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Phytoplankton from Lake Magelungen, Central Sweden 1960–1963

T. Willén

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PHYTOPLANKTON FROM LAKE MAGELUNGEN, CENTRAL SWEDEN

1960 - 1963

Torbjörn Willén
Institute of Limnology, University of Uppsala

ABSTRACT

The investigation of the qualitative and quantitative composition of phytoplankton in Lake Magelungen, Central Sweden, was carried out over a period of three years to illustrate the conditions before the release of waste water from the Ågesta Heat and Power Station began. Vertical sampling series were taken about once a month and samples from three different stations (named MA, MOB and MH) in the lake were analysed and compared.

Most importance was laid on the quantitative composition and the differences in total volumes between the different stations. Highest volume values were always recorded in late spring and in summer. Two algal groups predominated every year, viz. chlorophytes and cyanophytes. After a moderate spring outburst caused by diatoms (Stephanodiscus, Synedra and Asterionella) peak volume values of chlorophytes were recorded in June and July. Predominating genera were Scenedesmus, Coelastrum and Pediastrum. The chlorophyte maximum was always followed by an immense development of cyanophytes (Anabaena, Aphanizomenon and Microcystis).

The diatoms were well developed only during short periods; the chrysophyceans were of little significance as were all other algal groups.

A marked difference existed between the Station MOB compared with the two other stations. The water at Station MOB was more polluted and several algal genera indicating the pollution were recorded. Both chlorophytes and cyanophytes were often developed in very great quantities at this station.

The total volumes of phytoplankton in Lake Magelungen already are very high and the lake is to be considered as highly eutrophic. It is very possible that changes as to further additions of nutritional elements or/and changes in the thermal balance will increase the algal populations and accelerate the normal development of the lake.

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INTRODUCTION

The aim of this investigation was to give information about the qualitative and quantitative composition of phytoplankton in Lake Magelungen during a period of about three years before the outlet of waste water from the Ågesta Heat and Power Station began. Most importance has been attached to the quantitative composition of phytoplankton algae and to a comparison of the standing crop at three different stations in the lake.

Lake Magelungen (Fig. 1; 19.8 m above sea level) is situated ca 10 km S.S.W. of Stockholm. Its area is ca 2.4 km^2 and the maximum depth about 16.4 m. The drainage area measures ca 107 km^2. Round the lake some suburbs of Stockholm are situated: Farsta, Fagersjö, Ågesta, Södertörn's villastad, etc. Lake Magelungen mainly receives water from a small lake, Ågestasjön (20.7 m above sea level), which lake in turn receives water from Lake Trehörningen (21.8 m) and Lake Orlången (20.8 m). A paper about higher water vegetation, physico-chemical conditions and phytoplankton in the lakes Trehörningen and Orlången was published in 1953 by Kaaret.

Earlier when the lakes just mentioned had not yet been separated from each other as different basins because of the post-glacial land uplift there was a navigable channel from Lake Mälaren through the lakes Albysjön, Orlången, Ågestasjön, Magelungen, Drevviken etc. to the Baltic (Lundquist 1930, p. 225).

Lake Magelungen was mentioned by Teiling (1916) as an example of lakes belonging to the Baltic type as to phytoplankton composition. Some investigations in the lake were performed by Huss & Sondén (1920).

In 1960 a comprehensive investigation of Lake Magelungen began. Besides the quantitative and qualitative composition of phytoplankton, which will be treated in this paper, also zooplankton, physicochemical conditions and primary production (C^{14} - technique) have been investigated.

The first samples were collected on 28/III 1960 and then samples, as a rule, were taken once a month to 28/V 1963, inclusive. In 1960 and 1961 all series comprising samples from five or six levels, were taken at the same station, named MA in the following (see map, Fig. 1). Some preliminary samples, however, were also taken at two other stations, MH and MOB, to study the distribution of plankton more in detail. As these stations were of a somewhat different character, it was evident that a continued and more detailed comparison should be made between them. Thus, samples from the three stations, MA, MH and MOB were taken and analysed in 1962 and 1963. In all more than 425 samples have been analysed. Most importance has been laid upon the quantitative analyses of predominant species; in most samples, however, more than 25 different taxa have been counted.

The depth of water at Station MA is about 11 m, at Station MH ca 13 m and at Station MOB ca 5 m. At the deepest part of the lake, MH, there was often a marked stratification and a tendency to low oxygen content of the water at the deeper levels. Station MOB is situated close to the inflow of somewhat polluted water from Ågestasjön thus differing from the other stations.

As samples as a rule were taken only once a month, it has not been possible to follow the seasonal development of different taxa or genera and no attempt has been made to give diagrams showing the annual variation in the occurrence of any single organism. It is worth pointing out that samples must be taken more frequently during the year if a complete picture of the qualitative and quantitative plankton composition is desired. It is very probable that real peak values have been missed in this investigation.

This investigation has been supported by AB Atomenergi, Studsvik, Nyköping. All samples have been collected by the biological staff at Studsvik. I wish to express my gratitude to Dr. P-O Agnedal, Studsvik, who has given valuable information and kindly has put Figs. 2 - 5 at my disposal.

METHODS

Quantitative analysis

The water samples for quantitative analyses were collected by a Ruttner sampler at the following levels: at Station MA 0.2, 1.0, 3.0, 5.0, 8.0 and 10.5 m, at Station MH 0.2, 1.0, 5.0, 8.0, 10.5 and 12.5 m and at Station MOB 0.2, 1.0, 2.0, 3.0 and 4.5 m. The samples were fixed immediately by an acid Lugol's solution according to Utermöhl (1958, p. 10). The organisms were counted with an inverted plankton microscope and the analyses were performed according to the Utermöhl technique (for further details, see Utermöhl, op. c., Willén 1962 b). In general, a 1 ml counting chamber was analysed as to taxa clearly visible at a magnification of ca 100 x, while small species were counted in a 10 or 25 ml chamber at a magnification of ca 400 x. - Vertical net samples fixed in formalin were also collected.

Volume values for all organisms of some quantitative importance have been calculated; for details, see Willén 1962 b, p. 174 ff. The total volume values are given in $10^6 \mu^3/l$.

Graphical presentation

The seasonal and vertical distribution of phytoplankton is illustrated by three-dimensional diagrams, wing diagrams, Fig. 6 - 11. Three diagrams, Fig. 18 - 20 are modified spherical curves, "Würfelkurven", where the diameter of the cylinder corresponds to the cube root of the volume value per litre (Ruttner 1914 p. 277). In the actual figures, however, only one half of the cylinder is depicted.

PHYSICAL AND CHEMICAL DATA

A comprehensive material of physical and chemical data from all sampling dates exist. The analyses were performed partly at the Biological laboratory, AB Atomenergi, Studsvik, partly at the Institute of Limnology, Uppsala. In this paper only diagrams showing temperature, transparency values, specific conductivity and content of oxygen are included as Figs. 2 - 5, which figures have kindly been put at my disposal by Dr. P O Agnedal. Only some brief comments on the figures will be given.

Temperature

Fig. 2. At the Stations MA and MH a marked stratification was recorded in summer, while this was less accentuated at Station MOB where the depth of water was only ca 5 m and where the water was slowly streaming from the shallow parts of the lake in the N.W. to its deeper parts in the S.E.

As a rule, the lake was covered by ice from the end of November to the end of April or to the beginning of May. In 1961 the ice broke up very early, viz. at the beginning of April.

There were two periods of complete circualtion every year, one in connection with the breaking up of the ice and the other in October-November.

Transparency

Fig. 3. Only small differences existed between the values of transparency at Stations MA and MH. At Station MOB, however, always lowest values were obtained. In summer the transparency was very low (less than 1 m) at all stations due to large quantities of plankton algae; in winter 1962 - 1963 highest values, ca 4 m, were observed.

Specific conductivity

Fig. 4. Especially at Station MH a marked stratification occurred both in winter and in summer; at Station MA this was most accentuated in 1962 and 1963 with increased values of specific conductivity at deeper levels. At Station MOB the stratification was less marked (except in April, 1962). Considerably higher values were recorded in winters at all levels.

Oxygen content

Fig. 5. The stratification occurring at Station MA also existed at Station MH where it was, as a rule, more accentuated. Low oxygen concentrations often prevailed at Station MOB and specially in the winters of 1962 and 1963, when the bottom water layers were quite free from oxygen.

The oxygen conditions are of decisive importance as to the distribution of different organisms and examples will be given in the following illustrating differences in vertical distribution both of bacteriophytes and several algal taxa.

LIST OF SPECIES

This list includes taxa which appeared in considerable numbers in addition to some others of special interest.

BACTERIOPHYTA

Spirillum spp.
Hyalosoris lamprocystoides Skuja.
Sarcina tetras Skuja.
Siderocapsa geminata Skuja.
Planctomyces bekefii Gimesi.
Thiospira spp.

CYANOPHYTA

Microcystis pulverea (Wood) Forti var. incerta (Lemm.) Crow.
M. aeruginosa Kuetz., em. W.L., Teiling.
M. flos-aquae (Wittr.) Kirchn., em. W.L., Teiling.
Aphanocapsa elachista W. et G.S. West.
A. delicatissima W. et G.S. West.
Aphanothece clathrata W. et G.S. West.
Chroococcus limneticus Lemm.
Merismopedia minima G. Beck.
Coelosphaerium naegelianum Ung.
Gomphosphaeria lacustris Chod. var. compacta Lemm.
Oscillatoria limnetica Lemm.
O. spp.
Aphanizomenon flos-aquae (L.) Ralfs.
Anabaena circinalis Rbh.
Anabaena planctonica Brunnth
A. spiroides Klebahn.
- - var. minima Nyg.

CHLOROPHYTA

Polyblepharidinae

Scourfieldia complanata G.S. West.
Tetramitus sp.

Paramastix conifera Skuja.
Hexamitus sp.
Trepomonas sp.

Euchlorophyceae

Carteria spp.
Chlamydomonas spp.
Chlorogonium maximum Skuja.
Pteromonas angulosa Lemm.
Eudorina elegans Ehrnb.
Gloeococcus schroeteri (Chod.) Lemm.
Gloeocystis planctonica (W. et G.S. West) Lemm.
G. minuta Willén.
Pediastrum boryanum (Turp.) Menegh.
P. duplex Meyen.
P. tetras (Ehrnb.) Ralfs var. excisum Rbh.
Chlorella spp.
Micractinium pusillum Fresen.
Lagerheimia genevensis Chod.
L. wratislawienses Schroeder.
Chodatella ciliata (Lagern.) Lemm.
Ch. citriformis Snow.
Oocystis lacustris Chod.
O. solitaria Wittrock.
Kirchneriella contorta (Schmidle) Bohlin.
K. lunaris (Kirchn.) Moeb.
K. obesa (W. West) Schmidle.
Tetraëdron caudatum (Corda) Hansg. var. incisum Lagerheim.
T. minimum (A. Br.) Hansg.
T. muticum (A. Br.) Hansg.
- - fa. minor Reinsch.
T. regulare Kuetz.
- - var. incus Teiling.
Treubaria triappendiculata Bernard.
Scenedesmus abundans (Kirchn.) Chod.

Sc. acutus Meyen.
Sc. falcatus Chod.
Sc. quadricauda Turp. em. Chod.
Actinastrum hantzschii Lagerh.
Dictyosphaerium pulchellum Wood.
D. simplex Skuja.
Westella botryoides (W. West) Schmidle.
Didymogenes palatina Schmidle.
Crucigenia minima (Firschen) Brunnth.
C. quadrata Morren.
C. tetrapedia (Kirchn.) W. et G.S. West.
Tetrastrum staurogeniaeforme (Schroed.) Lemm.
Coelastrum microporum Naeg.
C. octaëdricum Skuja.
Selenastrum capricornutum Printz.
Selenastrum minutum (Naeg.) Collins.
Ankistrodesmus falcatus (Corda) Ralfs.
- - var. spirilliformis G.S. West.
Elakatothrix gelatinosa Wille fa. biplex Nyg.
Coccomyxa minor Skuja.
Stichococcus spp.

Conjugatae

Closterium acutum Bréb. var. variabile (Lemm.) Krieger.
Cosmarium spp.
Staurastrum spp.

Florin (1957, p. 111, 112) mentions the following taxa from Lake Magelungen: Closterium ehrenbergii Menegh., Cosmarium depressum (Nägeli) Lund var. planctonicum Reverdin, C. subtumidum Nordst. var. klebsii (Gutw.) W. & G.S. West, Spondylosium planum (Wolle) W. & G.S. West, Staurastrum chaetoceras (Schröder) G.M. Smith, St. longipes (Nordst.) Teil., St. pelagicum W. & G.S. West and Staurodesmus dejectus Bréb.

EUGLENOPHYTA

Euglena spp.
Phacus caudatus Hübner.
Trachelomonas volvocina Ehrnb.
T. hispida (Perty) Stein.
Astasia spp.
Menoidium spp.
Petalomonas spp.

CHRYSOPHYTA

Chrysophyceae

Chromulina spp.
Chrysococcus rufescens Klebs.
Kephyrion spp.
Stenokalyx inconstans Gerl. Schmid.

