Transactions of the Royal Society of New Zealand 581
Vol. 76, Part 4, pp. 581–588, 5 Figures, 1 Plate.

The Growth of a Species of the Genus *Lilaeopsis* in Fresh-water Reservoirs near Wellington.

By Greta B. Stevenson,
Department of Scientific and Industrial Research.

[*Read before Wellington Branch, October 4, 1946; received by Editor, October 8, 1946; issued separately, September, 1947.*]

Summary.

The growth is described of an unidentified *Lilaeopsis* species which, after seasons when the water level has fluctuated, forms extensive areas of dense turf on soft mud under shallow fresh water in the reservoirs of the Wellington City Council. When fermentation in the mud is active bubbles of gas collect beneath the turf, raising large blisters to the surface, where the wind breaks the turf and carries masses of it round the reservoir. Reduction of the water level for several fine days together not less frequently than once a year together with weeding and removal of soft mud is recommended in order to retard the development of large areas of *Lilaeopsis* turf and, at the same time, to check the growth of larger waterweeds.

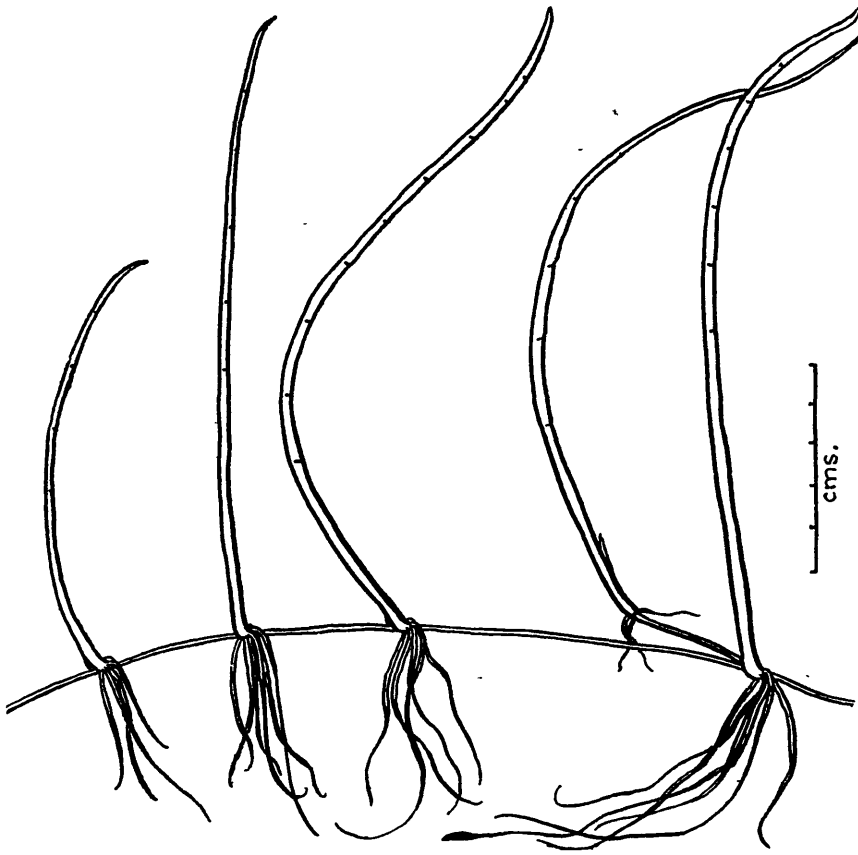
Introduction.

Plants referable to the genus *Lilaeopsis* are found in the neighbourhood of Wellington in many places round the coast, growing sparsely close to the sea, where they may be submerged occasionally by fresh or brackish water. The flattened, jointed leaves, approximately 4 to 8 cm. long, are characteristic, but when, more rarely, plants grow submerged in these situations the leaves are longer and terete. When the writer first visited the Wellington City Council Waterworks at Wainui-o-mata she was surprised to find in Morton reservoir that large areas of mud, many square metres in extent under shallow water, were covered exclusively by a dense sward of a *Lilaeopsis* species. This plant, which was growing only under water, had freely running rhizomes closely interlaced with membranous, terete, septate leaves, 6 to 36 cm. long and 3 to 4 mm. in diameter. A typical plant is illustrated in Text Fig. 1.

