parisons of the nitrogen contents of nodules and roots and those of shoots of nodulated and non-nodulated plants have given some indication of nitrogen fixation, but over-all the records are not conclusive (Allen and Allen, 1958).

Making use of isotopic nitrogen, Bond (1957) has been able to show that nodules of plants of six of the non-leguminous nodulated genera can fix atmospheric nitrogen. The three genera at present not conclusively shown to be capable of fixing nitrogen are thus: *Coriaria, Elaeagnus* and *Discaria.*

Nitrogen Fixation in Coriaria

It has been known for some years now that species of Coriaria in New Zealand were nodulated. An experiment with excised nodules of *Coriaria arborea,* to be published elsewhere, showed that these organs could fix significant amounts of ^{15}N when exposed to an atmosphere enriched with this isotope. Dr. G. Cone has shown (pers. com.) that intact plants of this same species are able to fix atmospheric nitrogen.

How far other species of *Coriaria* and other organs apart from nodules are able to carry out a similar process remains to be demonstrated. In this respect it is noteworthy that plants of *C. sarmentosa* from widely differing habitats have not yet been found to bear nodules.

Field evidence substantiates that plants of at least some species of *Coriara* can fix nitrogen, Thus plants belonging to this genus are characteristic on gravel screes, rock faces, river terraces and in tussock grasslands (Oliver, 1942). In tussock grassland on Mt. Egmont, *C. plumosa* and *C. pteridoides* have been observed to produce a vigorous response in growth of *Danthonia rigida* (A.P. Druce, pers. com.),

Discaria toumatou likewise is characteristic on loess, alluvial fans and gravel screes and is a member of the sparse vegetation of the arid regions of Central Otago. Nodules of this plant, to be described elsewhere, are morphologically similar to those of *Coriaria* and both appear to be infected by the same endophyte. Their nitrogen-fixing capacity has not yet been tested.

References

Allen, E. K., and Allen, O. N., 1958: *Encylopedia of Plant Physiology.* 8: 48-118. Ed. W. Ruhland, Springer-Verlag. Berlin.

Bond, G., 1957: Isotopic studies of nitrogen fixation in non-legume root nodules. *Ann. Bot. N.S.* 21: 513-521.

Bond, G., MacConnell, J. T. McCallum, A. H., 1956: The Nitrogen-nutrition of *Hippophae rhamnoides L. Ann. Bot. N.S.* 20: 501-512.

Engler, A., and Diels, L., 1936: *Syllabus der Pflanzenfamilien.* Berlin.

Fletcher, W. W., 1955: The development and structure of the root-nodules of *Myrica gale L.* with special reference to the nature of the endophyte. *Ann. Bot. N.S.* 19: 501-513.

Hawker, L. E. and Fraymouth, J., 1951: A re-investigation of the root-nodules of species of *Elaeagnus, Hippophae, Alnus* and *Myrica,* with special reference to the morphology and life histories of the causative organisms. *J. Gen. Microbiol.* 5, 369-386.

Hutchinson, J. 1926: *The families of flowering plants.* MacMillan & Co. London.

Kelley, A. P., 1950: *Mycotrophy in plants.* Chronica Botanica Co. U.S.A.

McVean, D. N., 1956: Ecology of *Alnus glutinosa* (L) Gaertn. III Seedling establishment. *J. Ecol.* 44: 195-218.

Oliver, W. R. B., 1942: The genus *Coriaria* in New Zealand. *Rec. Dom. Mus.* 1: 21.

Changes in Salt-marsh Vegetation

V. J. Chapman

The salt marshes on Scolt Head Island in Norfolk, Great Britain, were re-visited in August 1957 and remapped. These maps could be compared with maps prepared in 1932 and 1933. One portion, the western, of the island is in a state of steady growth and considerable changes have taken place in the marshes during the 25 years. Missel marsh, formerly a Salicornietum strictae, with considerable bare areas, has been transformed into an Asteretum tripolii and plants of the next stage, the General Salt Marsh, are already invading the area. Very little bare ground now remains.

On the youngest marsh, a sand flat with a Zosteretum nanae in 1933, the eel grass bed has been reduced as a result of increased height and fewer submergences, and there are a number of patches of *Spartina townsendii.* The most

spectacular change has been in a rather older marsh which has changed from a Zosteretum in 1933 to a Spartinetum townsendii in 1957. One corner, which was a Salicornietum, is now partly General Salt Marsh and partly a Puccinellio-Asteretum. Another corner, formerly an incipient Salicornietum is now an Asteretum. An adjacent small, closed marsh has changed from a Salicornietum strictae of 1932 to an Asteretum, whilst the algal vegetation has changed from a Chlorophyceae community and a *Fucus vesiculosus* ecad *caespitosus* community to a *Pelvetia libera—Bostrychia scorpioides* community. A small marsh (Anchor marsh) has changed from a Salicornietum to a General Salt Marsh community. The more rapid changes in the closed marshes are what would be expected in contrast to the rather slower changes on the open marshes. These changes can be compared with rates of change calculated from rates of accretion and the vertical extent of the different communities.

Experimental Work on Daphnia

V. M. Stout

The first work on most animals is their discovery and identification. Observations on their natural history follow. From these have developed studies on communities and populations and for freshwater plankton such studies have been intensively carried out for some time. They have resulted in much information about the composition, distribution and growth of the populations, and on fluctuations in populations together with the relation of the fluctuations to the biological and physico-chemical environment. Much work on freshwater Cladocera as populations or communities is being carried out at present and this work fills large sections of general texts on limnology. But only within recent years has much account been taken of the relation of the physiology of the animals to the general effect on the population.

Experimental work on animals has increased recently, partly in connection with physiological work. The animals can be kept in a controlled physical and biological environment, in which one factor is varied and the effect on the animal recorded. This enables detailed examination of specific relationships, such as the effect of temperature on the growth rate or on the number of eggs produced. These results could be used more fully to try to interpret information from studies on natural populations.

There has been much experimental work with Cladocera, and especially *Daphnia*. *Daphnia* is easy to keep in cultures and in controlled conditions. The animals reproduce parthenogenetically and it is possible to experiment with a genetically stable line by breeding several generations from one individual. *Daphnia* responds differently to different temperatures and various other factors and the effects on the animal can usually be expressed numerically.

Most of the experimental work has been concerned with factors contributing to population growth or decline, and recently there has been some work on the interrelations between different species. After the publication in 1926 of Raymond Pearl's "The biology of population growth", Terao and Tanaka selected the cladoceran, *Moina macrocopa,* as a suitable animal with which to demonstrate some of Pearl's theories and determine if there was any change in the size of a population at saturation point according to the temperature. In 1928 they published three short papers with their results. The first paper gives population growth at three different temperatures and shows different-sized populations at the different temperatures (Fig. 1). The results also demonstrate that population growth was logistic as far as the observations went. Later workers have shown, however, that the experiments were terminated too soon. The two other papers by Terao and Tanaka show a variation in the rate of reproduction with temperature, and the effect of density of the population on the rate of reproduction.