

- SCOTT, D. H., 1909. *Studies in Fossil Botany*, 2nd Edn. London, A. & C. Black Ltd.
- 1920. *Studies in Fossil Botany*, 3rd. Edn., vol. 1. London, A. & C. Black Ltd.
- 1923. *Ibid.*, vol. 2.
- WARDLAW, C. W., 1944a. Experimental Observations on the Relation between Leaf Development and Stelar Morphology in Species of *Dryopteris*. *Nature*, 153, 377.
- 1944b. Bud Regeneration at Cut Parenchymatous Surfaces in Onocleoid Ferns. *Nature*, 153, 588.
- 1945. An Experimental Treatment of the Apical Meristem in Ferns. *Nature*, 156, 39.
- ZIMMERMANN, W., 1930. *Phylogenie der Pflanzen*. Jena, Gustav Fischer. (Quoted from Bower, 1935, ch. 30.)

P.S.—Recent work by Wardlaw (see above) would modify the figure given here for the fern apex, by a small-celled tissue (meristematic) stretching across from the ends of the procambia to form a concave zone below the apical cell. This may not be universal among the ferns.—I. V. N., June, 1948.

EVOLUTION OF THE ALIEN FLORA OF NEW ZEALAND.

By A. J. HEALY, Department S.I.R., Wellington.

THE alien flora may be defined as that group of non-native plants (in this paper confined to Dicotyledones, Monocotyledones, Gymnospermae and Pteridophyta) that exist in the non-cultivated state in New Zealand.

The documented history of the evolution of the alien flora of New Zealand commences in 1786 with the publication of Forster's *Florulae Insularum Australium Prodrromus*, wherein is recorded the first alien species—canary grass (*Phalaris canariensis*), giving a definite evolutionary period of 160 years. It is possible that the initial stage of the evolution commenced about 1150 A.D. with the arrival of Toi, the first of the Maori voyagers, and continued through the pre-pakeha period to 1769, the arrival time of Cook's first expedition. The taro, paper mulberry, etc., were intentionally introduced during that period, and it seems feasible to suggest that such cosmopolitan species as *Oxalis corniculata*, *Calystegia sepium*, *Solanum nigrum*, and *Sonchus* sp. came in as "stowaways," perhaps in the soil about the roots of the useful plants; some of these species were collected by Banks and Solander, and had every appearance of aboriginal species.

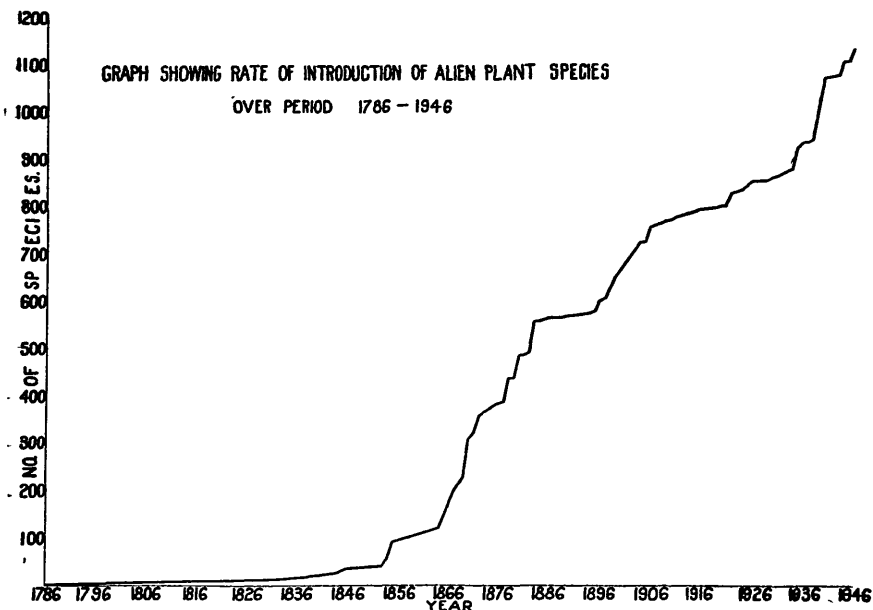
Two essential factors for the development of an alien flora are that there exists the necessary commercial intercourse between the particular region under consideration and other countries by which seeds can be introduced, and that a suitable environment is present for the establishment of the species so introduced. In the case of New Zealand, contact with overseas was initiated by the English and French expeditions which came at the beginning of the pakeha period, and was continued by the increasing advent of whalers, sealers and timber seekers who established bases in New Zealand. Samuel Marsden introduced farm livestock and initiated general agricultural activities in 1814, and was followed by other missionaries and the establishment of more missionary stations, and by 1840 considerable overseas trade was taking place, and the Bay of Islands had become a commercial centre.

After 1840, active colonization was the order of the day, and the area under settlement was increasing rapidly every year; large tracts of tussock grassland were taken up for pastoral purposes and were being sown with English grasses; land was being felled and/or burned out of forest and seed was sown on the ash. This widespread sowing of imported grass-seed mixtures with high content of extraneous seeds up to the time when local supplies of relatively high purity were available was responsible for the introduction of a large number of aliens, and for their widespread dispersal. The imported seed of many agricultural crops accounted for more introductions and has even been operative in recent years.