Distribution.

The four storage reservoirs of the Wellington City Council were examined and this waterweed was found in three of them.

Morton reservoir, which has a capacity of 97,000,000 gallons, was built in 1908. In January, 1941, it carried a dense turf of the *Lilaeopsis* species over all the large shallow-water areas from the shore to a line roughly corresponding to 1–1·25 m. depth of water. Over the *Lilaeopsis* were growing in places two larger waterweeds, *Potamogeton cheesemanii* Bennet and *Myriophyllum propinquum* Cunn., both of which extended into deeper water reaching a maximum depth of 2·25 m. An indication of the distribution of these weeds in Morton reservoir in January, 1941, is given in Text Fig. 2.

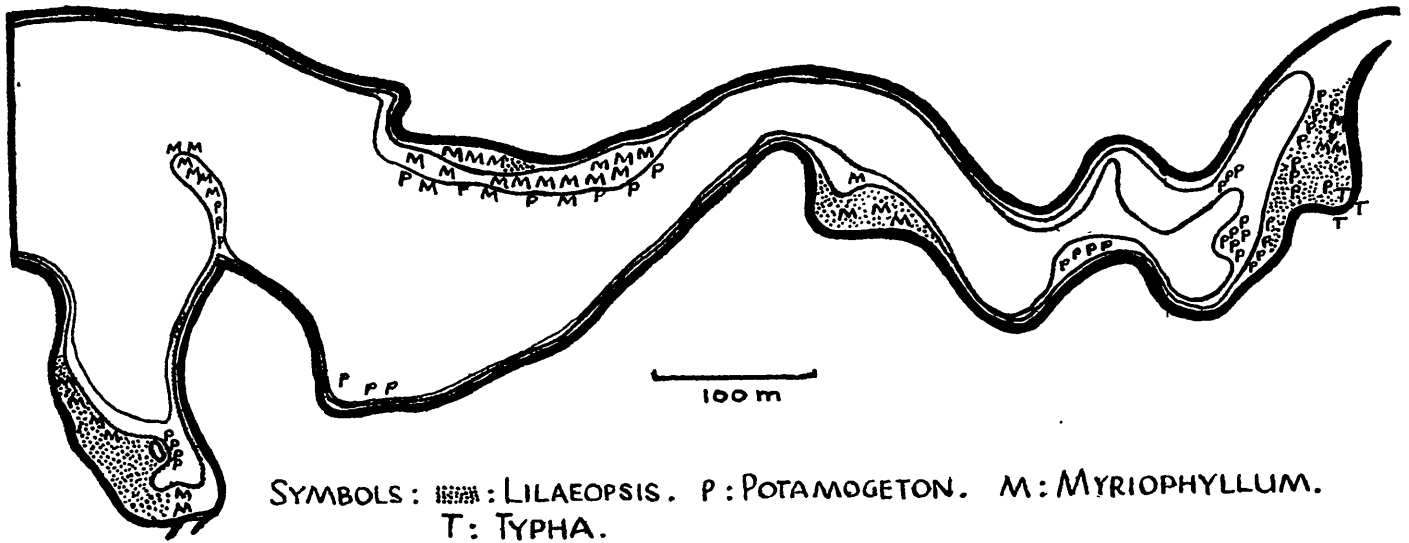


TEXT FIG. 1.—Typical subaqueous growth.

The lower reservoir at Wainui-o-mata, 0·6 km. from the Morton dam, has a capacity of 20,000,000 gallons and was built in 1884. The dominant plant in the shallow water of this reservoir was found to be *Typha angustifolia* L., which formed a dense thicket along the margin, ending in water approximately 1 m. deep. There were two small areas each about 10 sq. m. of shallow water where *Lilaeopsis* was growing in January, 1941. One was adjacent to the boatshed and the other close to the river inlet; and both may have represented fairly recently formed banks, though there were no records on this point.