Mallomonas akrokomos Ruttner.
M. fastigata Zach.
M. tonsurata Teiling.
Erkenia subaiquiciliata Skuja.
Synura petersenii Korschik.
Volvochrysis globosa Schiller.
Dinobryon bavaricum Imhof.
D. divergens Imhof.
D. sertularia Ehrnb.
D. utriculus Stein.
Bicosoeca ainikkiae Järnefelt.
B. crystallina Skuja.
B. cylindrica (Lackey) Bourr.
B. multiannulata Skuja.
Desmarella moniliformis Kent.
Lagenoeca ruttneri Bourr.
Salpingoeca gracilis Clark fa.
Codonosigopsis robini Senn.
Stelexomonas dichotoma Lackey.
Aulomonas purdyi Lackey.
Small monads.

Diatomeae

Melosira ambigua (Grun.) O. Muell.
M. granulata (Ehrnb.) Ralfs.
- - var. angustissima O. Muell.
Melosira spp.
Cyclotella spp.
Stephanodiscus astraea (Ehrnb.) Grun.
S. hantzschii Grun.
- - var. pusillus Grun.
Attheya zachariasi J. Brun.
Tabellaria fenestrata (lyngb.) Kuetz.
T. flocculosa (Roth.) Kuetz.
Diatoma elongatum (Lyngb.) Ag.
Meridion circulare (Grev.) Ag.
Fragilaria capucina Desmaz.
F. crotonensis Kitton.
Asterionella formosa Hassall.
A. gracillima (Hantzsch) Heiberg.
Synedra acus Kuetz.
S. ulna (Nitzsch.) Ehrnb.
S. spp.

Heterokontae

Botryococcus braunii Kuetz.

PYRROPHYTA

Cryptophyceae

Rhodomonas minuta Skuja.
Cryptomonas spp.
Cyathomonas truncata (Fres.) From.

Peridineae

Gymnodinium spp.
Peridinium aciculiferum Lemm.
P. spp.
Ceratium furcoides (Levander) Langhans.
C. hirundinella (O.F.M.) Schrank.

SEASONAL AND VERTICAL DEVELOPMENT OF DIFFERENT GROUPS

Bacteriophyta

The bacteriophytes have not been studied in detail and only a limited number has been recorded. In winter Hyalosoris lamprocystoides and, especially, Sarcina tetras were common at all localities. Spirillum spp. and Thiospira spp. were most common at Station MH, where low oxygen concentrations often were recorded both in summer and in winter. The ion bacterium Siderocapsa geminata was very common at Station MA during autumn 1960. Planctomyces bekefii, finally, was only recorded at Station MA on 9/IX 1960.

Cyanophyta

The cyanophytes (Figs. 6 and 12) dominated completely every year during the period July, August and September. As a rule, they rapidly decreased in number in October, even if they occurred in moderate quantities in autumn and winter. There was a limited number of taxa causing the water bloom; some differences in the composition existed between the investigated periods. In 1960 Aphanocapsa delicatissima, Anabaena planctonica, A. spiroides, Microcystis spp. and Oscillatoria spp. were predominating, in 1961 Anabaena spiroides (considerable numbers of filaments already on 15/V), Aphanizomenon flos-aquae and Microcystis spp. were most common. In 1962 Aphanizomenon flos-aquae predominated in June-July, followed by Anabaena spp. and Microcystis spp. in July and August. In 1963, finally, moderate quantities of Anabaena spp., Aphanizomenon flos-aquae and Oscillatoria spp. were recorded on 28/V.

Among other species occurring in moderate or small quantities Chroococcus limneticus, Coelosphaerium naegelianum and Gomphosphaeria lacustris var. compacta may be mentioned.

Every year the dominance of cyanophytes followed immediately after the chlorophyte maximum (Fig. 18). It is also worth mentioning that the number of small flagellates was always very low during the cyanophyte maxima.

Euchlorophyceae

Figs. 7 and 13. Besides the large cyanophyte populations it is also characteristic of the phytoplankton vegetation of Lake Magelungen that immense chlorophyte populations occur every year. The first peak values recorded every late winter or shortly before the breaking up of the ice agree with those generally observed in most lakes. At that time species belonging to the genera Carteria, Chlamydomonas and Chlorogonium occur in immense quantities (cf. Willén 1962 b, p. 187). This was studied, e.g., in 1962, when the genera just mentioned were only represented by single individuals on 16/IV. On 25/IV, however, they were all counted in great numbers and together represented more than half of the total phytoplankton volume. On 25/IV the diatoms were quite lacking: their maximum values were recorded in May.

The second peak values of chlorophytes were recorded during the period May-June every year. In July the chlorophyte dominance was always broken and it was followed by the cyanophyte maximum. However, most chlorophyte genera were represented in late summer and autumn to October, inclusive.

In 1960, the genus Scenedesmus was well represented on 10/V. This year no samples were collected in June and the real chlorophyte maximum values were never recorded, see Fig. 13. In July considerable numbers of the genera Scenedesmus and Pediastrum occurred with Coelastrum and Oocystis in small quantities.

On 15/V 1961 a lot of genera was recorded in great quantities: Actinastrum, Ankistrodesmus, Dictyosphaerium, Elakatothrix, Micractinium, Pediastrum and Scenedesmus. On 12/VI Scenedesmus spp. were counted in ca 3.5 million coenobia per litre and Coelastrum microporum in ca 630,000 coenobia per litre. Pediastrum boryanum and P. duplex were also very common.

In 1962 the same genera predominated. Scenedesmus spp. were recorded in ca 1 million coen./l on 21/V and in 4 million coen./l on 12/VI. At the same date Pediastrum spp. were very common and

Coelastrum was counted in ca 1.2 million coen./l. The genera Elakatothrix, Oocystis and Tetraëdron were well represented.

On 7/V 1963 the genera Carteria, Chlamydomonas and Chlorogonium (ca 100,000 cells/l) dominated together with the diatom Stephanodiscus pusillus. On 28/V 4.4 million coen./l of Scenedesmus spp. and 1.3 million coen./l of Coelastrum microporum were recorded, while the genera Pediastrum, Kirchneriella, Oocystis and Tetraëdron were well represented.

Scenedesmus abundans, Sc. acutus, Sc. falcatus and Sc. quadricauda were most common among the Scenedesmus spp. occurring in the lake. It would be most interesting to follow the seasonal distribution more in detail and to study the variation in shape and size of all these taxa. Among taxa not mentioned above as to quantities but occurring as a rule in considerable numbers the following may be mentioned: Pteromonas angulosa, Lagerheimia genevensis, Tetraëdron caudatum var. incisum, T. minimum, T. muticum, Actinastrum hantschii, Crucigenia minima, C. quadrata, Selenastrum capricornutum, S. minutum and Coccomyxa minor.

Chrysophyceae

Figs. 8 and 14. This group often plays an important rôle both as to number of species and to total volume in most lakes. In Lake Magelungen, however, the number of species recorded was moderate and volumetrically the group was quite subordinate in comparison with cyanophytes and chlorophytes. The percentage values were high only in winter, Fig. 8, when different small monads were well developed under the ice.

Dinobryon spp. (D. bavaricum, D. divergens and D. sertularia) were recorded in small quantities: a few thousand cells/l in summer and autumn. Synura petersenii was counted in ca 900,000 cells/l on 10/X 1960. Bicosoeca crystallina was observed in large numbers at Station MOB on 7/V 1963. Desmarella moniliformis was common in winter. Stelexomonas dichotoma, a species as a rule only appearing in single specimens, was counted in ca 250,000 specimens/l on 10/IV 1961, etc. The list given here only exemplifies that most species were counted in small quantities and that they often occurred during short periods at the time of investigation. In June and in autumn, when this group often predominates in most Swedish lakes, it was without any significance in Lake Magelungen.

The group named "small monads" consists of a lot of small flagellated taxa which are impossible to determinate in fixed samples. To this group often more than 1 million cells/l were referred. During the period of cyanophyte maxima the number of small monads was always very low, ca 500,000 cells/l.

Diatomeae

Figs. 9 and 15. Likewise the diatoms were of subordinate significance during the whole period of investigation. Certainly the two common periods every year of maximum development (early spring and autumn) could be distinguished, but the total volume values were always relatively low and hardly exceeding $1,000 \cdot 10^6 \mu^3/l$, Fig. 16. About the same taxa occurred every year.

On 10/V 1960 Stephanodiscus hantzschii var. pusillus was counted in more than 15 million cells/l, Asterionella formosa in ca 250,000 cells/l and Synedra spp. in considerable numbers. In autumn Asterionella occurred in about the same quantity, while Melosira granulata var. angustissima was counted in ca 2,750 cm/l. Stephanodiscus hantzschii var. pusillus then was recorded in small quantities.

In 1961 there was an early breaking up of the ice and already on 10/IV the maximum development of Stephanodiscus, Asterionella and Synedra was recorded. In May Diatoma elongatum was very common. In autumn Melosira granulata var. angustissima again predominated.

On 21/V 1962 Stephanodiscus hantzschii var. pusillus was counted in ca 6 million cells/l together with great quantities of Asterionella and Synedra. This autumn (10/X) Stephanodiscus astraea predominated.

In 1963 the small Stephanodiscus hantzschii var. pusillus again showed a maximum development on 7/V. Three weeks later this species was still very frequent together with Diatoma elongatum and some Synedra spp.

Some taxa were observed every year but always in small quantities, e.g. Attheya zachariasii, Rhizosolenia longiseta, Fragilaria spp. and Tabellaria spp.

Cryptophyceae

Figs. 10 and 16. Except in winter the genera Cryptomonas and Rhodomonas as a rule were observed in all samples. Peak volume values were reached every year during a period after the breaking up of the ice. At Station MA the highest volume value was recorded on 21/V 1962, 1 m, with 1.6 million cells/l of Cryptomonas spp. and 3.5 million cells/l of Rhodomonas minuta. The values obtained at Station MH, however, were higher: 5.8 and 6.3 million cells/l, respectively (Fig. 17). In 1961, when the ice broke up earlier than usual the corresponding peak values of the actual genera were observed at the beginning of April. In 1960 relatively high volume figures were obtained also in October, caused by Rhodomonas minuta which species was counted in 1.2 - 2.0 million cells/l.

Other groups

Polyblepharidinae. - Species belonging to the genera Hexamitus, Paramastix, Tetramitus and Trepomonas were most common at Station MOB, indicating that this Station was more polluted than the other two. Some comments will be given in the following chapter.

Conjugatae. - All desmids were only recorded as single specimens and the group played a subordinate rôle quantitatively.

Euglenophyta. - The genera Euglena, Phacus and Trachelomonas never occurred in great quantities. Some Astasia and Menoidium spp. were relatively common at Station MOB and they also occurred at Station MH at deeper levels with low oxygen concentration.

Heterokontae. - Botryococcus braunii was recorded from Station MOB in single specimens.

Peridineae. - Small Gymnodinium spp. occurred in moderate quantities. Peridinium aciculiferum, Ceratium hirundinella and C. furcoides were only recorded as single specimens.

Total volumes of phytoplankton

Figs. 11 and 17. - Both figures show the characteristic features as to the seasonal distribution of the total volumes of phytoplankton. Highest volume values were always recorded during a period from the end of May to August-September. Sometimes another peak was recorded in October, e.g. in October 1962 when a minor peak in the total volume values was caused by a temporary increase in the number of Stephanodiscus astraea at two stations.

During the period May-September chlorophytes and cyanophytes were quite dominating as mentioned above. This dominance was recorded every year and was only displaced in time by differences as to light and temperature conditions.

All values recorded from the winter periods (December-March/April) were very low.

DIFFERENCES BETWEEN THREE STATIONS IN THE LAKE

The direct comparison between three stations in Lake Magelungen, MA, MOB and MH (Fig. 1) was made in 1962 and 1963. In general, the species composition was about the same at all stations, but some differences existed and the total volume values sometimes showed a marked variation. In the diagrams, Figs. 12 - 17, mean values from the levels 0.2 - 5.0 m have been indicated; cf. Tables 1 - 4. The type of diagram (semi-logarithmic) gives an impression of overestimation of low values obtained, e.g. in winter, while differences as to high volume values, $10{,}000 \cdot 10^6 \mu^3/l$ and higher, are less marked. All values from Stations MOB and MH have only been marked with dots in the diagrams. A complete comparison has not been performed as samples from Station MH were never collected at some sampling dates. Figs. 18 - 20, finally, are constructed as spherical curves according to Ruttner (cube root of the volume values) but only the right half of the figures are depicted in the diagrams. Some brief comments will be given as complement to the figures.

Cyanophyta

Figs. 12 and 18. On 9/VII 1962 Anabaena spiroides mainly caused the peak volume values at Station MOB (Fig 12). This species together with Microcystis spp. was also most frequent on 6/VIII at all stations, while Microcystis spp. predominated on 4/IX.

The genus Oscillatoria was most frequent at Station MOB: it was common, e.g. on 9/VII and 4/IX 1962. On 28/V 1963 it was recorded in great quantity also at Station MA, while it consequently was very rare or quite lacking at Station MH throughout the year.

Euchlorophyceae

From Fig. 13 it is evident that this group predominated at Station MOB in 1962. The most important genera have already been enumerated in the previous chapter and their occurrence was about the same at all stations. On 12/VI 1962, however, Coelastrum microporum was most frequent at Stations MOB and MH. On 1/X 1962 Eudorina elegans caused peak values at Station MOB (ca 30,000 col./l) and at Station MA (ca 20,000 col./l) together with Coelastrum and Scenedesmus. At Station MH only single colonies of Eudorina were observed; Coelastrum and Scenedesmus predominated. Possibly, this is an example of the influence from Station MOB on the species composition at Station MA.