Apart from the widespread agricultural and pastoral activities, the factors influencing the evolution of the alien flora are legion, some very diverse ones having been operative over the years past, some at present—the sentimental regard of the early colonists for their homeland left legacies including the sweet briar (*Rosa eglantaria*), horticultural activity has contributed many species including the spectacular eschscholtzia (*Eschscholtzia californica*), early herbal culture in Canterbury gave us the hemlock (*Conium maculatum*), and general commercial activities delivered to different parts of New Zealand a number of species per medium of ballast; in recent times, there was the introduction of an European brome grass (*Bromus rubens*) with U.S.A. as an intermediate domicile, it coming in to Paekakariki with the American military forces during the last war.

The development of the alien flora of New Zealand is of particular interest in that it has taken place over a period of which relatively reliable records are available; how different by comparison is the case of the British Isles, where commerce dates back to the early Phoenicians of the pre-Christian era—one can speculate that the alien flora of this region had reached goodly proportions prior to botanical records being made; the number of species of doubtful nativity in the British flora is immeasurably greater than in the New Zealand indigenous flora. The evolution can be traced with a reasonable degree of accuracy over the period in so far as numbers is concerned, but of the processes involved our knowledge is much less complete—Kirk's statement in 1872 has held over a long period, "In truth, it is far easier to recognize results than to watch the processes by which the results are brought about . . ."

The early records of alien plants were irregular in appearance, being contributed by the botanists of the different expeditions, but with the spread of settlement and the presence of resident workers, the records became more regular and the number of species showed a steady increase; following Forster, Richard, the Cunninghams and Raoul, we have the colonial botanists contributing material to Hooker for his several Floras, and then the era of the colonial botanists publishing their findings in the *Transactions of the N.Z. Institute*—no mention of the alien flora would be complete without acknowledgment of the debt we owe to J. B. and J. F. Armstrong (1872–80), Thomas Kirk (1867–99), T. F. Cheeseman (1872–1925), G. M. Thomson (1875–1922), and H. H. Allan (1924 onwards) for our knowledge. In all, some 44 workers have contributed to that knowledge, which, when collated, shows that the alien flora has evolved from a single species



in 1786 to 1126 species in a period of 160 years; of these 541 are common to both islands, 110 restricted to the South Island, 265 restricted to the North Island, 210 are doubtful records and 46 records have been rejected. The number of species approximates to between 50-60 per cent. of that known for the indigenous flora; numerically it is large, ecologically it is an important vegetational element.

The picture presented by the graph tends to be somewhat misleading, in that no allowance has been made of the time lag between the introduction of a species and its recording; some species may be established for many years before being recorded—it is also apparent that for some years prior to the issue of a new flora the number of species recorded is low, with a large number coming with the new flora; it is well nigh impossible in the case of most species to determine the exact date of introduction, but it is felt that the actual time of recording is the most reliable basis for giving a perspective.

In the past, much of the work in connection with the alien flora has been concerned with the actual recording of the species, rather than with their role in the different vegetational associations—if it is to be seen in its right perspective in the future, investigations will have to be carried out along floristic and ecological lines.

During the course of evolution, the alien flora is increasing its impact both vegetationally and economically, and is becoming more so with the passage of time—as Allan (1931) well puts it, “. . . we have now in New Zealand two floras and two vegetations. And this second flora plays such an important part of our economic life that it deserves and demands the most intensive study we can give it.”

In conclusion, it can be definitely stated that the alien flora is in a dynamic rather than a static state, and will continue so, providing a wealth of problems to be investigated—fundamental botanical data as well as valuable economic knowledge will result from such work. The words of W. T. L. Travers, delivered in the Presidential address to the Wellington Philosophical Society in 1872, are very true to-day: “In few countries, if, indeed, in any, do the means of obtaining reliable information upon this important subject exist to a greater extent than in New Zealand; and it will undoubtedly be a matter of reproach hereafter if we neglect the opportunities afforded to us of accumulating facts which will tend, when carefully examined and collated, to elucidate points of importance at present buried in obscurity.”

References.

1. ALLAN, H. H., 1931. *N.Z. Journal Agriculture*, vol. 42, p. 394.
2. KIRK, T., 1872. *Trans. N.Z. Inst.*, vol. 2, pp. 92-3.
3. TRAVERS, W. T. L., 1872. *Trans. N.Z. Inst.*, vol. 5, p. 403.

FOREST DETERIORATION IN THE TARARUAS DUE TO DEER AND OPOSSUM.

By V. D. Zorov, Plant Research Bureau, Wellington.

THE inner hills east of the main divide of the Tararua Mountains, with the exception of the high tops (4,000 ft. to 5,000 ft.) are nearly all forested. Mountain scrub, mainly leatherwood (*Olearia colensoi*), occurs in extensive areas in the northern reaches. In the valleys the main species are clinker beech (*Nothofagus truncata*) and red beech (*N. fusca*), either or both, together with rimu (*Dacrydium cupressinum*) and rata (*Metrosideros robusta*). Kamahi (*Weinmannia racemosa*) is more or less abundant throughout and there are numerous species of under-storey and lower undergrowth. Above 2,000 ft. elevation the forest tends to be predominantly silver beech (*Nothofagus menziesii*), which is the only tall tree reaching the timber line (4,000 ft.).

In an undisturbed state, as I knew it in the summer of 1930-31, the forest had a dense undergrowth of mosses, ferns, various herbs and shrubs. The undergrowth was particularly dense at elevations above 2,000 ft. The undergrowth is now rapidly disappearing and in some places forest trees are also