The upper Karori reservoir, with a capacity of 60,000,000 gallons, was built in 1908. It has steeply shelving, rocky shores and has been rigorously weeded. The main weeds found were a small amount of an exotic, *Ottelia ovalifolia* L., which extended into water 3 m. deep, and small amounts of both *M. propinquum* and *P. cheesemanii.*

The lower Karori reservoir, built in 1872, has a capacity of 40,000,000 gallons. It has a small area of shallow water which had, in January, 1941, a growth of *Lilaeopsis* forming a turf of total area approximately 100 sq. m. between the margin and the 1 m. contour.



TEXT FIG. 2.—Morton reservoir, showing coastline and contours at 1 m. and 2 m. depth of water. The distribution of water weeds in January, 1941, indicated by symbols.

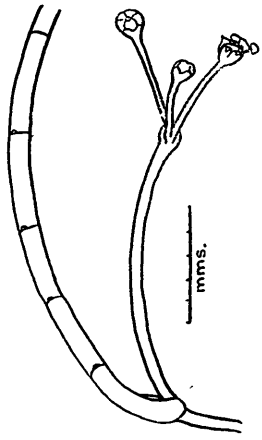
On the *Lilaeopsis* turf and extending into deper water was a small amount of the three larger waterweeds, *O. ovalifolia, M. propinquum* and *P. cheesemanii.*

The distance between the Karori and Wainui-o-mata reservoirs is approximately 22 km. and there is no connection between the two systems.

The Species.

The writer visited Morton reservoir fortnightly during 1941 and 1942 and from that time till September, 1946, a visit has been made every one to three months. Neither flowers nor fruits of the *Lilaeopsis* were found there on any occasion. Turves were removed from underwater many times and planted out of water near the edge of the reservoir; but they were soon overgrown by other plants and smothered. In April, 1942, an aquarium, 30 x 20 x 24 cm., was set up with mud and *Lilaeopsis* turf from Morton reservoir in the bottom and kept full of water in a well-lit room; but although it was closely watched no flowers were found in it during the next two years.

In January, 1944, Miss Lucy B. Moore, of the Botany Division, Wellington, kindly took charge of this aquarium and kept it in a dimly-lit room. She allowed the water level to fall occasionally and expose the turf. In November, 1945, when the turf was covered with water the culture flowered and two inflorescences each with three flowers were preserved, others being left for chances of fruit, but none were found. One inflorescence is illustrated in Text Fig. 3. Two



Text Fig. 3.
Inflorescence of *Lilaeopsis* sp.

dishes of submerged weed have been kept by the writer since November, 1945, in a shady place in a cool greenhouse and occasionally allowed to dry up till leaves were growing out of water; but neither flowers nor fruit have appeared. Subaerial growth, which is smaller and more slender than when the plant is submerged, is illustrated in Text Fig. 4.

Some of the Morton reservoir material and the flowering specimens from the aquarium had very small processes approximately 0·1 mm. long on the leaves at the constrictions (Text Fig. 3). Much larger processes in a form of *L. lacustris* from Lake Rotokakahi were