On 28/V 1963 somewhat higher volume values were obtained at Station MH in comparison with other stations. The genera Coelastrum, Scenedesmus and Pediastrum predominated in the whole lake; the last-mentioned genus, however, was most frequent at Station MH.

The vernal development of the chlorophytes in 1962 is illustrated by the following table. However, considerably higher values as to the genera Chlamydomonas and Chlorogonium have been observed in other years. As mentioned above, samples must be collected much more often to illustrate the development of single genera.

	Number/l, 0.2 m		
16/IV 1962	MOB	MA	MH
Ankistrodesmus falcatus	3,000	20,000	8,000
Chlamydomonas spp.	15,000	37,000	12,000
Coelastrum microporum	+	-	+
Scenedesmus spp.	+	+	-
25/IV 1962			
Ankistrodesmus falcatus	$1.0 \cdot 10^6$	96,000	-
Chlamydomonas spp.	$5.1 \cdot 10^6$	555,000	-
Chlorogonium spp.	10,000	2,000	-
Coelastrum microporum	7,000	-	-
Scenedesmus spp.	37,000	7,000	-
21/V 1962			
Ankistrodesmus falcatus	175,000	72,000	63,000
Chlamysomonas spp.	+	3,000	15,000
Chlorogonium spp.	-	5,000	-
Coelastrum microporum	69,000	33,000	30,000
Scenedesmus spp.	$1.3 \cdot 10^6$	890,000	407,000
Actinastrum hantzschii	+	+	+
Crucigenia spp.	-	+	-
Dictyosphaerium pulchellum	-	+	+
Kirchneriella contorta	+	-	-
Oocystis spp.	+	+	+
Pediastrum boryanum	+	+	+
Selenastrum capricornutum	+	-	+
Tetraëdron spp.	+	+	+

Chrysophyceae

While the development at Stations MA and MH was about the same in 1962 and 1963 (Figs. 14 and 19), higher values were obtained at Station MOB in autumn 1962 and in winter 1963. On 1/X 1962 the genus Synura caused the peak values at Station MOB; in November and in December Mallomonas akrokomos was most frequent. This species, however, also occurred in single specimens at Stations MA and MH. In winter small flagellates were most numerous at Station MOB.

Bicosoeca cylindrica was observed at all stations on 7 /V 1963; B. crystallina, however, was only recorded from Station MOB.

Diatomeae

There were no greater differences between the three stations as to the development of diatoms, Figs. 15 and 20. As a rule, lowest values were recorded at Station MH. On 6/VIII 1962 small Stephanodiscus spp. were most common at Station MOB; on 1/X 1962 Stephanodiscus astraea predominated at Station MA.

Cryptophyceae

Figs. 16 and 19. As to this group, differences were often found between the stations and the horisontal distribution in the lake was inhomogeneous. At Station MH great populations of both Cryptomonas and Rhodomonas were recorded on 21/V 1962; three weeks later Rhodomonas predominated. In December 1962, however, both genera were well developed at Station MOB, while they were almost lacking at Stations MA and MH. Otherwise, the group was without any significance at Station MOB with one exception, viz., on 28/V 1963, when Cryptomonas spp. were counted in ca 310,000 cells/l and Rhodomonas minuta in ca 5.5 million cells/l.

Other groups

The bacteriophytes have not been counted or studied in detail. As mentioned above, they occurred at all stations in immense quantities when the oxygen concentration was low. Especially, this could be studied during the winter 1962 - 1963 (cf. Fig. 4). At Station MOB large bacteriophyte populations were recorded from February to April 1963, inclusive.

At Station MA the samples from 8/I 1963 were relatively free from bacteriophytes and colourless organisms; in 12/II Sarcina tetras and some other bacteriophytes were recorded at 8.0 and 10.5 m; on 11/III bacteriophytes and some euglenophytes were observed at 3.0 m and at deeper levels; on 8/IV these organisms were recorded from the same levels: they were developed in immense quantities at the level of 5.0 m and deeper; on 7/V there was a marked stratification with the just mentioned organisms at 8.0 m and deeper and with "normal" populations of chlorophytes, diatoms etc. from surface down to this layer. On 28/V, finally, this stratification yet prevailed. The same conditions were observed at Station MH in 1963. At Station MOB, where the depth of water is only ca 5 m, no stratification existed during May; from February to April inclusive, however, the same bacteriophytes and colourless organisms had been common at this station.

Species belonging to the genera Hexamitus, Tetramitus, Scourfieldia, etc. (Polyblepharidinae) were most common at Station MOB, indicating a somewhat polluted water. Especially, they were frequent in late autumn and winter together with several bacteriophytes and euglenophytes Scourfieldia complanata, e.g., was counted at Station MOB in ca 800,000 cells/l on 11/XII 1962 and in ca 100,000 cells/l on 21/I 1963. At Stations MA and MH these taxa sometimes were observed in moderate quantities in winter and they also appeared at deeper levels with low oxygen concentration.

Total volumes

From Figs. 17 and 20 it is evident that the total volume values in general did not show any greater differences between the stations. It is clear, however, that all values from Station MOB were as high as those from Stations MA and MH or as a rule somewhat higher. On Fig. 17 the differences in winter have been visually over-dimensioned because of the type of diagram chosen, but at least in 1963 the populations at Station MOB were consequently the greatest. All marked differences between the stations have been discussed above.

CONCLUSIONS

Lake Magelungen is relatively rich in algal species. My list includes about 150 species, but the actual number is considerably higher as special studies have not been devoted to the great group of small flagellates etc. The chlorophytes belonging to the order of Chlorococcales are especially numerous. However, only few taxa occurred in large numbers and the most common of them have been enumerated above. In the future it is enough to count a limited number of taxa if it should be of interest to follow the further development of the lake.

In lakes of similar size and with relatively low values of specific conductivity and without any noticeable pollution diatoms and other chrysophyceans often predominate both as to number of species and of individuals. Lake Magelungen is an example of another type of lake where these groups are of secondary importance and where quite other groups, viz. cyanophytes and chlorophytes, predominate.

The total volume values of Lake Magelungen are very high in spring and summer, $10,000 - 15,000 \cdot 10^6 \mu^3/l$. These values may be compared with corresponding values from Lake Mälaren, the bay of Görväln: ca $6,000 \cdot 10^6 \mu^3/l$ (Willén 1959), a pond lake near Stockholm, Ösbysjön: ca $3,100 \cdot 10^6 \mu^3/l$ (Willén 1961 a) and a clear obligotrophic lake, S. Vixen: $1,900 \cdot 10^6 \mu^3/l$ (Willén 1961 b), etc.

Ahlgren (1963) has described another lake, Lake Norrviken, situated near Stockholm, where the algal composition and development is similar to that of Lake Magelungen. In Lake Norrviken cryptomonads and rhodomonads predominated on 23/V 1961. They were followed by chlorophytes at the beginning of June (Pediastrum, Coelastrum and Scenedesmus) and these in turn were followed by cyanophytes (especially Aphanizomenon flos-aquae) from the beginning of July. The last-mentioned species predominated until the lake was covered by ice. In winter bacteriophytes were developed in immense quantities. After a chlorophyte maximum in connection with the breaking up of the ice in April 1962, diatoms (especially Stephanodiscus hantzschii var. pusillus) predominated in May. The total volume values were higher in Lake Norrviken, mainly due to the great cyanophyte populations. This lake, however, is more directly polluted than Lake Magelungen.

In general the same taxa were observed at the three different stations investigated in Lake Magelungen. At Station MOB, however, some species belonging to the groups Bacteriophyta, Polyblepharidinae and Euglenophyta were also common. They indicated that the water at this station was more polluted than that in the open lake. The total volume values of phytoplankton were also somewhat higher at Station MOB.

Further additions of nutritional elements to the lake probably will increase the algal and bacterial populations thus causing considerable water bloom and other troubles. The reeds which already nowadays are large will grow denser and higher. The thermal balance of the water may be changed by the release of waste water. Then other conditions may be offered: the normal stratification will be changed by water movements, bottom water with nutritional elements put into circulation, etc. and these conditions may result in increased algal growth. It seems important to follow the future development of the lake in detail.

REFERENCES

AHLGREN, G and AHLGREN, I,
Näringsbalans och primärproduktion i sjön Norrviken. - Mimeographed Institute of Limnology, Uppsala. 1963.

FLORIN, M-B,
Plankton of fresh and brackish waters in the Södertälje area. - Acta Phytogeogr. Suec., 37 (1957).

HUSS, H and SONDÉN, K,
Vattnet i sjöar och vattendrag inom Stockholm och i dess omgivningar. Stockholms stads hälsovårdnämnd. Serie 2, 1920.

KAARET, P,
Wasservegetation der Seen Orlången und Trehörningen. - Acta Phytogoegr. Suec., 32 (1953).

LOHMANN, H,
Untersuchungen zur Feststellung des vollständigen Gehaltes des Meeres an Plankton. - Wiss. Meeresunters. N.F. Abt. Kiel. 10 (1908).

LUNDQVIST, G,
Drag ur Stockholmstraktens hydrografi. - Ymer 50 (1930).

RUTTNER, F,
Die Verteilung des Planktons in Süsswasserseen. - Fortschr. naturwiss. Forsch. 10 (1914).

TEILING, E,
En kaledonisk fytoplanktonformation. - Svensk Bot. Tidskr. 10 (1916).

THOMASSON, K,
Die Kugelkurven in der Planktologie. - Int. Revue ges. Hydrobiol. 47 (1963).

UTERMÖHL, H,
Zur Vervollkommung der quantitativen Phytoplankton-Methodik. - Mitt. int. Ver. Limnol. 9 (1958).

WILLÉN, T,
The phytoplankton of Görväln, a bay of Lake Mälaren. - Oikos 10 (1959).

WILLÉN, T,
a. The phytoplankton of Ösbysjön, Djursholm.
I. Seasonal and vertical distribution of the species.
Oikos. 12 (1961) 1.

WILLÉN, T,
b. Lake Södra Vixen, S.Sweden, and its phytoplankton. - Bot. Notiser 114 (1961).

WILLÉN, T,
a. The Utål Lake Chain, Central Sweden, and its phytoplankton. - Oikos, Suppl. 5 (1962).

WILLÉN, T,
b. Studies on the phytoplankton of some lakes connected with or recently isolated from the baltic. - Oikos. 13 (1962) 2.

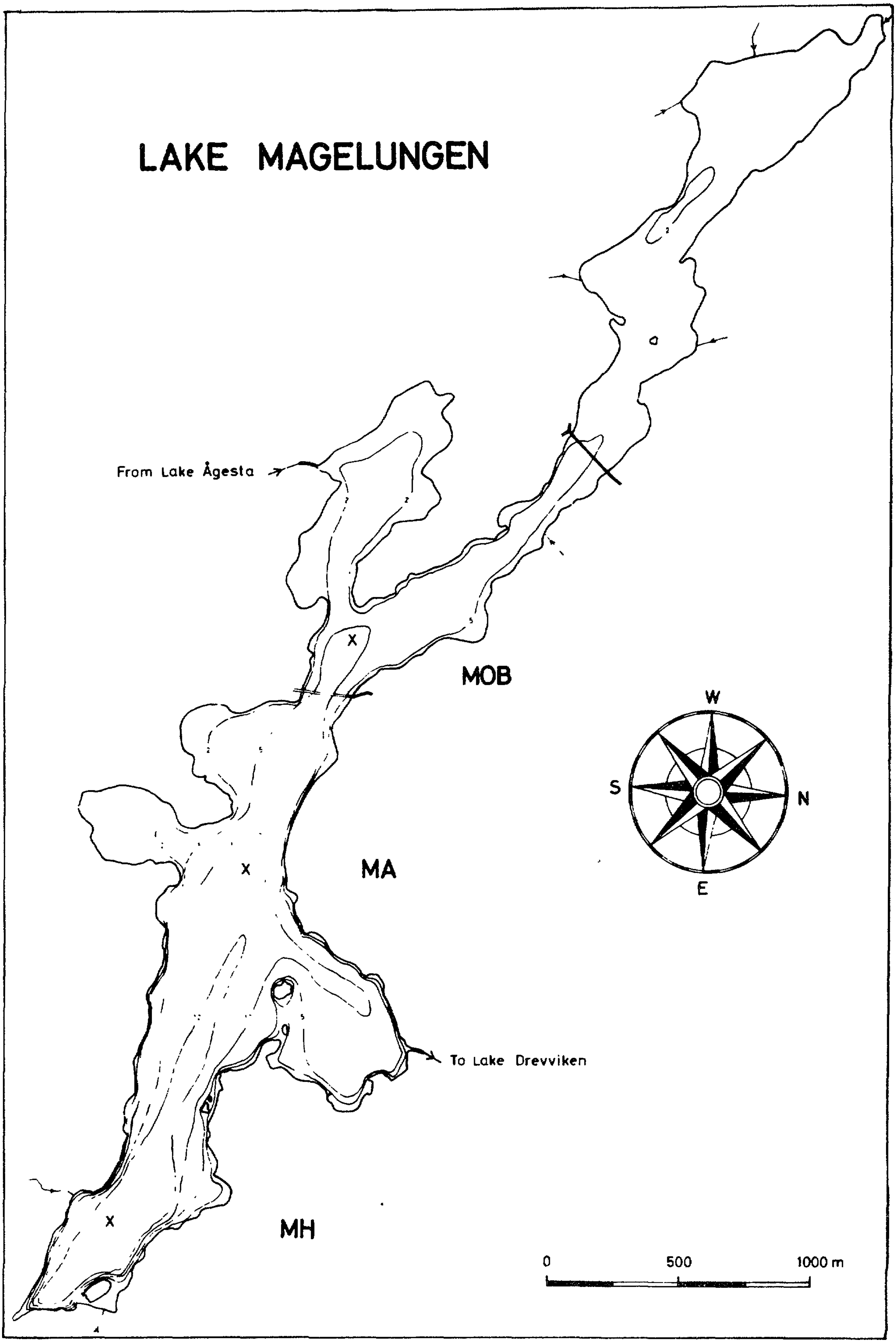

Fig. 1. Map of Lake Magelungen showing the situation of Stations MA, MOB, and MH and isobaths for 2.0 m, 5.0 m, 10.0 m and 12.0 m.

