 4.2	5.5—7.0 6.0	6.0—10.5 8.4	1.5—7.0 5.3	4.5—6.5 5.7	5.0—7.5 6.1	3.0—4.5 3.7	3.0—6.0 4.3	4.0—9.0 5.3	4.0
Fe	0.04—1.2 0.6	0.0—0.05 0.01	0.0—0.05	0.0—0.35 0.06	0.0—0.1	0.0—0.2	0.1—0.8 0.3	0.2—1.3 0.6	0.0—1.1	0.0
K	3.3	3.0—6.2 5.1	5.1—5.8 5.5	2.8—5.0 3.6	3.1—7.9 5.5	2.7—5.0 3.6	3.3—5.3 4.5	1.7—4.5 2.8	2.2—17.0 5.9	1.5
Cl	21—23 22	14—24 19	16—20 18	14—20 17	17—32 24	18—20 19	17—25 20	14—24 18	18—22 20	15
SO_4	20—28 24	41—67 50	27—66 40	43—72 50	38—75 61	40—68 58	32—55 46	22—53 41	30—62 45	12
NO_3	$<$1—7.5	0.6—10.0 4.4	1.0—15.0 6.2	0.1—13.0 4.2	1.1—7.5 5.7	1.2—9.5 5.5	$<$1—13.5	1.0—8.5 5.7	$<$1—15.0	0.5
SiO_2	0.1—5.0 2.1	0.4—1.4 0.8	0.4—0.6 0.8	0.6—3.0 1.2	0.2—1.3 0.8	0.0—2.0 0.9	0.2—2.0 1.0	0.8—2.2 1.2	0.2—2.0 1.0	—
Soluble P	68—100 84	10—220	34—200	20—134 52	14—24 19	26—42 34	68—320 170	14—220	4—300	110
HCO_3	121—178 158	212—262 229	183—245 207	165—212 179	166—268 206	185—234 209	149—213 186	85—247 153	249—390 328	39
Colour	50—90 76	50—73 63	45—63 52	16—41 26	21—48 38	33—50 42	40—160 100	50—210 127	12—35 25	140

The relationships between water chemistry and geology.

LUNDH (1951 p. 22) has summarized the characteristic geological features of the surroundings of the investigated lakes and expressed some assumptions about the dependence of the salt content upon the geological conditions. It may be of certain interest to discuss the question if these assumptions agree with the results of the water-analyses.

If the lakes situated on Archaean bedrock (Västersjön, Rösjön, Dagstorpssjön, Kvesarumssjön, Tjörnarpssjön, Bosarpssjön and Finjasjön) are compared with the remaining lakes, mostly situated on the plains, one finds a difference in the total content of electrolytes, which is gradual as already mentioned (p. 154). The lakes on the Archaean rocks have the lowest salt content. Araslövssjön and Hammarsjön are not included here, as they have special water conditions.

Of the Archaean lakes, however, two are divergent with higher concentrations of electrolytes, namely Kvesarumssjön and Finjasjön. The higher values are found as regards almost all the studied ions.

The lakes most deficient in salts of the Archaean lakes are Västersjön and Rösjön, which also have a divergent vegetation. Furthermore, they are situated in an area poorer in lime than the other lakes of this type, which are surrounded by more or less limy moraine (LUNDH 1951, p. 17).

The lakes on the Kristianstad plain, Råbelövssjön and Levrasjön, the bottom of which sometimes is formed by cretaceous rocks, would *a priori* have a water richer in calcium than any of the remaining lakes. This is not the case, however, but on the south-western plains some lakes are to be found with the same high content. Thus Yddingen has the water which is richest in calcium. It is also impossible to establish whether Råbelövssjön and Levrasjön are richer in phosphate or more influenced by culture. The latter factor is very difficult to study exactly.

Of the lakes situated in the south-western Scania Börringesjön, Krageholmssjön and Ellestasjön should be those most influenced by culture, as they are mainly surrounded by fields, but this is also difficult to prove. The total salt content is almost the same as in the lakes on the Kristianstad plain.

The three lakes on the Vomb plain Heljesjön, Vombsjön and Krankesjön are all rich in lime, in spite of their position in a leached sand plain, and they are all rich in salts. This agrees with the statements made by LUNDH.