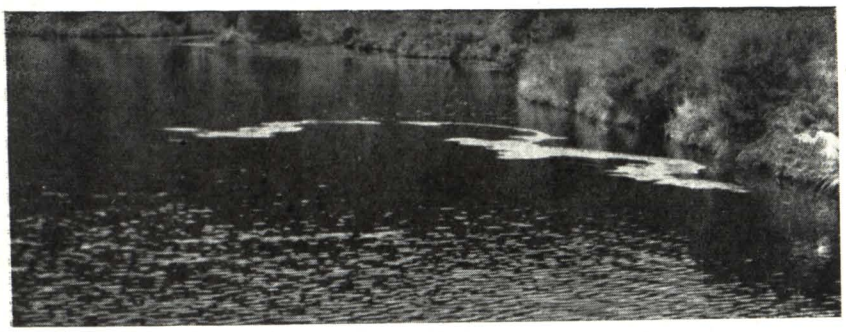
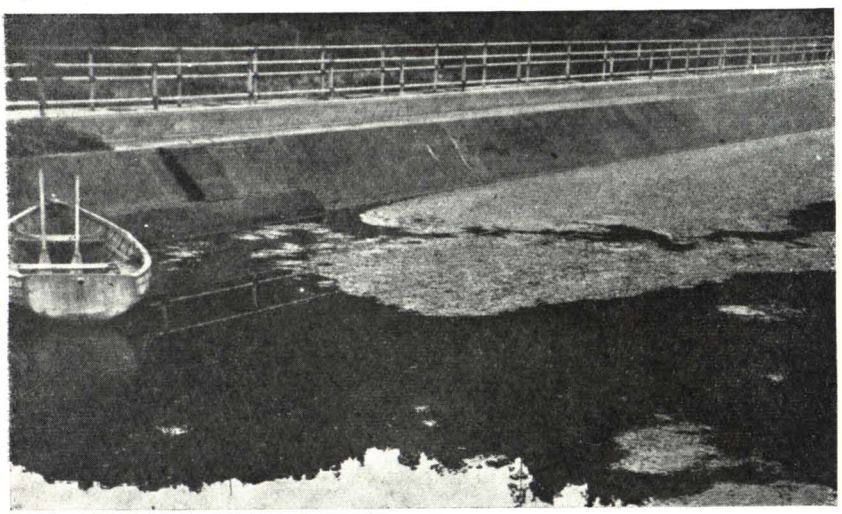
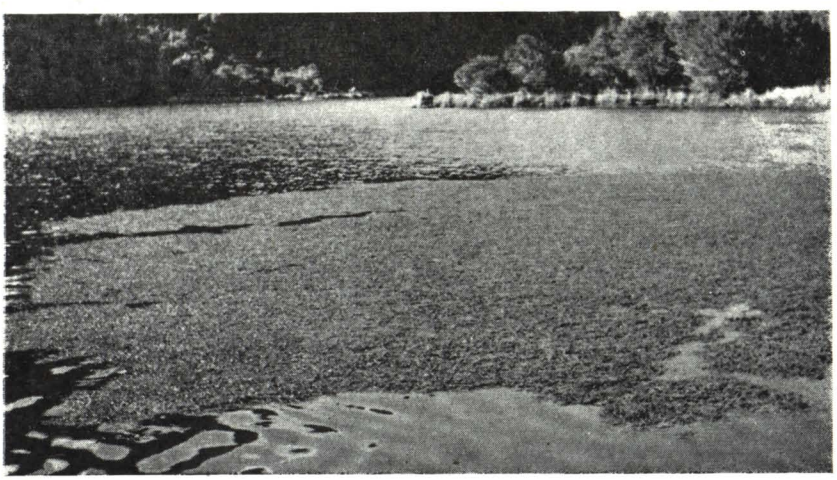


