Pollen-Bearing Deposits and Forest History

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TECHNIQUES

It has become comparatively easy nowadays to get pollen and spore floras from sedimentary deposits, not only from carbonaceous but also from mineral sediments, provided that the latter are not too coarse or too oxidised. This places within our reach a research tool which has proved its value for certain stratigraphic uses.

The most fundamental outcome of a study of these deposits would be a reconstruction of climate history as this would give a key to various processes which have been at work and which have influenced the development of the Wellington landscape with its soils, its flora and its fauna. Such a goal, however, may be idealistic and over-ambitious and I think we should not be discouraged if we can see no immediate prospect of its attainment. Other and more immediate objectives require to be considered, and consideration of these more immediate objectives will influence the amount of attention given to the various types of material which our sedimentary deposits are capable of yielding. The types of material obtainable with more or less success include leaves, other plant fragments of various kinds, seeds, pollen grains, spores, and the remains of microscopic organisms which have resistant structures.

Wood fragments are identifiable with more or less precision according to the species and to the state of preservation, and except perhaps when we are dealing with river or delta deposits, they may be taken as derived from plants which grew at the site of deposition, but of course with roots penetrating into underlying strata. It is obvious, however, that unless very many pieces of wood are collected and identified, such specimens throw only a limited light on the nature of the vegetation.

Seeds likewise may be taken usually as of quite local origin and they are identifiable with a fair degree of precision. They are proving quite valuable in historical investigations but their use is limited by the fact that often they are not preserved and when present they may represent only a few quite local species of the bog or swamp vegetation.

Pollen grains and spores are more widely dispersed, they are small and extremely resistant, and can be recovered in very large numbers. With a few exceptions they are identifiable only to genus but they offer the advantage of giving a more generalised picture of the vegetation and a more continuous record since they may be recovered from sediments which yield little or nothing in the way of macroscopic plant remains. It is for reasons such as these that this type of fossil material has attracted a good deal of attention.

While slides are being systematically examined for pollen grains and spores, other minute objects are found, such as smaller fragments of plant tissue, diatoms, and the remains of various minute aquatic organisms. Each type of material differs in the kind of information it is capable of yielding and in its importance relatively either to the conditions of deposition or to the general environment surrounding the deposit. Two points worth remembering are (1) that whatever aspect of an environment attracts our interest we will always have this problem of relating the part to the whole, and (2) that any factual evidence relating to the past history and distribution of a group of organisms is likely to be of value sooner or later to students of that group.

For these reasons I think that regardless of the problems we may attempt to solve, it is of great importance to have in different parts of the country some well-studied areas. Theoretical and systematic studies in such areas, with all the advantages that they offer in the way of background information, will mean that we are much better equipped to deal with problems in less accessible and less frequented parts of the country.

I cannot hope to present a full and connected account of the work which has been done at different times which in one way or another

A more detailed study of peat formation in this and other Wellington areas is in preparation.

relates to the pollen-bearing deposits of the Wellington region. Nor is it my aim to deal with problems solved or with work which has been completed, but rather to touch on studies which are in progress.

Pollen and Spore Identifications

Recent work has enabled us to distinguish, in favourable circumstances, the species principally involved in counts of beech pollen. Similarly, as a result of special studies, N.T. Moar is now able to indicate means for distinguishing some species in the conifer pollen. These are advances which as yet are too recent to have had much application in the investigation of pollen bearing deposits.

Pollen Analysis and Ecological Reconstruction

A complete sequence of deposits in or related to the Hutt Valley has not yet been studied. The few examples mentioned here, however, are discussed in order of age except for the Mangaroa swamp.

KAITOKE GRAVELS

Only a few days ago we found a carbonaceous bed some 10 to 15 feet thick in the Kaitoke, the oldest Pleistocene formation in the Hutt Valley. A quick survey of slides from four of these samples yielded the results given in Table 1. Such a succession strongly suggests cooling climate. The species of *Dacrydium* and of *Phyllocladus* cannot be determined on pollen morphology except that the *Dacrydium* is *D. bidwillii*, *D. biforme* or *D. kirkii*. If continuous cooling is assumed, leading from coniferous forest to tussock grassland, then it is not unlikely that the *Phyllocladus* was *P. alpinus* and the *Dacrydium* would then be *D. biforme*.

Sample No.	L1226	L1227	L1229	L1228
Dacrydium cupressinum	1	2	1	54
Podocarpus spp.	1	5	4	40
Nothofagus spp.	1	3	10	4
N. menziesii	10	10	27	2
Phyllocladus sp.	31	4	0	0
Grass	28	22	13	0
Compositae	7	10	8	0*

Increasing cold from older layers at bottom upwards in the profile.
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* *Plus a few tree ferns.*

TABLE 1.—*Percentage composition of pollen from four samples from the Kaitoke beds.*

HAYWARDS GRAVELS

These gravels are well exposed on the Haywards Hill and have been dated by C14 at > 42000 B.P. (Brodie, 1957). Pollen from the same bed as the dated sample showed *Phyllocladus* dominant, sedge and grass abundant, beech and rimu rare. The Haywards Gravels are considered early Pleistocene but probably are not as old as the Kaitoke Gravels. The climate may have been cooler than the present day.