Gyllebosjön and Tunbyholmssjön, both lying in an area of sandstone moraine in south-eastern Scania, should according to their position have a relatively low content of calcium in their water, probably of the same degree as the lakes on Linderödsåsen. This holds also true for Tunbyholmssjön, which agrees with Kvesarumssjön and Finjasjön. Gyllebosjön, however, is a typical lime lake. This is probably due to the influences of lime occurrences in the moraine and the glaciofluvial deposits originating from the Kristianstad plain or the Baltic.

Finally, Ringsjön situated in the centre of the province, in the transition area between Archaean bedrock and the plains, also forms an intermediate in salt concentration.

The effects of outlets of sewage in the lakes.

As LUNDH (1951) already has discussed the Scanian lakes have been affected by culture in many respects. The problem is whether or not such influences can result in notable changes in the ion concentrations of the lake waters. In this connexion two sources of pollution will be discussed, namely the direct outlet of sewage in the lakes and the influences of manuring the fields.

An outlet of sewage into a lake is generally accompanied by an enormous development of plankton algae (*cf.* THUNMARK 1945 a and RODHE 1948) but the changes in the composition of the higher vegetation and in the salt concentrations of the water seem to have been less studied.

Only a few of the investigated lakes receive waste water from factories and communities namely the following.

V o m b s j ö n: its tributary Björkaån is recipient for the communities Vollsjö, Lövestad and Sjöbo. This river had a relatively high specific conductivity (table 5) which is caused mainly by the high content of calcium bicarbonate, but the other ions seemed to be of the same concentrations as in Vombsjön.

S ö v d e s j ö n (the northern part): the village Sövde with a dairy.

E a s t e r n R i n g s j ö n: the river Hörbyån is recipient for the sewage from the market town Hörby. From the analyses performed by the water-works of Hälsingborg no marked differences in the ion concentrations of the different parts of Ringsjön were to be found (*cf.* ANDERSSON 1948). On the other hand there was a higher concentration of bacteria in Eastern Ringsjön than in Western Ringsjön.

S ä t o f t a s j ö n (the northern part of Eastern Ringsjön) is polluted by water from the market town Höör.

H a m m a r s j ö n: recipient for the sewage from the city of Kristianstad.

F i n j a s j ö n: recipient for the sewage from the city of Hässleholm.

Moreover some lakes receive waste water from seasonal factories, *e.g.*, starch factories, namely Krankesjön, Råbelövssjön (at Råbelöv and Österslöv), Oppmannasjön (at Kiaby and Norregård) and Levrasjön.

Finally most lakes receive some polluted water from farms during all the year.

Usually it is not possible to study the changes in the ion content by pollution as no analyses are available from earlier times. A good object for such studies, however, is Hammarsjön, through which the river Helgeå flows. If no pollution had taken place it could be assumed that the river at the outlet from Hammarsjön would have a water similar to that above Kristianstad. Thus if the water of Helgeå is analyzed before the entrance into Hammarsjön and after passing the lake it should be possible to study the effect of pollution. Perhaps a reservation should be made here. The lake contains many reed swamps and it is possible that the water is not absolutely uniformly mixed, but larger concentrations of sewage may be found in well sheltered parts of the lakes especially at low water. Table 6 illustrates some values from a study from Helgeå and Hammarsjön. It proved that compared with Torsebro a marked increase in electrolytes was found at Pynten, where the sewage was mixed with a relatively small volume of lake water. At Kavrö, however, the increase was relatively insignificant, probably due to greater dilution. The most apparent feature was the increase in sulphate. Naturally if the conversion of water in Hammarsjön had been less it is probable that the increases in ion concentrations would have been stronger. Such large sources of pollution are not situated at the other lakes and for this reason they are not suited for studies of this type.

By rich precipitation a more or less strong leaching of the salts and organic substances from artificial manuring, natural manuring and the remains of animals and plants in decomposition takes place on the surface of the fields. The dissolved compounds are transported in the surface water by brooks and runnels into the lakes. It is impossible to calculate the amounts of such substances, as the leaching occurs mainly during rich precipitation and then the concentration of the salts in the brooks is very low. As regards the lakes on the plains, however, the quantity seems to be of a rather large order of magnitude, as they generally are surrounded of fields. From this leaching the high contents of nitrate in the lakes apparently originate.

A study of the values from the investigated tributaries (table 5), all of which belong to the plains with the exception of Lärkesholmsån, shows that the contents of electrolytes are generally higher than in the reci-

Table 6. Survey of water analyses from Helgeå and Hammarsjön.