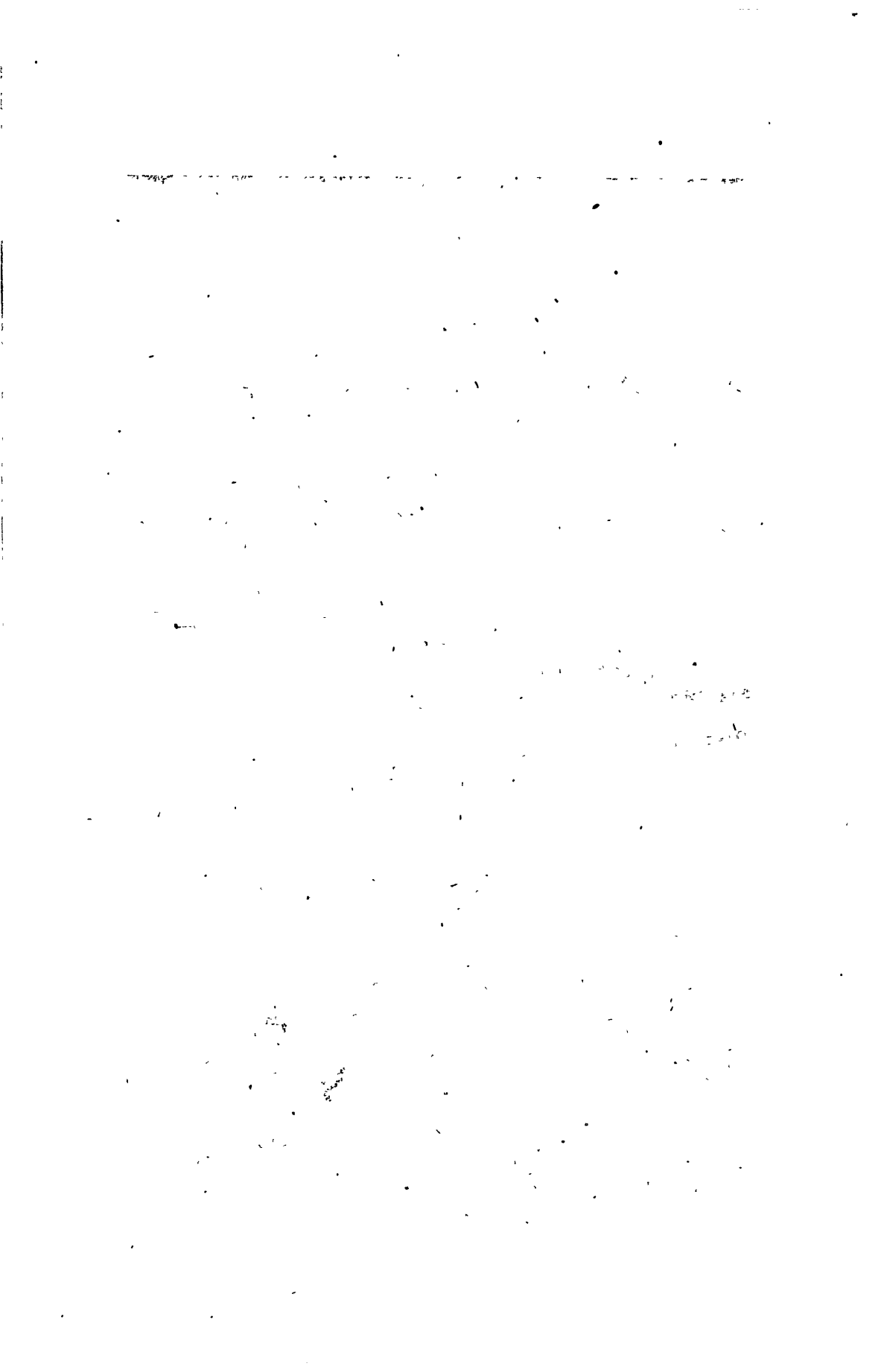
FIG. 1.—Rings of floating *Lilaeopsis* turf marking the boundaries of blisters on Morton reservoir.

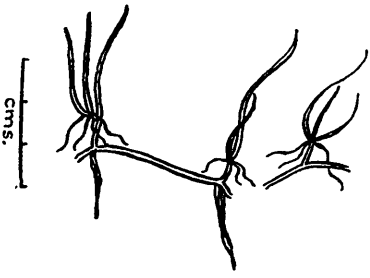




FIGS. 2 and 3.—Masses of floating turf collected by the wind on Morton reservoir.

[*To face page 584.*





TEXT FIG. 4.
Typical subaerial growth of *Lilaeopsis*.