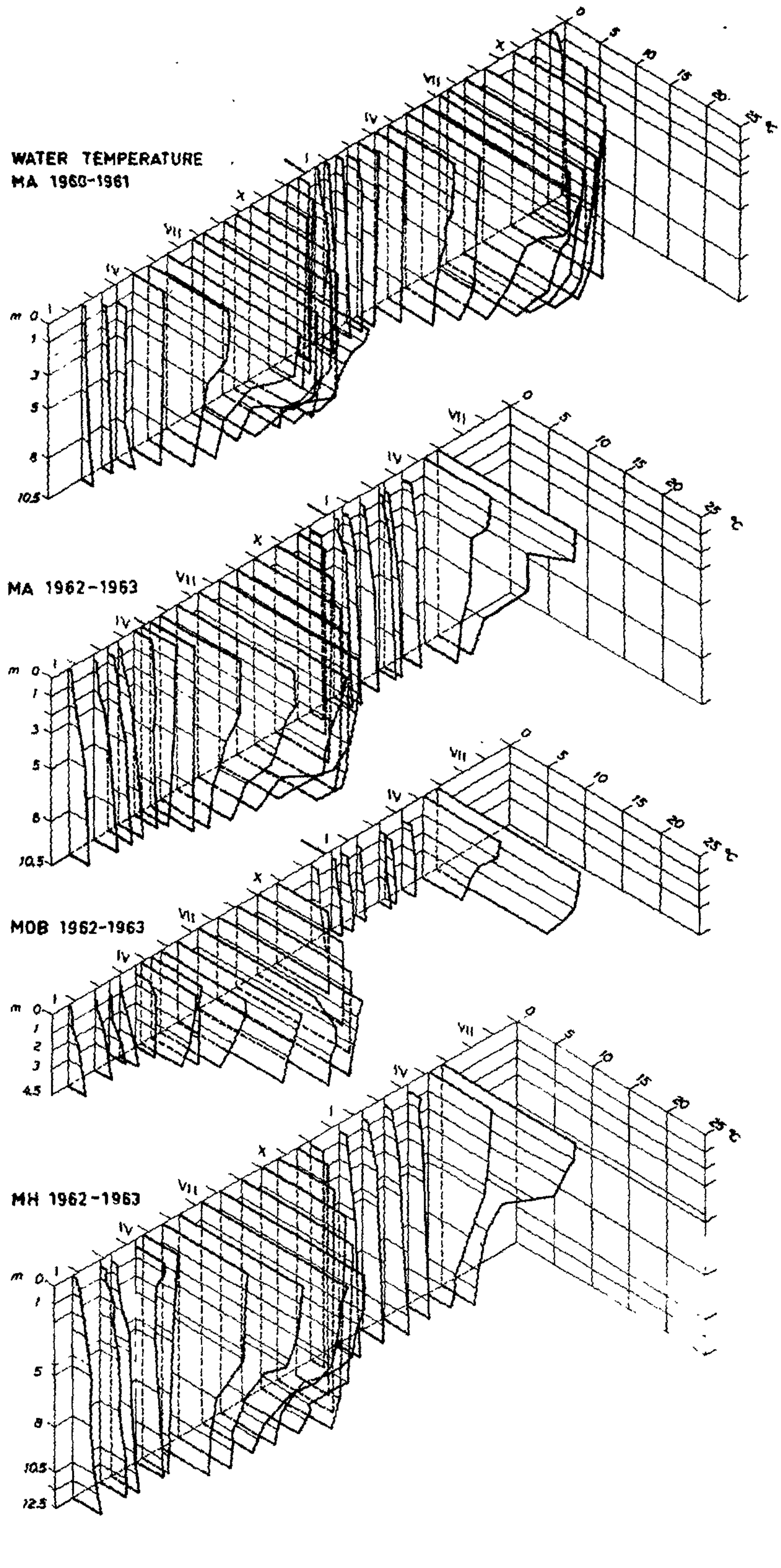

Fig. 2. Water temperature at the different stations, 1960 - 1963.

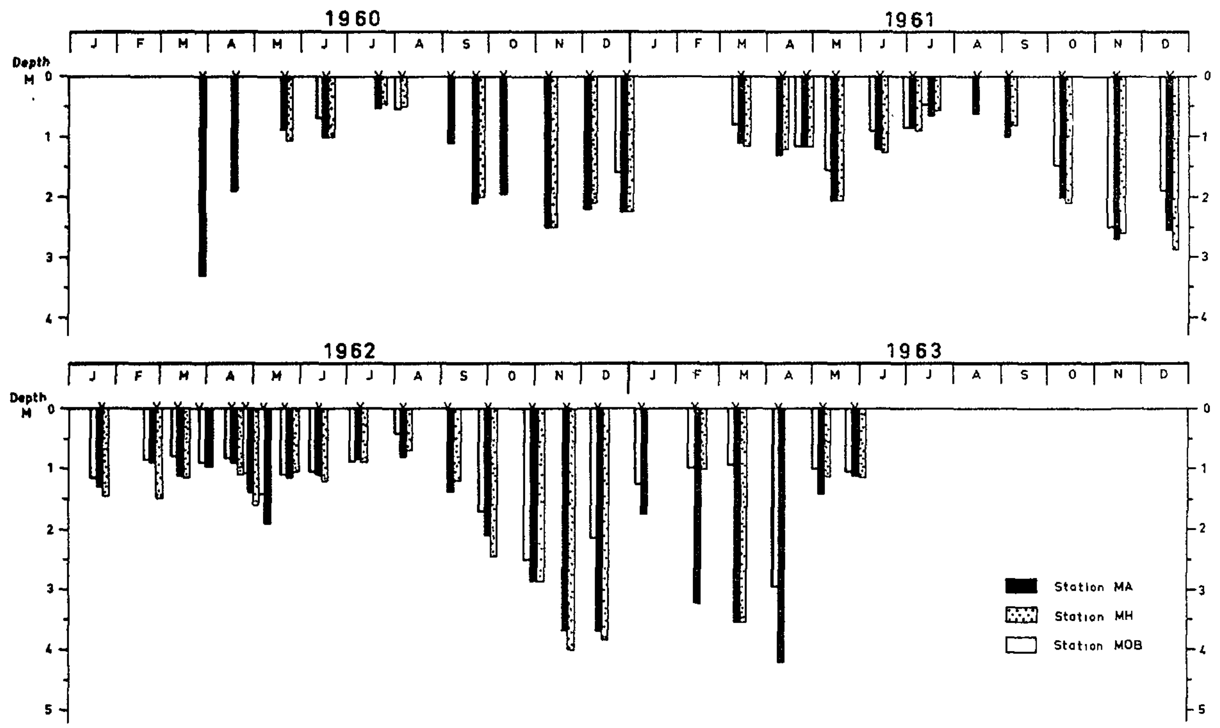

Fig. 3. Transparency values from the different stations, 1960 - 1963 .

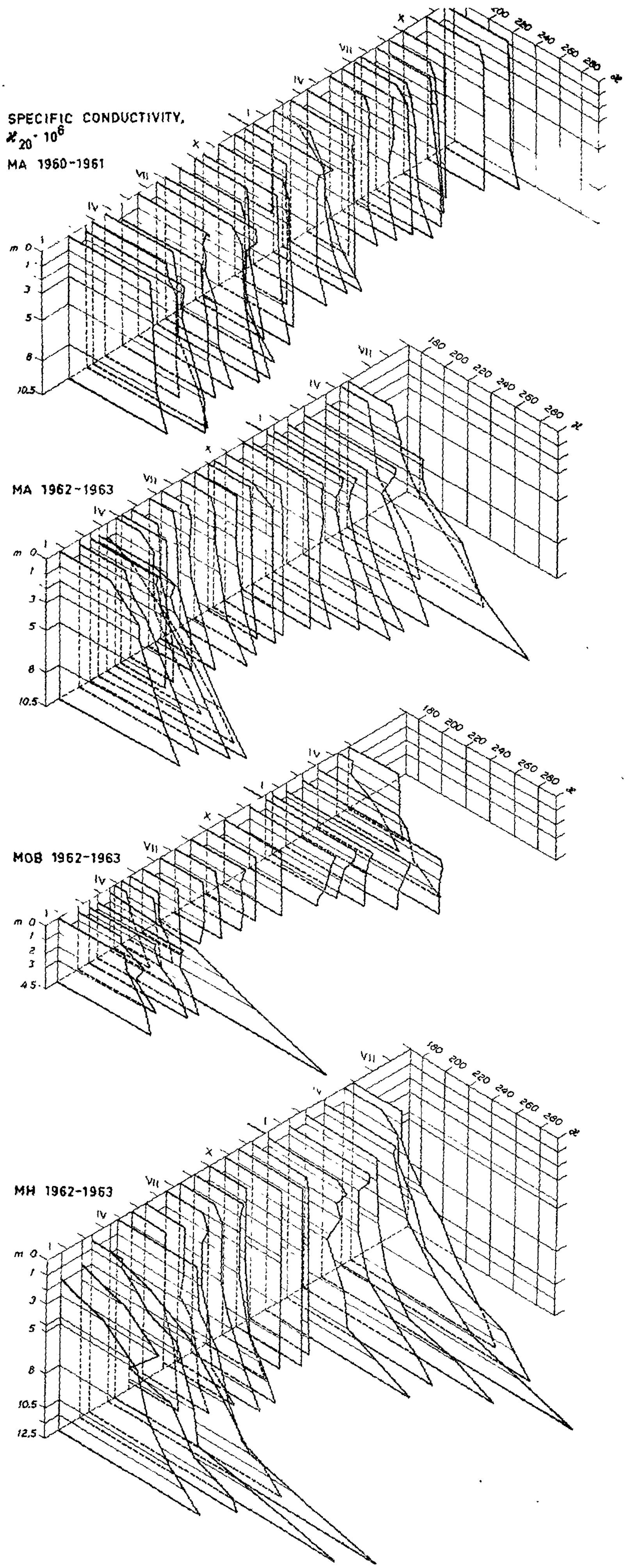

Fig. 4. Specific conductivity, $\varkappa_{20} \cdot 10^6$, at the different stations, 1960 - 1963.

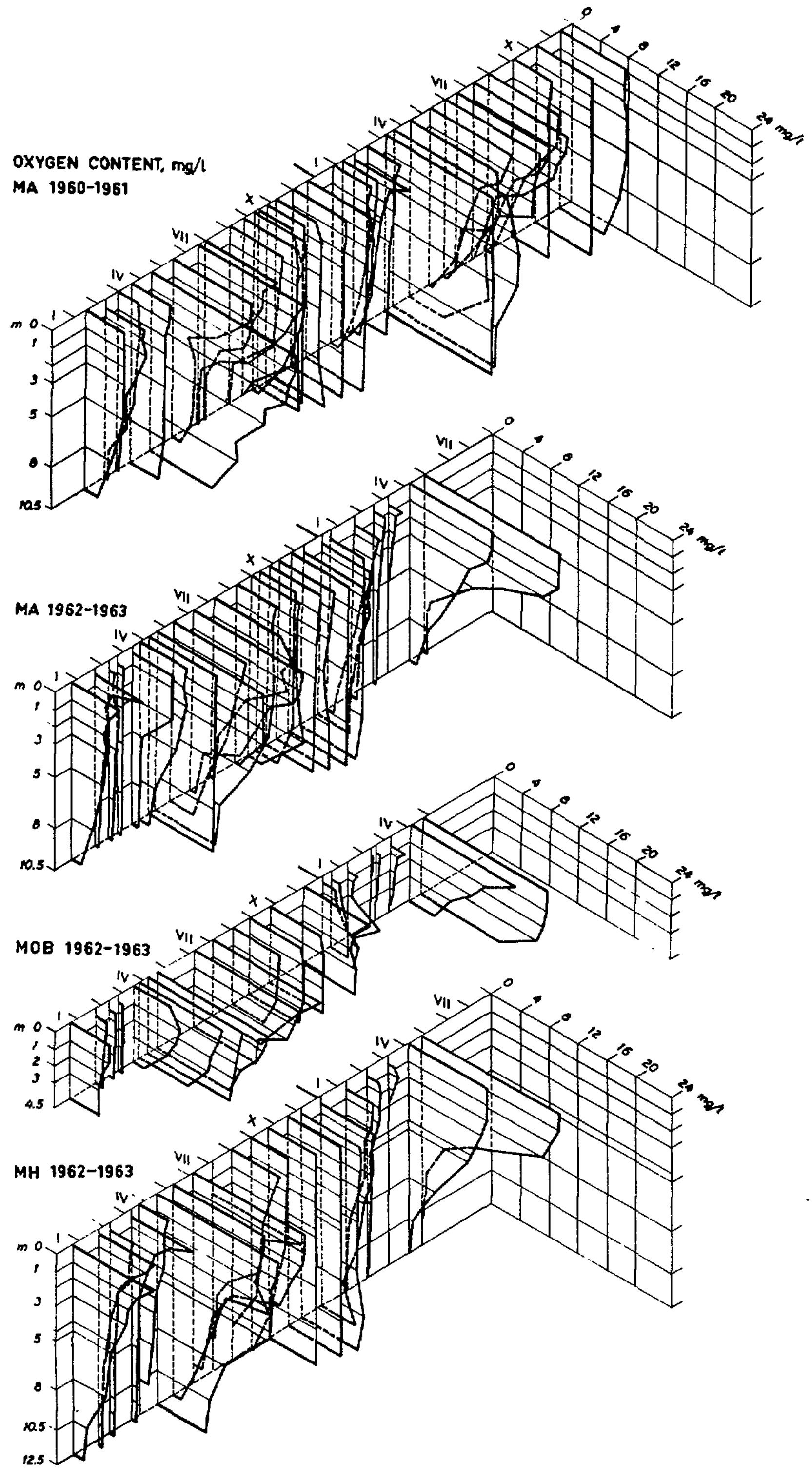

Fig. 5. Oxygen content, mg/l, at the different stations, 1960 - 1963.