Locality	Torsebro					Pynten					Hammarsjön			Kavrö		
Date	12.8	18.4	22.5	12.6	15.7	6.6	18.4	22.5	12.6	15.7	1.8	29.7	29.7	22.5	12.6	15.7
	1946	1948	1948	1918	1948	1946	1948	1948	1948	1948	1946	1947	1947	1948	1948	1948
Hour	1730	1600	1915	1930	2015	—	1640	1800	1920	1945	1100	—	—	1715	1845	1910
Temperature	19.0	12.7	16.3	20.2	19.5	16.8	13.4	16.2	21.1	20.2	—	—	—	15.7	21.2	19.7
pH	7.2	6.9	7.4	7.4	7.2	7.0	6.9	7.3	7.2	6.9	7.3	7.8	7.2	7.3	7.4	7.1
$KMnO_4$	92	62	64	66	60	83	64	153	69	54	99	102	108	84	67	50
$\varkappa_{18} \cdot 10^6$	70	89	86	87	86	155	130	98	180	111	142	164	119	95	103	100
Total solids	94	—	83	82	—	—	—	318	135	—	170	138	124	111	90	—
Non-volatile solids	41	—	53	—	—	—	—	188	—	—	128	72	53	46	—	—
Total hardness °DH	1.6	1.7	1.1	1.2	1.2	—	2.2	1.2	2.2	1.4	1.7	4.4	2.8	1.5	1.4	1.5
Ca	9	—	10	12	10	—	—	14	20	12	14	62	25	10	13	11
Mg	3.0	—	3.5	3.5	1.0	—	—	3.5	4.0	2.0	3.0	3.0	5.0	3.5	4.3	2.1
Fe	0.8	—	0.4	0.8	0.8	—	—	1.1	0.6	0.8	trace	1.1	1.2	0.7	0.5	0.5
Cl	10	11	11	9	11	—	13	10	17	20	14	17	15	11	12	12
SO_4	12	—	14	14	—	—	—	29	45	—	14	18	27	32	31	—
NO_3	2	—	0.6	1.1	1.5	—	—	7.2	0.8	1.0	1.0	trace	trace	1.1	0.5	1.0
SiO_2	0.4	—	1.9	0.4	1.6	—	—	0.4	0.4	2.0	1.2	—	—	0.3	0.4	1.2
P	26	—	—	—	—	—	—	—	—	—	30	240	280	—	—	—
HCO_3	43	31	29	26	31	—	29	35	63	35	21	73	45	34	33	44
Colour	140	—	60	80	70	90	—	110	80	55	100	40	64	60	80	60

For the positions of the stations see LUNDH 1951 figure 38.

Torsebro is situated about 2.5 km. north of the mouth of Helgeå into Araslövssjön.

Pynten: about 100 m. eastwards the inlet of the sewage conduit of Kristianstad into Hammarsjön. It may be noted that only a part of the sewage is let out here. The rest runs out into the river at several points above Pynten.

Kavrö: at the bridge over Helgeå, 1 km. from its outflow from Hammarsjön.

pient lake. The amounts of calcium and bicarbonate predominate and are often present in large quantities. The magnesium and potassium contents deviate only slightly from those of the lakes. The chloride content is somewhat higher and the same is also true of sulphate. A very apparent feature is also the high content of nitrate and sometimes also the high phosphorus concentration.

The larger concentrations of electrolytes in the brooks do not evidently depend upon the leaching from the fields as most of the analyses have been made when the water flow has been slight, but it must be due to the fact that the brooks contain ground water, which on its way through the soil has leached salts. This is especially marked in Lärkesholmsån, running through a district poor in fields. The high concentration of nitrate and phosphorus are partly due to this leaching, partly to sewage from farms. The electrolyte content of the tributaries probably plays a rather unimportant part in the composition of the lake water, as the water supply from the brooks is insignificant in relation to the total water volume of the lake.

The lake contains a mixture of ground water and surface water, as it constitutes a reservoir for the large volumes of rain and melted snow which do not penetrate the soils. Consequently the lake water must be more diluted than the ground water and the tributaries when the precipitation is low or lacking. For the same reason the higher values of electrolytes in the brooks compared with the lake do not necessarily originate from a strong influence by culture.