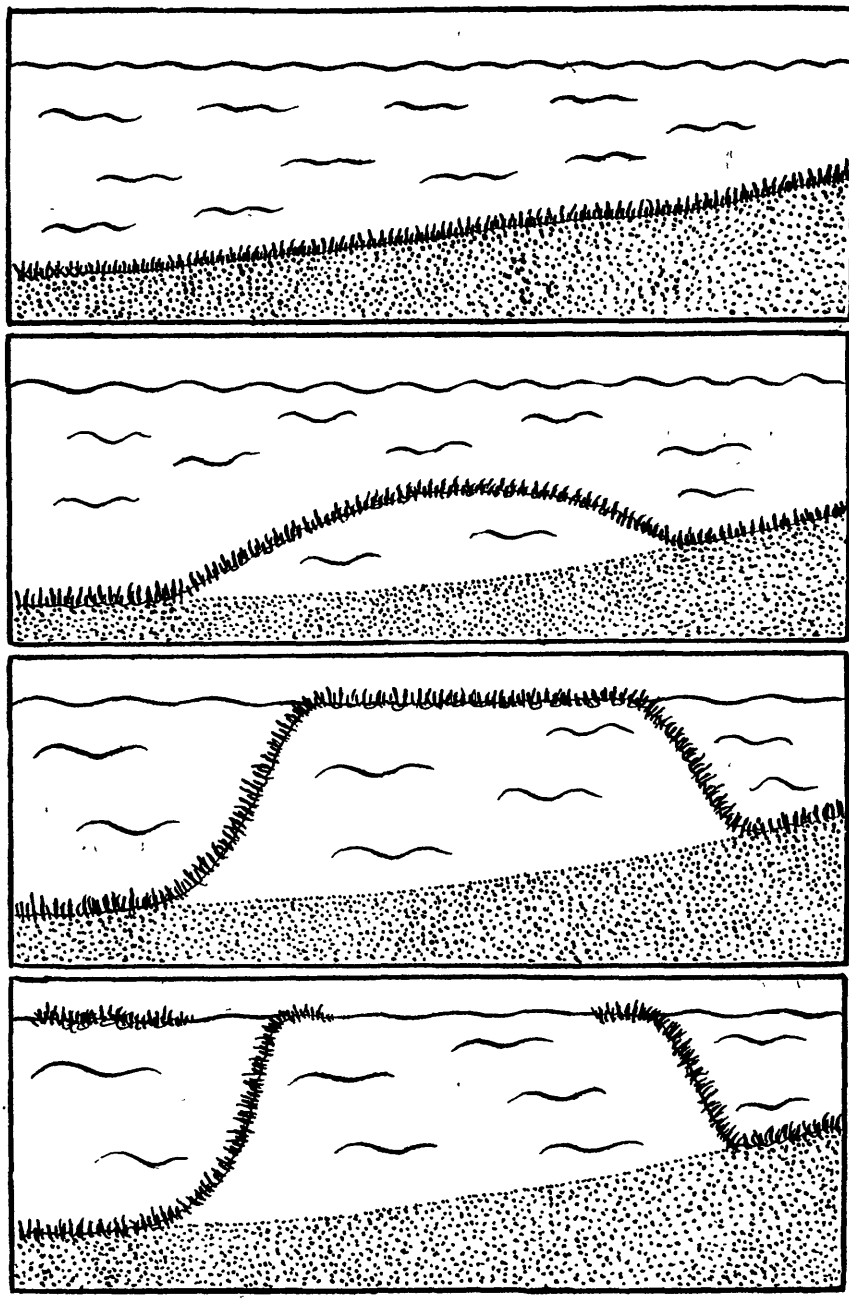
illustrated by Hill (1927), who suggested that they represented leaflets. It is not clear that this feature is restricted to any one species. The identification of the species of *Lilaeopsis* depends on mature fruit, and as these have not been found for the species from the Wellington reservoirs in the five and a-half years during which the plant has been under observation, its specific identity cannot be established.

BEHAVIOUR.

In Morton reservoir, as shown in Text Fig. 2, the close turf of *Lilaeopsis* spread continuously over large areas. At most times of the year there was some fermentation in the mud beneath the turf, resulting in the formation of gas which rose in bubbles to the surface. This was particularly noticeable in late summer and autumn and if at this time of the year the mud was stirred with an oar or trodden down large bubbles of gas were released.

During May and June of 1941 the *Lilaeopsis* mat was lifted from the mud in Morton reservoir by bubbles of gas collecting under the turf, so that it rose in blisters from 1 to 3 m. in diameter. These blisters soon reached the surface of the water, where they were broken by the ripple and masses of turf floated away. This process is illustrated by diagrams in Text Fig. 5. Rings of floating turf still attached to the main mat on the mud were left round the edge of broken blisters. Plate 62, Fig. 1, shows a photograph of some of these rings, while the following photographs (Plate 62, Figs. 2 and 3) show masses of *Lilaeopsis* turf collected together by the wind floating on Morton reservoir. Up till November, 1941, small pieces of the turf continued to float away, and by the end of November there were about twelve bare patches in the turf, most of them where several blisters had coalesced, all on soft mud into which a person wading sank deeply. Four bare patches, two approximately 5 m. and two approximately 2 m. in diameter, were marked around the margin with stakes.