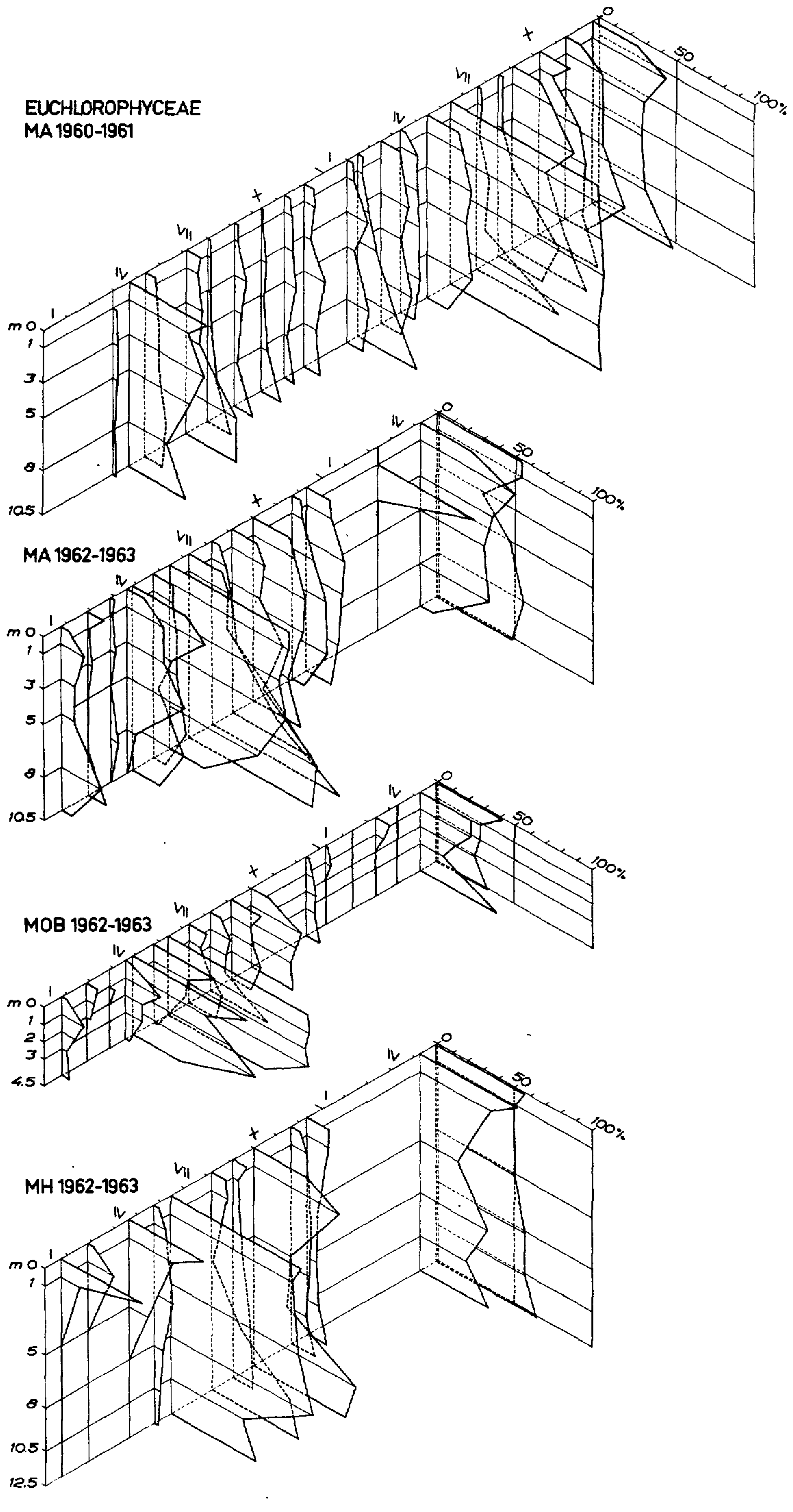

Fig 7. Percentage distribution of Euchlorophyceae.

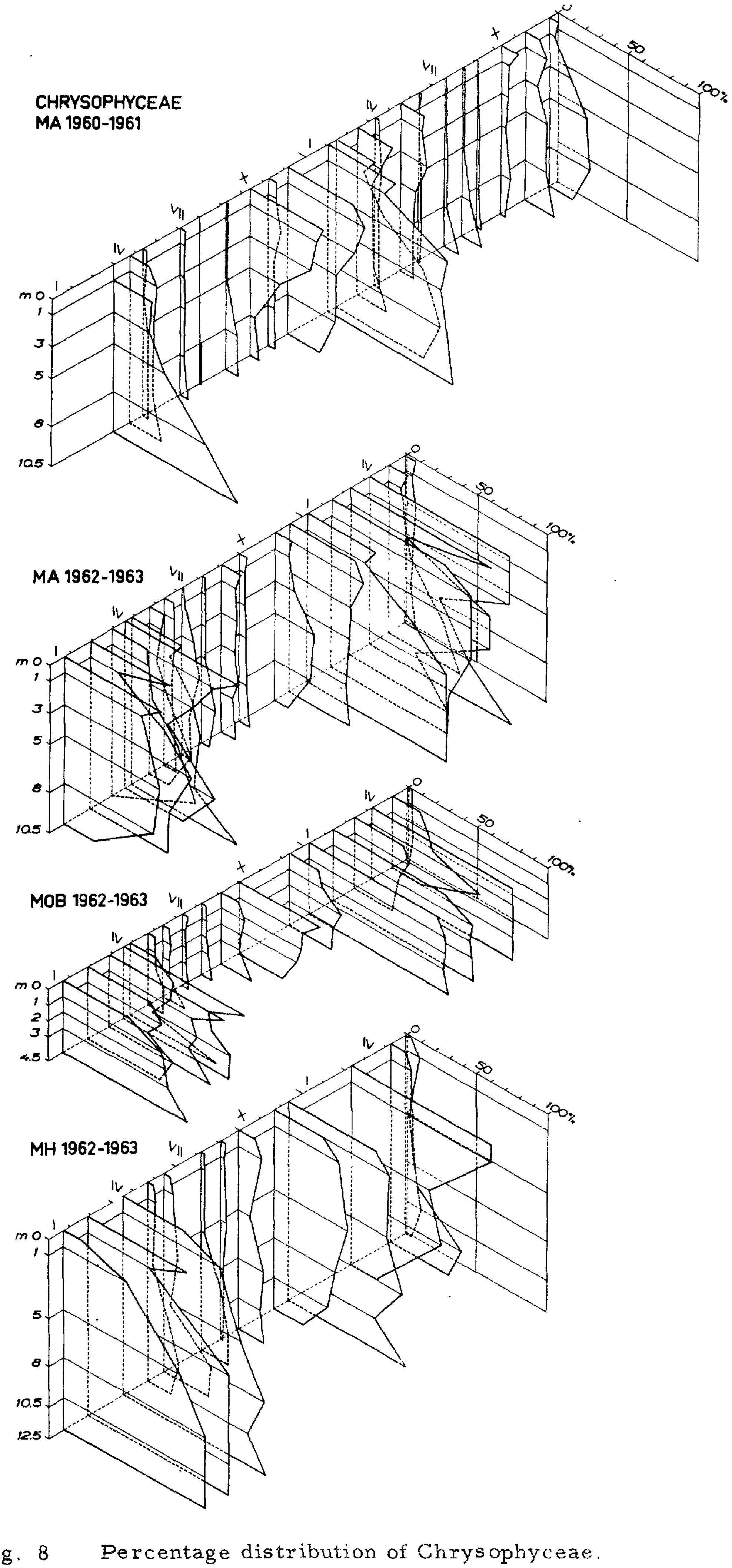

Fig. 8 Percentage distribution of Chrysophyceae.

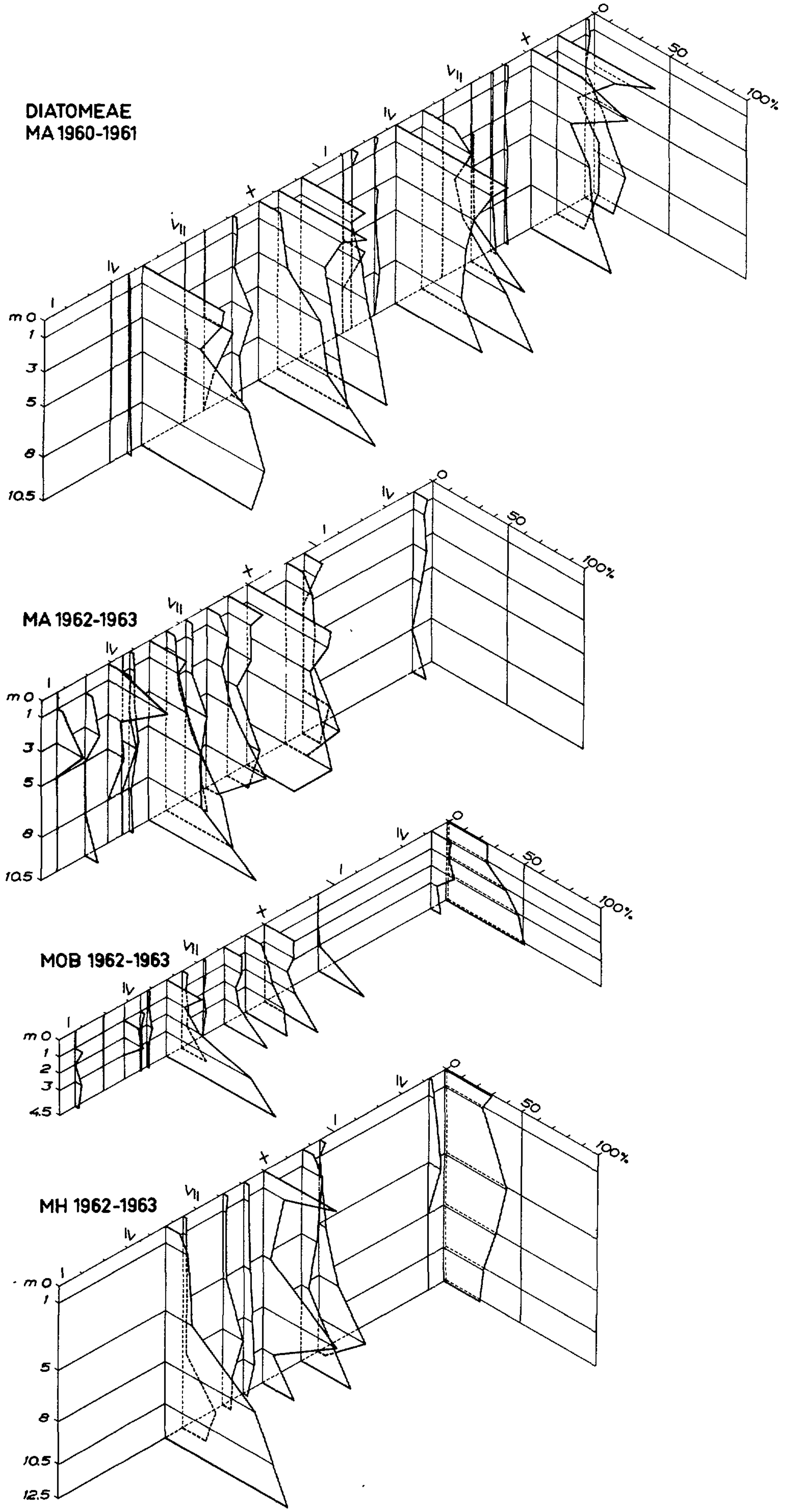

Fig. 9. Percentage distribution of Diatomeae.