As is evident from the discussion above it is very difficult to discover the influences of sewage on the concentrations of electrolytes in the lake waters. Since a great source of pollution is necessary only Hammarsjön is suitable for such a study, but the conditions in this lake do not quite agree with other lakes on account of the large variations in the water. A slight increase has, however, been discovered in Hammarsjön, and it is assumable that this would have been greater in a smaller lake with less conversion. As regards the influence of manuring it is impossible to study its effects by analyses of the water in the brooks.

Discussion.

It is clear from the table given by LUNDH (1951, pp. 120 to 121), that the recorded water plants are not uniformly distributed over all the studied lakes. Only some have a ubiquitous distribution. Some are apparently restricted to the lakes on the plains and other to the lakes situated on Archaean rocks. The lakes thus differ in some of their vegetation.

The results from the chemical studies have also established that there is a variation in the concentrations of the ions, even if it is more or less marked. The differences are especially large for calcium, bicarbonate and sulphate, and less for magnesium, potassium and chloride. Exceptions, however, are encountered. On the other hand the contents of nitrate, phosphorus and iron and the hydrogen ion concentration do not show any significant differences.

If the total concentrations of the ions are calculated for the most electrolyte-rich lake Yddingen and for the most electrolyte-deficient, for example Rösjön, the following results are obtained:

	Yddingen	Rösjön
Cations mEq.	4.40	0.70
Anions mEq.	5.32	0.85

The differences between the cations and the anions are mainly due to the undetermined sodium. From these values it is evident that the salt content is about 6 to 7 times greater in a typical lowland lake than in a lake on Archaean rocks. Generally the quotient does not amount to this value as Yddingen is extremely rich in salts.

As regards nitrate, phosphorus and potassium, which belong to the most important nutrients for the plants, it may be stated that the differences between the lakes are less than would be expected *a priori*.

As already mentioned the variation is most pronounced in the content of calcium bicarbonate. By experimental investigations upon the effects of the pH and bicarbonate on the growth of *Ceratophyllum* and *Elodea* STEEMANN-NIELSEN (1944) has shown that the content of bicarbonate is of decisive importance for the development of these two plants and not the pH. Perhaps the different contents of bicarbonate in the lowland lakes and in the Archaean lakes might partly explain the aberrations in the vegetation.

This investigation like LOHAMMAR's has established that it is impossible to draw any conclusions about the distributions of the species from the content of common ions in lake waters. Even if still more thorough analyses were performed it would be impossible to solve the problem in this way, as the ion content is only a small part of the big complex of mostly unknown factors which together constitute the environments. Furthermore only a vague idea of the total salt content and the metabolism in the lake is obtained from single analyses. On the whole information of the actual requirements of nutrients, trace elements and other growth factors cannot be achieved from an investigation of this type.

Summary.

In the summers of 1946, 1947 and 1948 the author has studied the concentrations of some ions together with some other factors in the water from 31 Scanian lakes, the vegetations of which at the same time were investigated by ASTA LUNDH. The problem was to establish the characteristic features of the electrolyte concentrations and if possible to study whether or not there is any simple correlation between the ion concentrations and the distributions of aquatic plants. The following ions have been studied: Ca, Mg, Fe, K, Cl, SO_4, NO_3, PO_4, SiO_2, and HCO_3 and of other factors: pH, $KMnO_4$-consumption, specific conductivity, total solids, non-volatile solids, total hardness and colour. The analytical methods are described.

The most striking result is the variation found in the concentrations of Ca and HCO_3 in the different lakes. The concentrations of the other ions agree more or less or the variation is heterogeneous. No significant differences seem to occur. As regards the common plant nutrients, K, P and NO_3, no apparent differences between lakes with aberrant vegetation seem to be present from the values here given. It is impossible to discover the origin of the variant lake vegetation from an investigation of this type as the salt concentration is only one factor of the large complex forming the environments and it gives no contribution to the knowledge of the true requirements of the individual species.

References.

ANDERSSON, A. 1948. Näringstillgång och planktonutveckling i några skånska sjöar. — Vattenhygien 4: 9. Stockholm.

ANDERSSON, A. och LUNDH, A. 1948. Algstudier i Vegeån (with an English summary). — Bot. Not. 1948: 285. Lund.

Anvisningar för bakteriologiska och fysikalisk-kemiska vattenundersökningar. II. Fysikalisk-kemiska analysmetoder. — Sv. Kom.-Tekn. För. Handl. N:r 6. Stockholm. 1942.

BURSTRÖM, H. 1942. The colorimetric determination of nitrate in plant material. — Sv. Kem. Tidskr. 54: 139. Stockholm.