From February to May, 1942, this phenomenon was repeated and a few more blisters arose. The stakes which had marked the 1941 areas were stolen; but the writer estimated that the amount of turf which had floated away during 1942 was less than one-fifth of that which was lifted during the previous year. In places on the bare patches the roots of *M. propinquum* and *P. cheesemanii* were left and in the following spring these quickly grew shoots again. The *Lilaeopsis* started to run on to the bare patches from the sides; but the places



TEXT FIG. 5.—Diagrams illustrating the formation of blisters which break to form floating rings of *Lilacopsis* turf in Morton reservoir.

from which the *Lilaeopsis* lifted in 1941 were by 1943 covered mainly by *M. propinquum*. During 1944 and 1945 negligible amounts of *Lilaeopsis* turf floated away and both newly bared mud and old turf became more overgrown by the larger weeds, *M. propinquum* predominant. At the same time in the deeper water the areas of these two larger weeds showed only a slight increase.

By June, 1946, the larger weeds had made such growth in the shallow water that the area occupied by *Lilaeopsis* had been reduced to approximately one-twentieth of that first seen in 1941. The level of the reservoir at this time was purposely lowered in order to reduce the total amount of weed, the level being kept approximately 2 m. below the overflow for seven days, and some weeding was done. When the level was allowed to rise again most of the *M. propinquum* and *P. cheesemanii* was apparently dead, but the *Lilaeopsis*, which had lost most of its original submerged leaves while exposed to the atmosphere, had commenced to grow new, smaller leaves, and though the turf appeared to be thinned it was not killed by emergence. Undoubtedly fluctuation of the water level in the reservoirs favours the growth of the *Lilaeopsis* in the shallow water because it is the only plant there which grows readily both submerged and out of the water.

During the two summers previous to 1941 the level of the reservoir had fluctuated below the overflow for several weeks, thus allowing a luxuriant turf of *Lilaeopsis* comparatively free from larger weeds to become established. From 1941 to 1945 the reservoir remained continuously filled except for two weeks in April, 1943, a condition which permitted the expansion of *M. propinquum* and *P. cheesemanii* at the expense of the *Lilaeopsis*. Exact data for the fluctuations in water level are not available.

The much larger weed *T. angustifolia*, which has covered the shallow water areas of the lower Wainui-o-mata reservoir, is also established on one area not much larger than 1 sq. m. of Morton reservoir. During five years this plant has increased slowly in the Morton reservoir by not more than one-half of its former amount. From this observation and the condition seen in the lower Wainui-o-mata reservoir, the writer suggests that *T. angustifolia* probably would slowly become the dominant plant of the shallow waters in the Morton reservoir also. The *Typha* thicket nearest to the shore of the lower Wainui-o-mata reservoir has consolidated sufficiently to allow *Coprosma* and *Hebe* shrubs to become established among the *Typha*, indicating a progression from shallow-water vegetation to native bush.

CONCLUSION.

It is concluded that the conditions which favour the growth of the *Lilaeopsis* in the reservoirs are equally those which retard the two common waterweeds *M. propinquum* and *P. cheesemanii*, that is, submergence with occasional exposure to the air. In order to prevent the formation of a dense turf on top of soft mud from which may arise masses of floating weed, a period of low level, approximately 2 m. below the overflow, of five to seven days together during fine

weather at least once a year is recommended; when the level is lowered, and also when it falls naturally during dry summers, weed and soft mud should be removed.

Acknowledgment.

Thanks are due to Miss Lucy B. Moore for tending the aquarium and collecting the inflorescences and thanks are also due to Dr. H. H. Allan for permitting the writer to use the facilities of the Botany Division. The Wellington City Engineer has kindly allowed the publication of these observations, which were made while the writer was employed in his department.

Reference.

Hill, A. W., 1927. The Genus *Lilaeopsis*: a Study in Geographical Distribution. *J. Linn. Soc.*, vol. 47, p. 525.