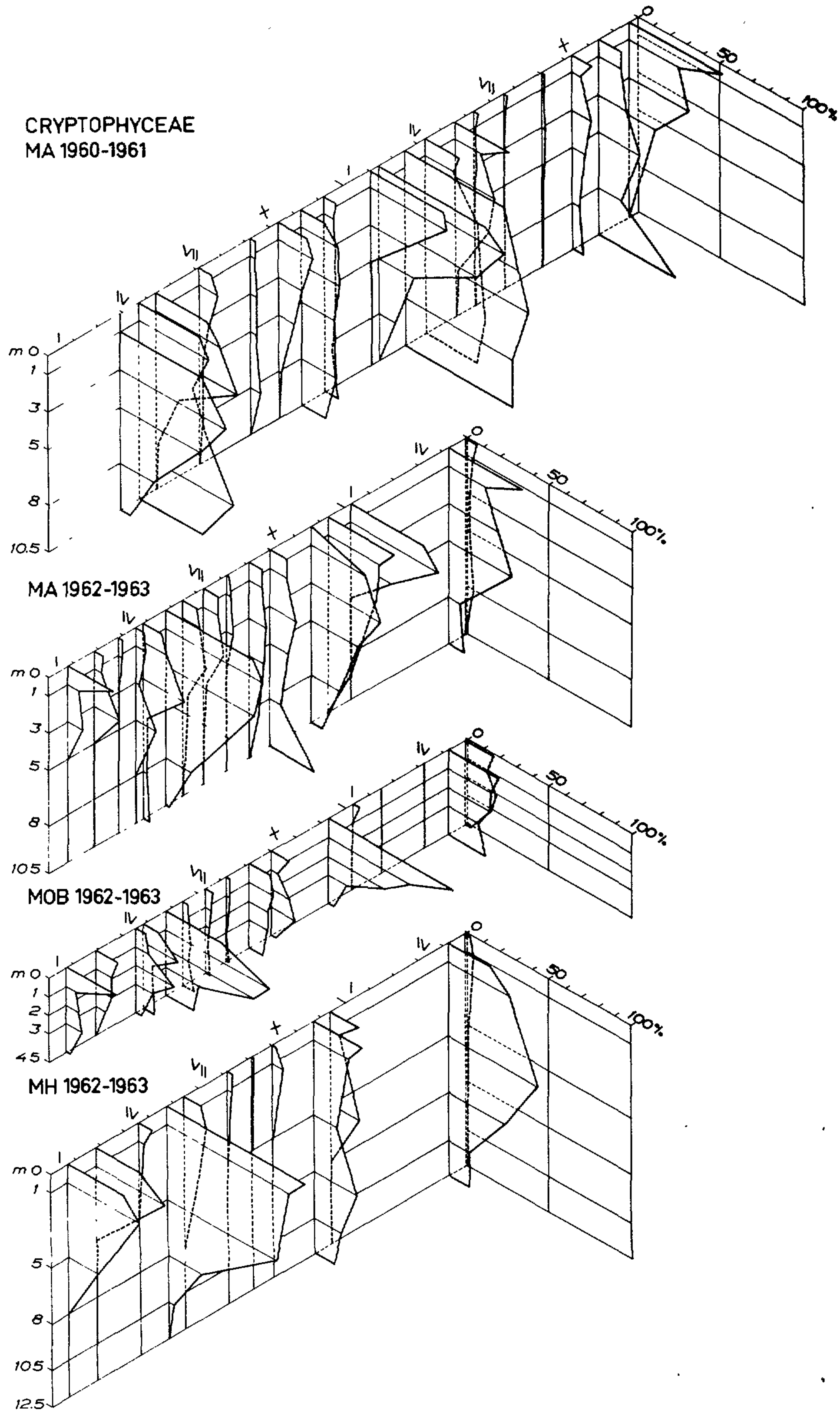

Fig. 10. Percentage distribution of Cryptophyceae.

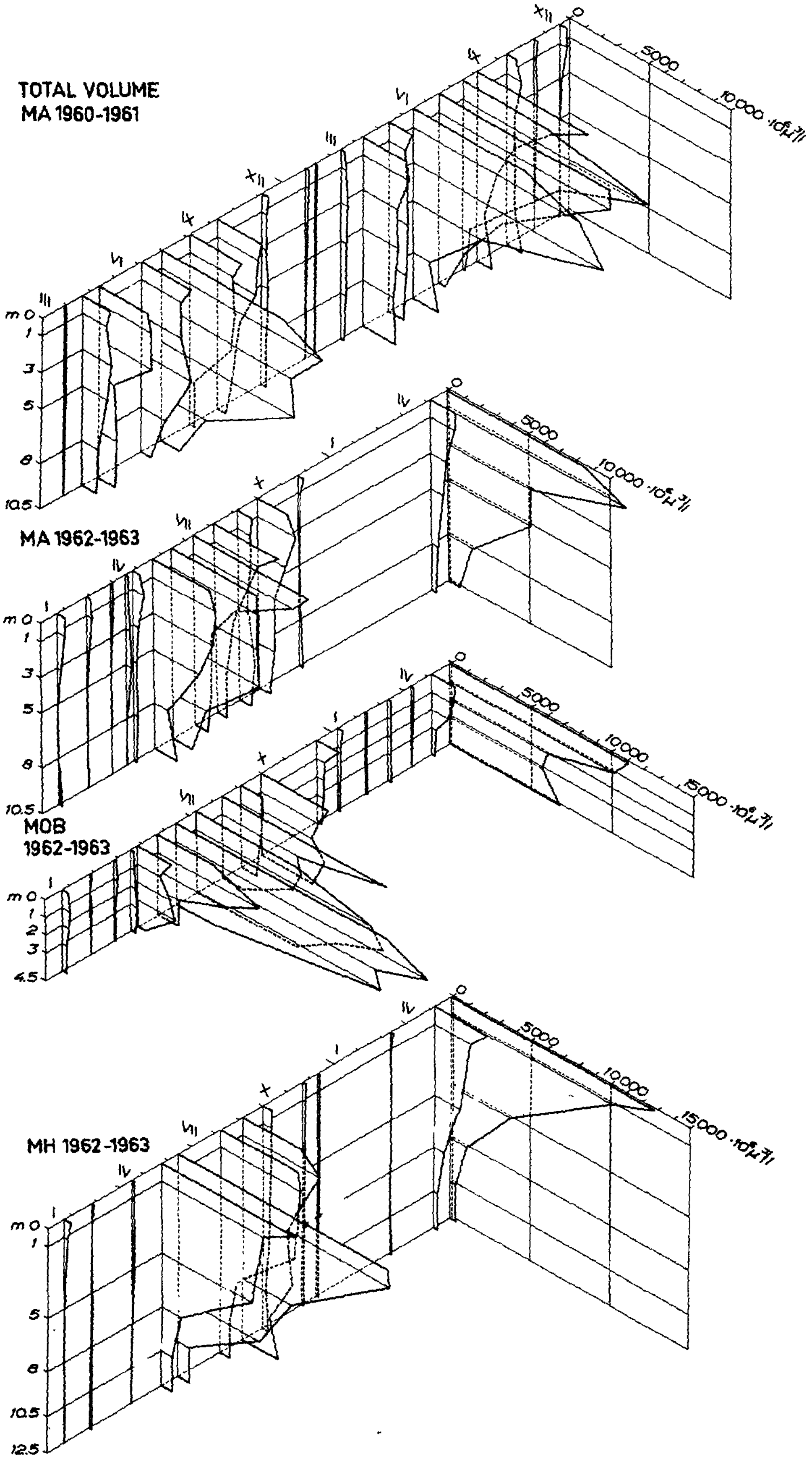

Fig. 11. Total volume values, $10^6 \mu^3/l$ (=$\mu g/l$).

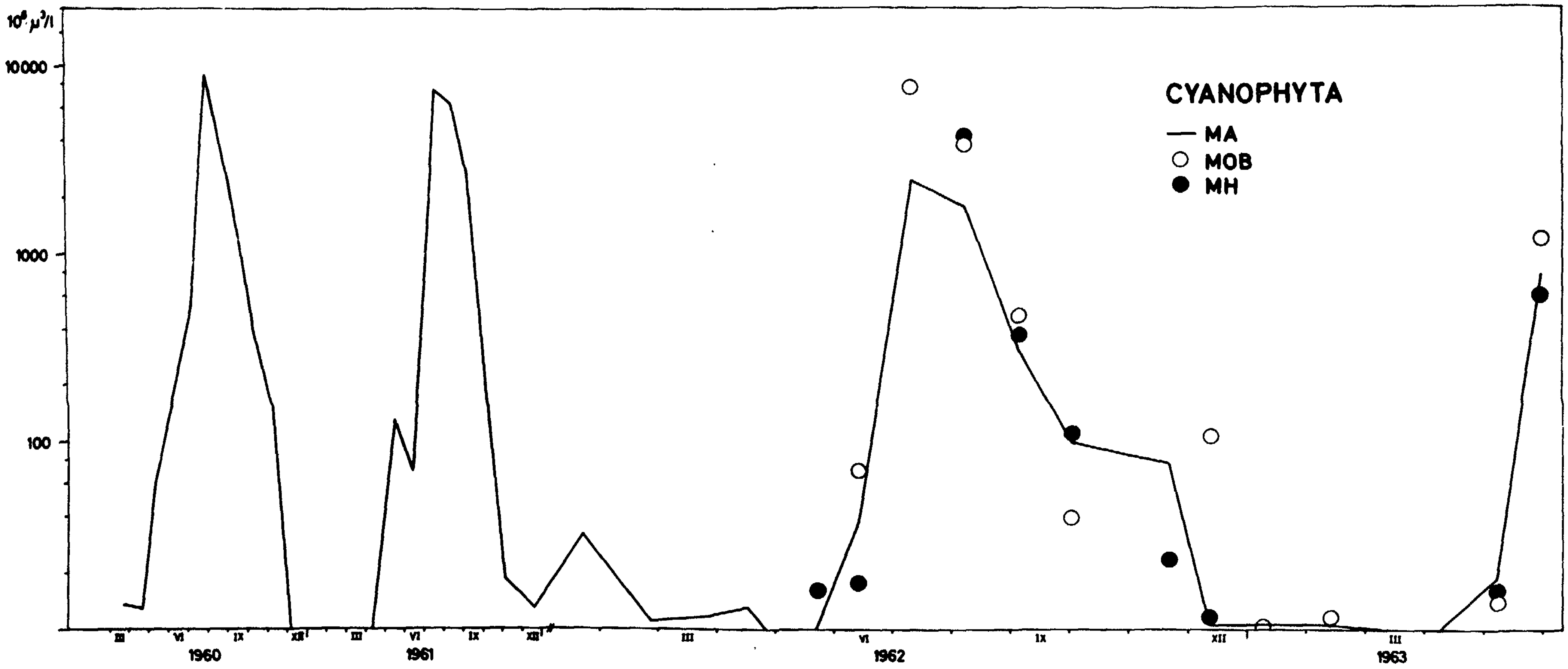

Fig. 12. Distribution of Cyanophyta 1960 - 1963; average values 0.2 - 5.0 m.

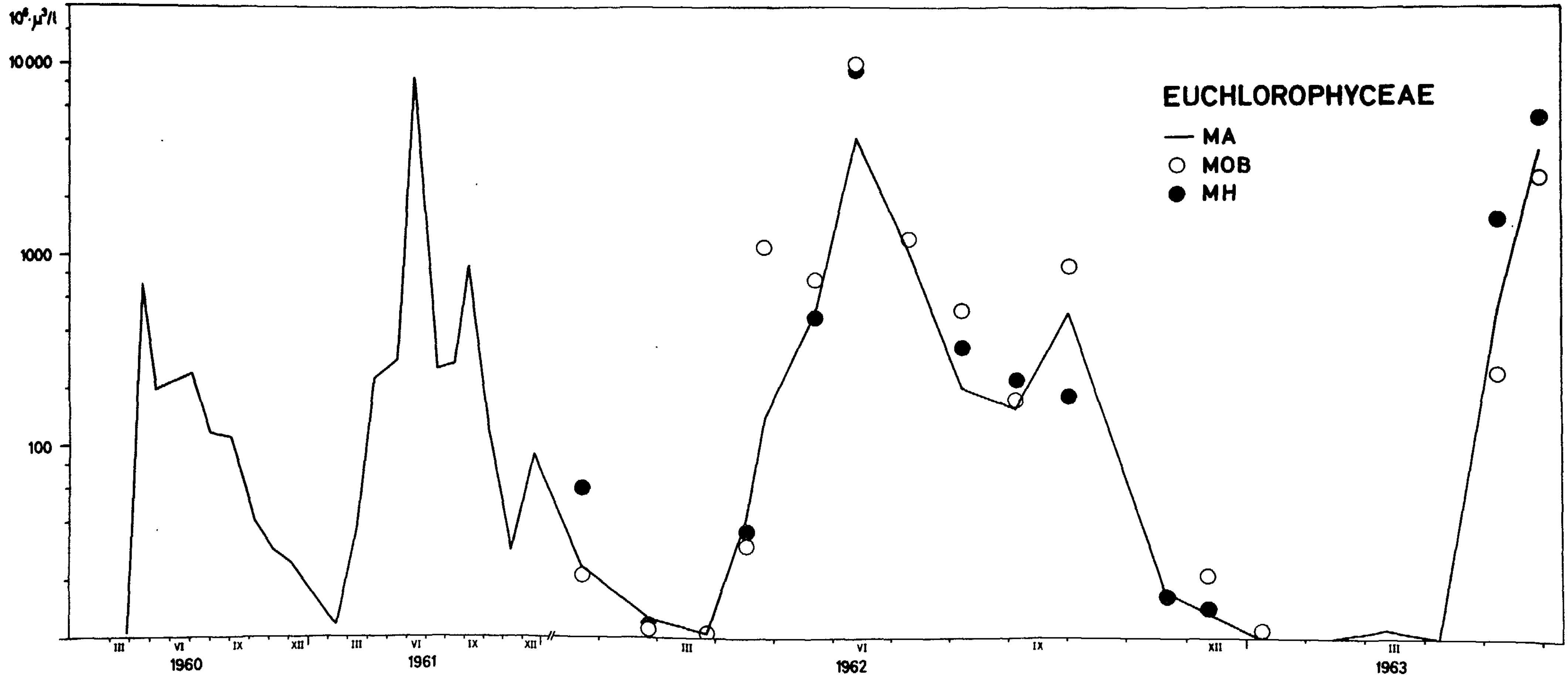

Fig. 13. Distribution of Euchlorophyceae 1960 - 1963; average values 0.2 - 5.0 m.