TRENTHAM AND MANGAROA

It has been suggested (T.L. Grant Taylor pers. comm.) that peat accumulation at the Wallaceville or Mangaroa swamp occurred during the building up of these surfaces.

C14 samples from a depth of 20 ft. indicate that peat accumulation (which will be discussed later) began over 8,000 years ago. Pollen of silver beech is more abundant in the deepest samples than subsequently. During the succeeding 8,000 years there was a period of much conifer pollen and little beech followed by a period when the proportions were reversed though the dominant beech pollen then was not silver beech. (Harris, 1951). This could correspond with a change from warm moist to cooler and drier conditions.

MELLING

Wood samples from buried forest near present river level gave radiocarbon dates of 4350 ± 100 and 4275 ± 100 years B.P. (Stevens, 1956). Forest trees are represented by abundant pollen of *Dacrydium cupressinum* together with pollen of species of *Podocarpus* including both the *ferrugineus-spicatus* group and the *totara-acutifolius* group. A few pollens of *Nothofagus* spp. (*fusca* group), *Knightia excelsa* and *Phyllocladus* sp., were also identified. Tree fern spores are particularly abundant.

Seed and wood specimens were identified as follows: Stumps (in place) of *Podocarpus spicatus* and *Laurelia novae-zelandiae* and leaves and seeds of *Podocarpus ferrugineus*, *P. spicatus*, *Dacrydium cupressinum*, and *Griselinia lucida*.

The vegetation seems to indicate conditions similar to those of the present day.

MANGAROA SWAMP

A brief summary of the development of this deposit has already been given (Harris, 1951). When interpreting pollen results the fact has to be taken into consideration that forest was present over much of the area during the earliest stage of deposition and has invaded parts of the area subsequently. The effect of this on pollen statistics seems to be that although the general overall picture is consistent from borehole to borehole, there is a tendency for constituent elements to be variously emphasised at different points over the area. Thus in six boreholes rimu is the most abundant pollen during the conifer stage whereas in three other boreholes pollen of *Podocarpus* species, chiefly of the miro-matai type, predominates, though in one of these the two types (rimu and podocarpoid) are very nearly equal.

During the beech stage (in the younger layers of the deposit) the pollen of *Nothofagus solandri* (black beech) as indicated by pore counts, exerts a strong though slightly varying influence on the pollen rain. The influence of *Nothofagus menziesii* is slight except in the deepest layers where, at a depth of over 20 ft., it varies from 2 to 20 per cent. of the forest pollen.

Pollen and spores of various forest species occur throughout but the variety and frequency is greater during the conifer period. Spores of *Dicksonia squarrosa* and of *Cyathea colensoi* occur in the deepest layers, where the tree ferns are well represented, spores of *Cyathea smithii* being the most abundant. Identification of the spores of the two species of *Cyathea* mentioned was supported by the presence also of sporangia of these ferns.

It seems clear from the results that over eight thousand years ago (radio-carbon date of peat at a depth of 20 ft.) the swamp area was colonised from mixed forest in which the principal species with wind-borne pollen were conifers, especially rimu, miro, matai and totara. *Phyllocladus* pollen occurs consistently, though in small percentages, and *Podocarpus dacrydioides* pollen occurs throughout in varying amounts, but chiefly in the deepest and again in the shallowest layers. *Suttonia* pollen is not uncommon in peats and its presence is therefore not particularly noteworthy, but the consistent and appreciable percentage of pollen of *Ascarina*, especially during the conifer pollen and transition stages, is worthy of mention.

The swamp appears to have developed under a rising water table and the remains of aquatic organisms are frequent throughout. In the deeper layers there is a variety of diatoms. *Pediastrum* was found and also shelled rhizopods and the tests and statoblasts of dinoflagellates. For a study of organisms at present living in the peat, samples have been submitted for examination to Dr. di Menna, Soil Bureau, (yeasts) and Dr. J. Stout, also of Soil Bureau, (rhizopods and ciliates). Fern peat, with a pH of 3.2 to 3.5, yielded a poor fauna and a low concentration of yeasts. Peat from a marginal seepage bog, pH 5.7, provided a richer fauna but an even lower concentration of yeasts. Sedge peat proved richer in yeasts and *Sphagnum* peat, pH 4.0 and pH 4.5, in rhizopods. From green and from decaying *Sphagnum* 24 species of rhizopods were obtained by comparison with 38 species from the raised bog, Moanatuatua, in the Hamilton district. Evidently a mossy environment is suitable.

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