HAZEN, A. 1892. A new color-standard for natural waters. — Amer. Chem. Journ. 14: 300.

IVERSEN, J. 1929. Studien über die pH-Verhältnisse dänischer Gewässer und ihren Einfluss auf die Hydrophyten-Vegetation. — Bot. Tidsskr. 40: 277. København.

— and OLSEN, S. 1943. Die Verbreitung der Wasserpflanzen in Relation zur Chemie des Wassers. — Ibid. 46: 136. København.

KLUT, H. 1927. Untersuchung des Wassers an Ort und Stelle. — 5 Aufl. Berlin.

LILLIEROTH, S. 1949. Om ogynnsamma följder av sjösänkning och vattenförorening i nordvästra Skåne. — Skånes Natur. 36: 6. Lund.

— 1950. Über die Folgen kulturbedingter Wasserstandssenkungen für Makrophyten- und Planktongemeinschaften in seichten Seen des südschwedischen Oligotrophiegebietes. — Acta Limnologica 3. Lund.

LOHAMMAR, G. 1938. Wasserchemie und höhere Vegetation schwedischer Seen. — Symb. Bot. Ups. III: 1. Uppsala.

LUNDH, A. 1951. Studies on the vegetation and hydrochemistry of Scanian lakes I. Higher aquatic vegetation. — Bot. Not. Suppl. 2: 3. Lund.

NYGAARD, G. 1938. Hydrobiologische Studien über dänische Teiche und Seen. — 1. Teil. Chemisch-physikalische Untersuchungen und Planktonwägungen. — Arch. Hydrobiol. 32: 523. Stuttgart.

OHLMÜLLER-SPITTA. 1931. Untersuchung und Beurteilung des Wassers und des Abwassers. — 5 Aufl. Berlin.

OLSEN, S. 1950 a. Aquatic plants and hydrospheric factors. I. Aquatic plants in SW-Jutland, Denmark. — Sv. Bot. Tidskr. 44: 1. Uppsala.

— 1950 b. Aquatic plants and hydrospheric factors. II. The hydrospheric types. — Ibid. 44: 332. Uppsala.

RODHE, W. 1948. Sjön Norrvikens vattenbeskaffenhet år 1946—47 och vattenblomningens bekämpande med kopparsulfat sommaren 1947 (with an English summary). — Vattenhygien 4:38. Stockholm.

— 1949. The ionic composition of lake waters. — Verh. Int. Ver. Limn. 10:377. Stuttgart.

SAYWELL, L. G. and CUNNINGHAM, B. 1937. Colorimetric o-phenantroline method. — Ind. Eng. Chem. Anal. Ed. 9:67. Easton.

SCHEEL, K. 1936. Die colorimetrische Bestimmung der Phosphorsäure in Düngemitteln mit dem Pulfrich-Photometer. — Z. anal. Chem. 105. München.

STEEMANN-NIELSEN, E. 1944. Dependance of freshwater plants on quantity of carbon dioxide and hydrogen ion concentration illustrated through experimental investigations. — Dansk. Bot. Ark. 11. Nr. 8. København.

THUNMARK, S. 1945 a. Die Abwasserfrage der Växjöseen in hydrobiologischer Beleuchtung. — Medd. Lunds Univ. Limn. Inst. 4. Lund.

— 1945 b. Zur Soziologie des Süsswasserplanktons. Eine methodologisch-ökologische Studie. — Folia Limnol. Scand. No. 3. Lund.

— 1948. Sjöar och myrar i Lenhovda socken. — Lenhovda. En Värendssocken berättar. p. 665. Moheda.

WERESCAGIN, G. J. 1931. Methoden der hydrochemischen Analyse. — Arch. Hydrobiol. 23. Stuttgart.

WITTING, M. 1947. Katjonsbestämningar i myrvatten (with an English summary). — Bot. Not. 1947:287. Lund.

— 1948. Preliminärt meddelande om fortsatta katjonsbestämningar i myrvatten sommaren 1947 (with an English summary). — Sv. Bot. Tidskr. 42:116. Uppsala.

— 1949. Kalciumhalten i några nordsvenska myrvatten (with an English summary). — Ibid. 43:715. Uppsala.

ÅBERG, B. und RODHE, W. 1942. Über die Milieufaktoren in einigen südschwedischen Seen. — Symb. Bot. Ups. V:3. Uppsala.