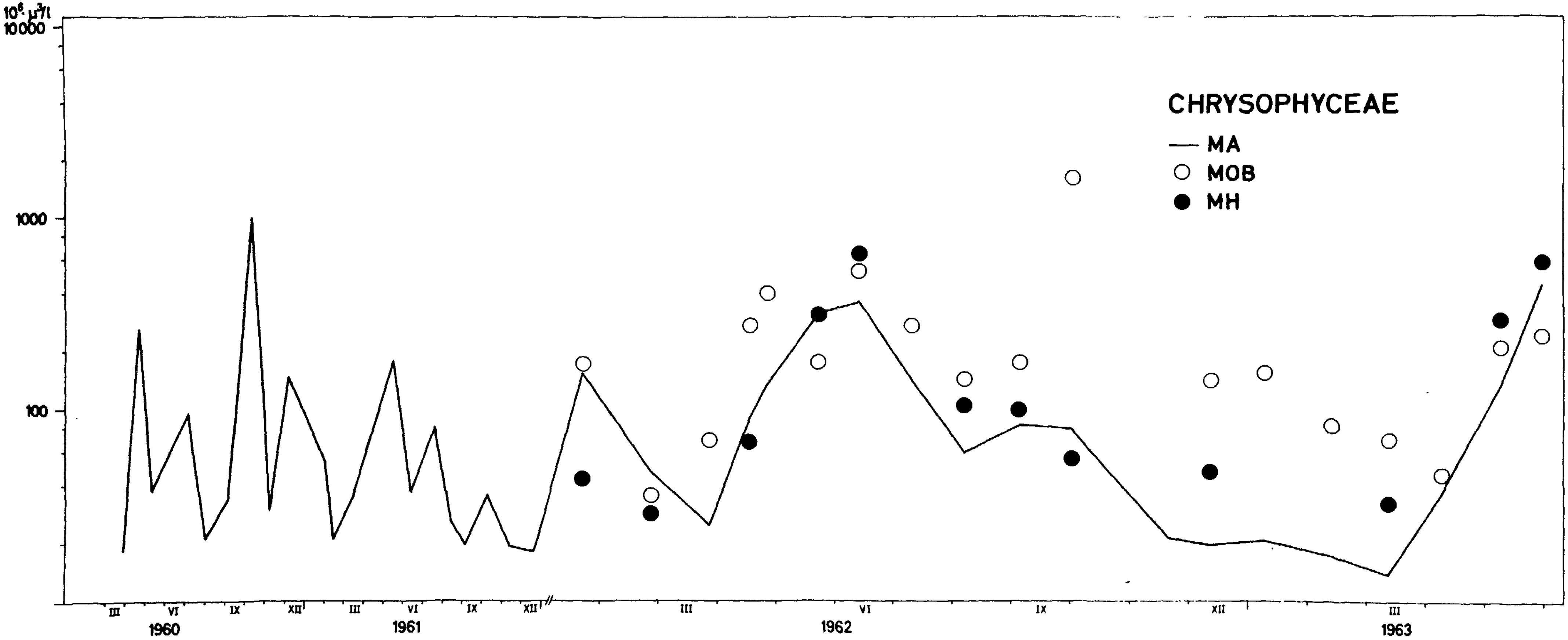

Fig. 14. Distribution of Chrysophyceae 1960 - 1963; average values 0.2 - 5.0 m.

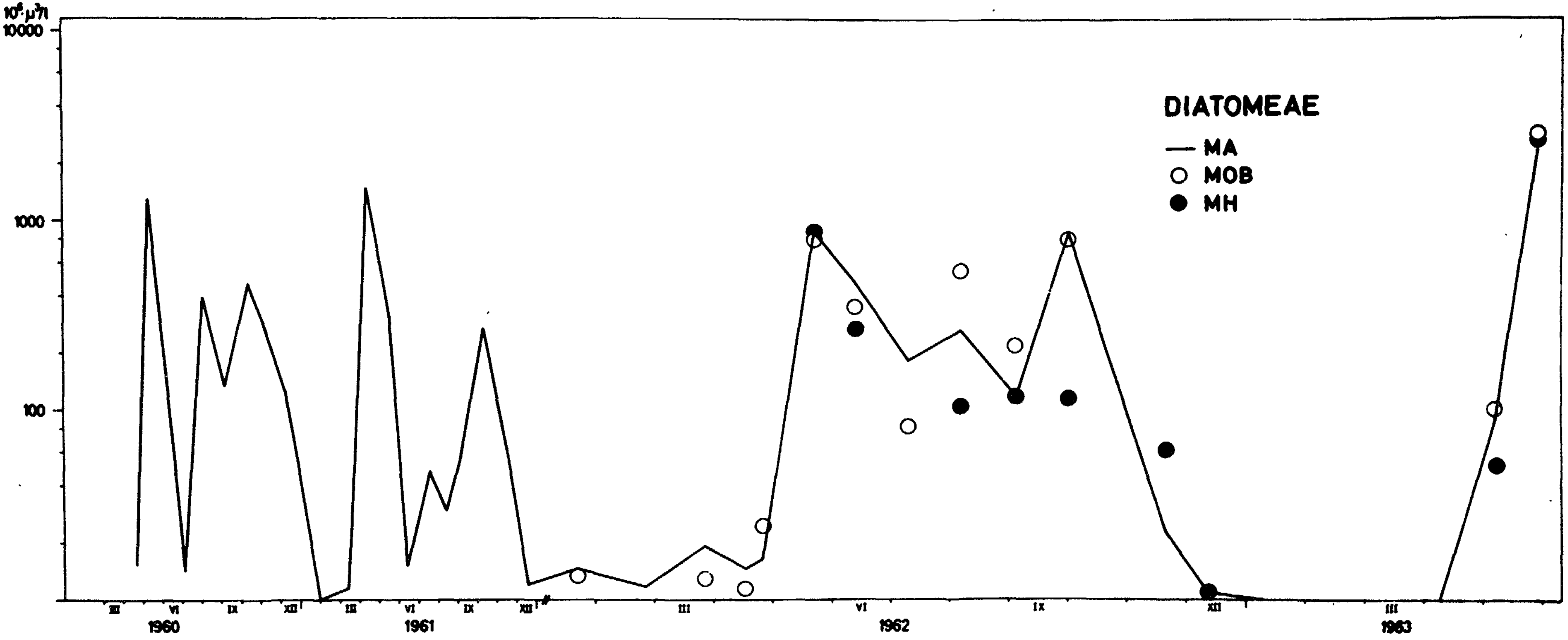

Fig. 15. Distribution of Diatomeae 1960 - 1963; average values 0.2 - 5.0 m.

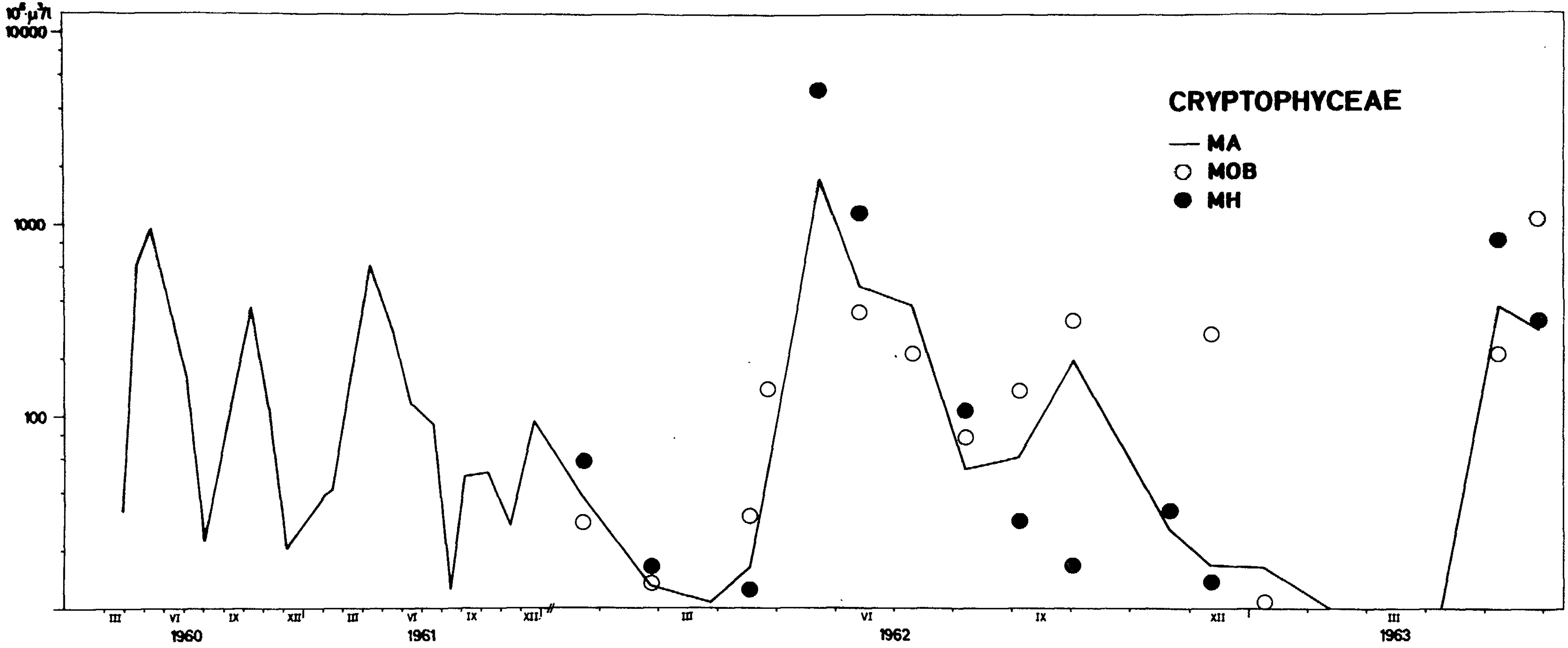

Fig. 16. Distribution of Cryptophyceae 1960 - 1963; average values 0.2 - 5.0 m.

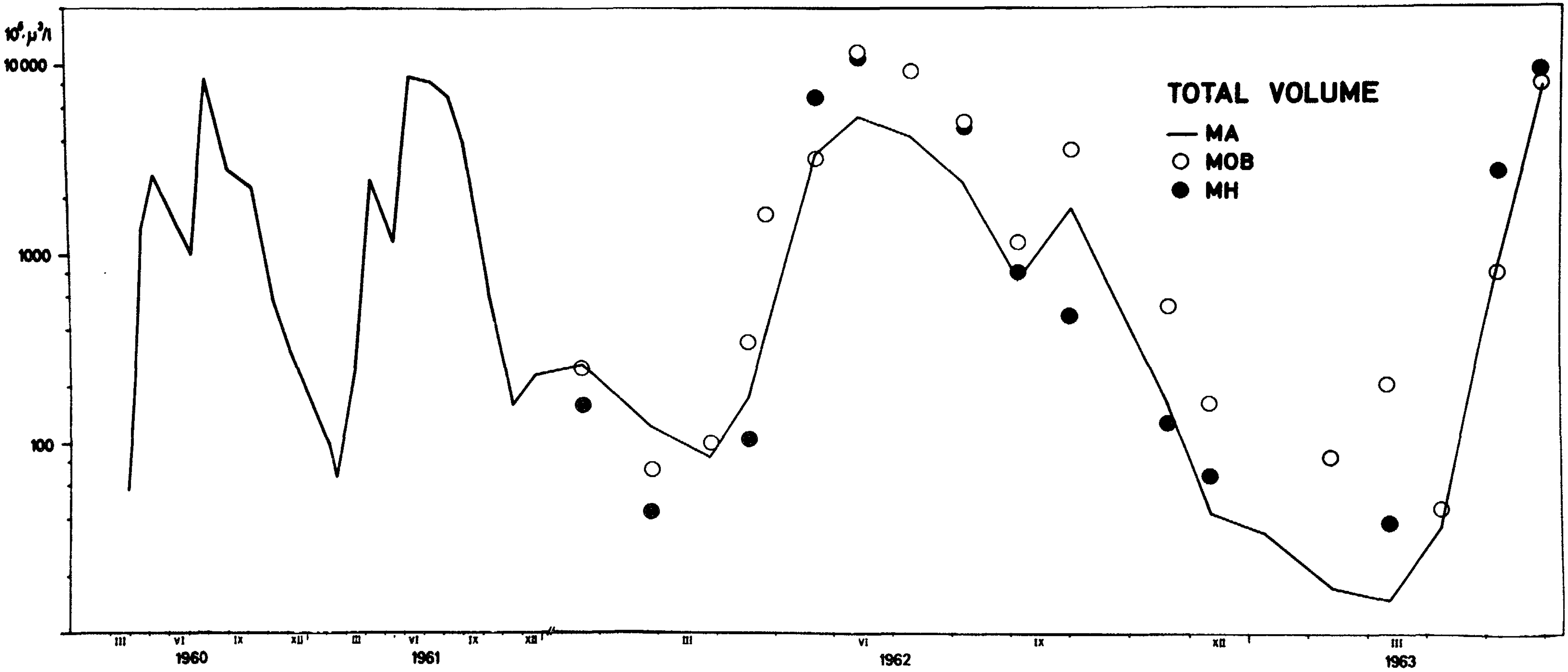

Fig. 17. Total volume of phytoplankton 1960 - 1963; average values 0.2 - 5.0 m.

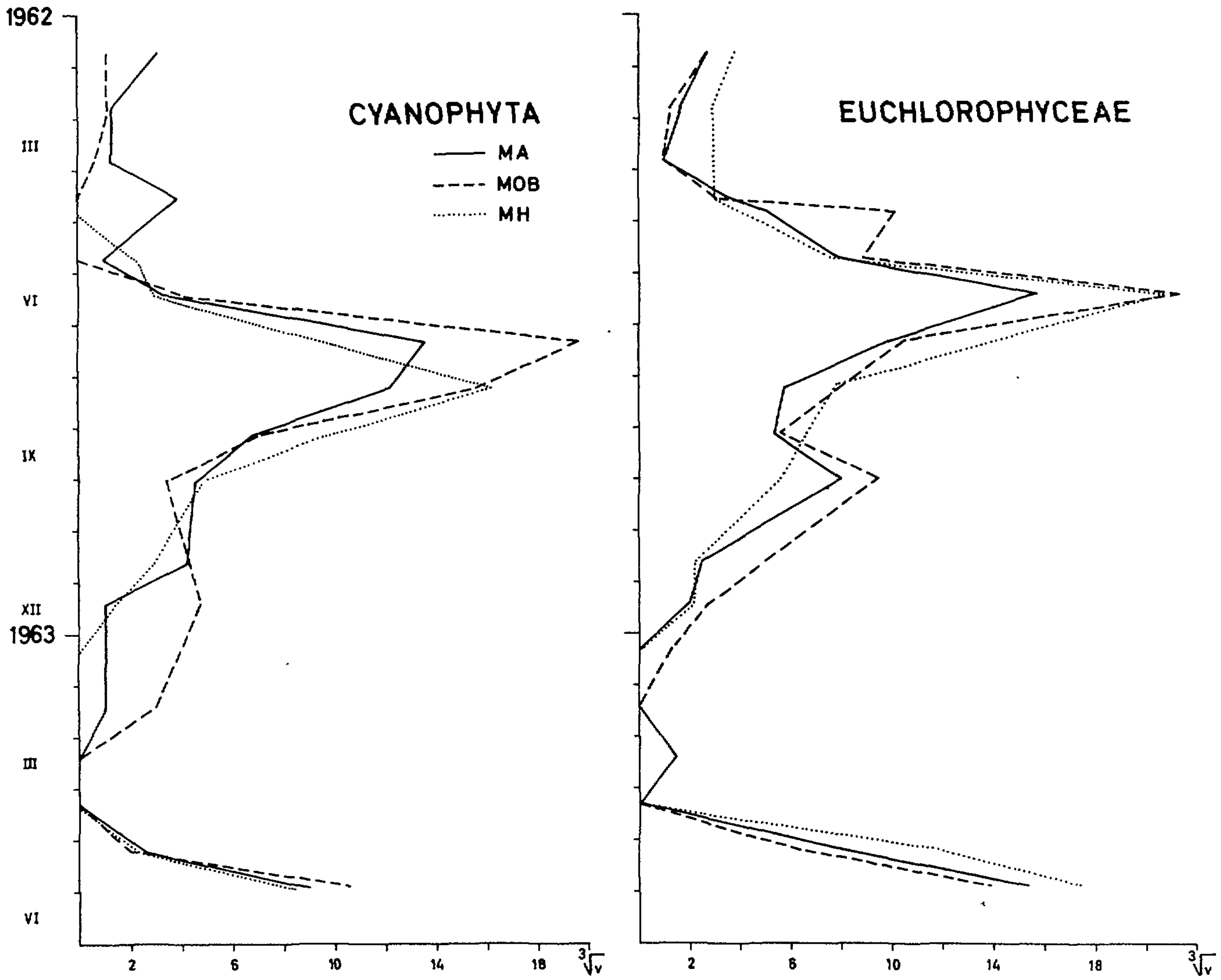

Fig. 18. Distribution of Cyanophyta and Euchlorophyceae at the different stations 1962 - 1963; average values 0.2 - 5.0 m.

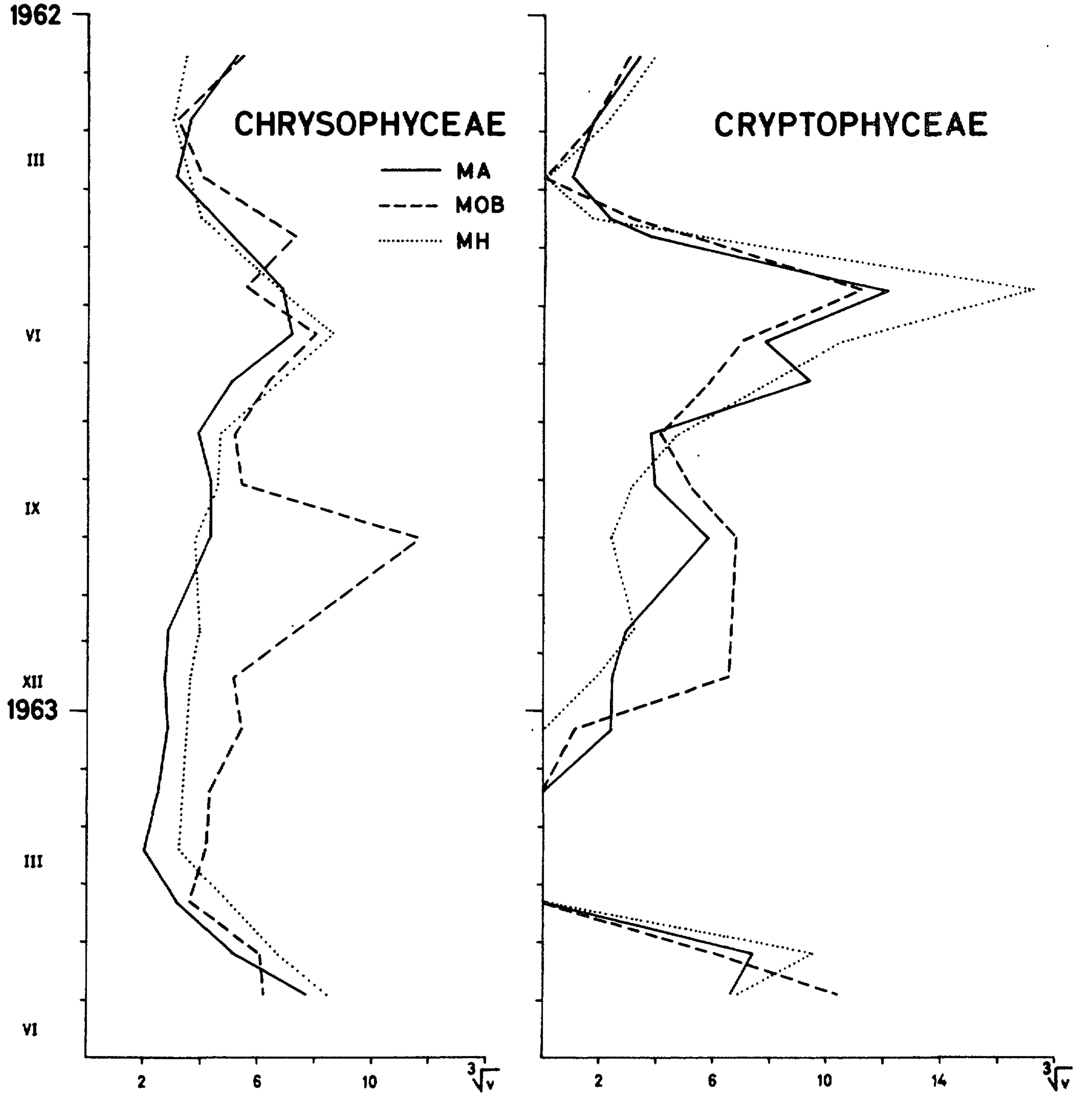

Fig. 19. Distribution of Chrysophyceae and Cryptophyceae at the different stations 1962 - 1963; average values 0.2 - 5.0 m.

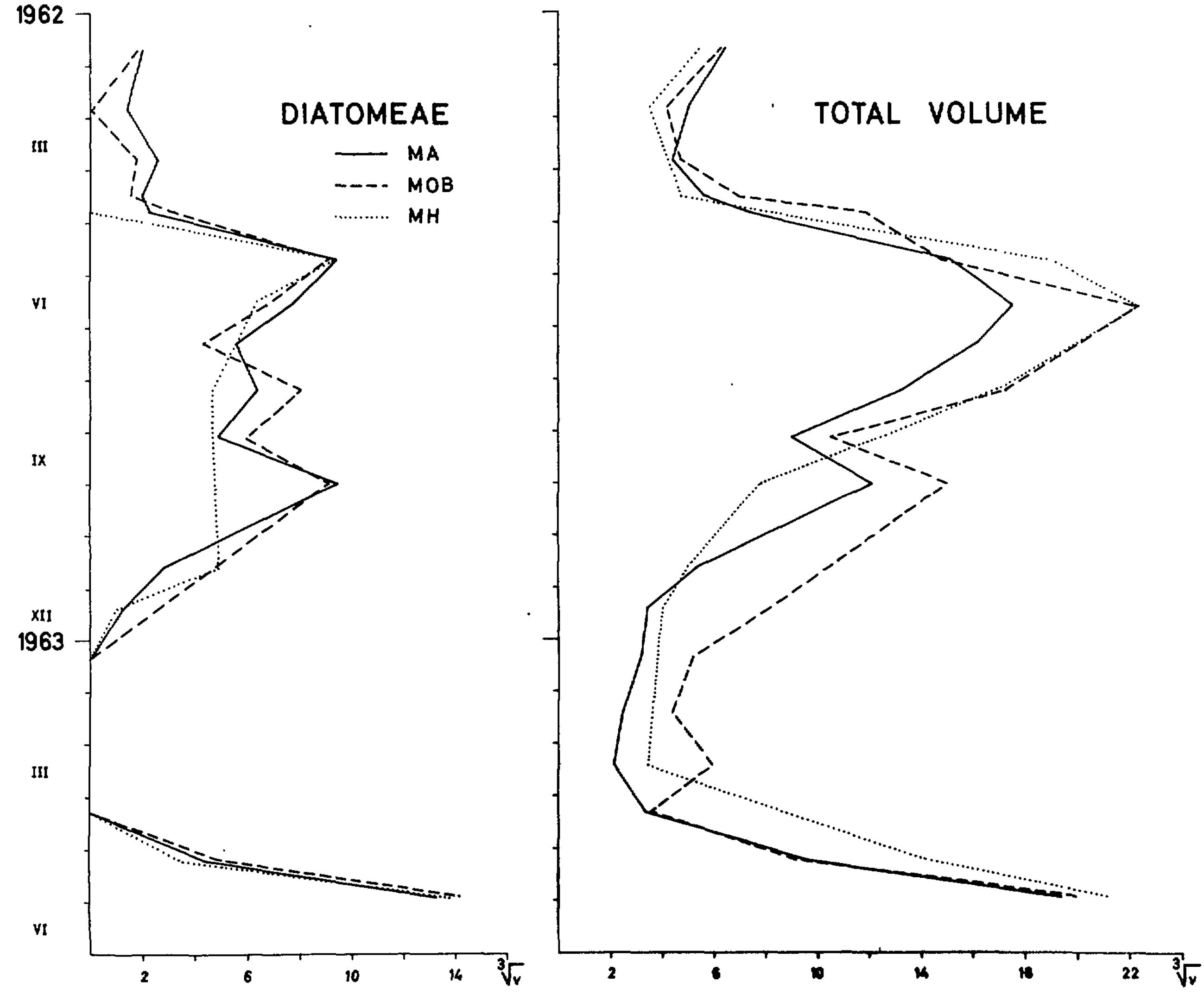

Fig. 20. Distribution of Diatomeae and total volume at the different stations 1962 - 1963; average values 0.2 - 5.0 m.

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