matics, physics and chemistry to biological problems. In experimental biology the Trustees decided that the utilitarian must never be the yardstick ; the test must be knowledge. Yet the religious impulse was still there. We find the Foundation asking : "Can we develop so sound and extensive genetics that we can hope to breed in future superior men ? Can we solve the mysteries of various vitamins so that we can nurture a race sufficiently healthy and resistant ? Can we rationalize human behaviour and create a new science of man ?" Dr. Warren Weaver, by now head of the Natural Sciences Department, saw the century of biology as one of the great episodes in man's intellectual history.

It was Beardsley Ruml, director of the Laura Spelman Memorial, who moved the Foundation into the field of social sciences, with the argument that all who work towards the end of human welfare are embarrassed by the lack of knowledge which the social sciences must provide. It was, he said, as though engineers were at work without an adequate development of physics and chemistry. The research then being done by the universities was largely deductive and speculative, on the basis of second-hand observations. Ruml said that what was needed was to create facilities for research, to increase the number of able men working in the field and focus the grants on bringing together various disciplines of social sciences in the systematic investigation of concrete social problems.

The Institute of Human Relations, which the Memorial and the Foundation jointly financed, made a weak beginning but later made a significant contribution to psychology, anthropology and psychiatry. When the Memorial was merged with the Foundation in 1929, Ruml retired, and Edmund Day, professor of economics at Harvard, headed the Division.

Three major fields of special interest were laid out for support—international relations, economic stabilization and public administration. Efforts were made to develop the research resources in universities abroad as well as in the United States. Nuffield College and the Institute of Statistics at Oxford benefited from the Foundation. At Cambridge its funds went to the Departments of Applied Economics, and to the Economics Research Section of the University of Manchester. Willets, the new director of social sciences, was another Rockefeller official who put the emphasis on first-class men : "I would break any rule in the book", he said, "for a chance to gamble on talent".

Dr. Fosdick is one of those who are optimistic about the future of the social sciences, though he is well aware of their shortcomings. The actual construction of a genuine science of human behaviour still, he says, lies largely in the future. But the new directions in which effort is being expended do provide significant manifestations for advance. Nor has the Foundation neglected humanistic studies. It has done much for libraries and for the study of Oriental languages, for the drama, for music. It has rescued many refugee scholars from Europe (and, incidentally, greatly enriched American scholarship by so doing).

The last chapter of Fosdick's history of the Foundation deals with Foundation principles and practices. Great advantage, he says, accrues from the elastic charter which gives the trustees full responsibility for the operation of the organization and the use of funds. Money is a feeble offering without the study which will make its expenditure effective. Once grants are made to responsible groups or institutions, no degree of control over the operation of the grants should be exercised by a foundation. Every social agency, including the Foundation, carries within itself not only the seeds of possible decay but also a tendency to exalt the machinery of organization above the purpose for which the organization was intended. The proper objective of a foundation, unless created for a particularized purpose, is to prime the pump, never to act as a permanent reservoir. A foundation easily falls into the habit of frittering away its funds in an extensive series of small grants—which Gates used to call, "the iniquity of retail giving". Finally, modesty becomes foundations because the question of financial support in all circumstances requires tact and good taste.

SOIL RESEARCH IN NEW ZEALAND

THE TAITA EXPERIMENTAL STATION

By R. H. THORNTON

THE Soil Bureau of the Department of Scientific and Industrial Research, New Zealand, established in September 1952 an experimental station to provide for the study of soils under various types of vegetation on hilly land. A hill station was selected, for it is the soils of hilly and steep land of New Zealand, of which there are some 24 million acres, that offer the highest potential for increasing primary production.

The Station is at Taita, fifteen miles from Wellington, and comprises approximately two hundred acres. It consists of several steep-sided spurs abutting on the main range of high hills flanking the east of the Hutt River valley. The catchments of several small streams are enclosed by these spurs. The area is little interfered with apart from chance burning and is of low natural fertility, which will allow various parts to be brought to, and maintained at, different levels of fertility. The Station, at present mainly under forest and scrub, will consist essentially of three parts : a catchment of indigenous vegetation, a catchment of exotic (tree) vegetation and an area of grassland. The two catchments are in the centre of the Station and the area of grassland will surround them, serving an added role as a fire-break. This arrangement will provide an opportunity for studying grass and forest regimes alongside one another. The soil type, Taita silt loam, is in the moderately weathered, yellow brown earth group of soils which are directly related to 9 million acres of New Zealand, 4 million more than any other group of soils.

The catchment of indigenous vegetation, an area of approximately thirty-eight acres at present in forest

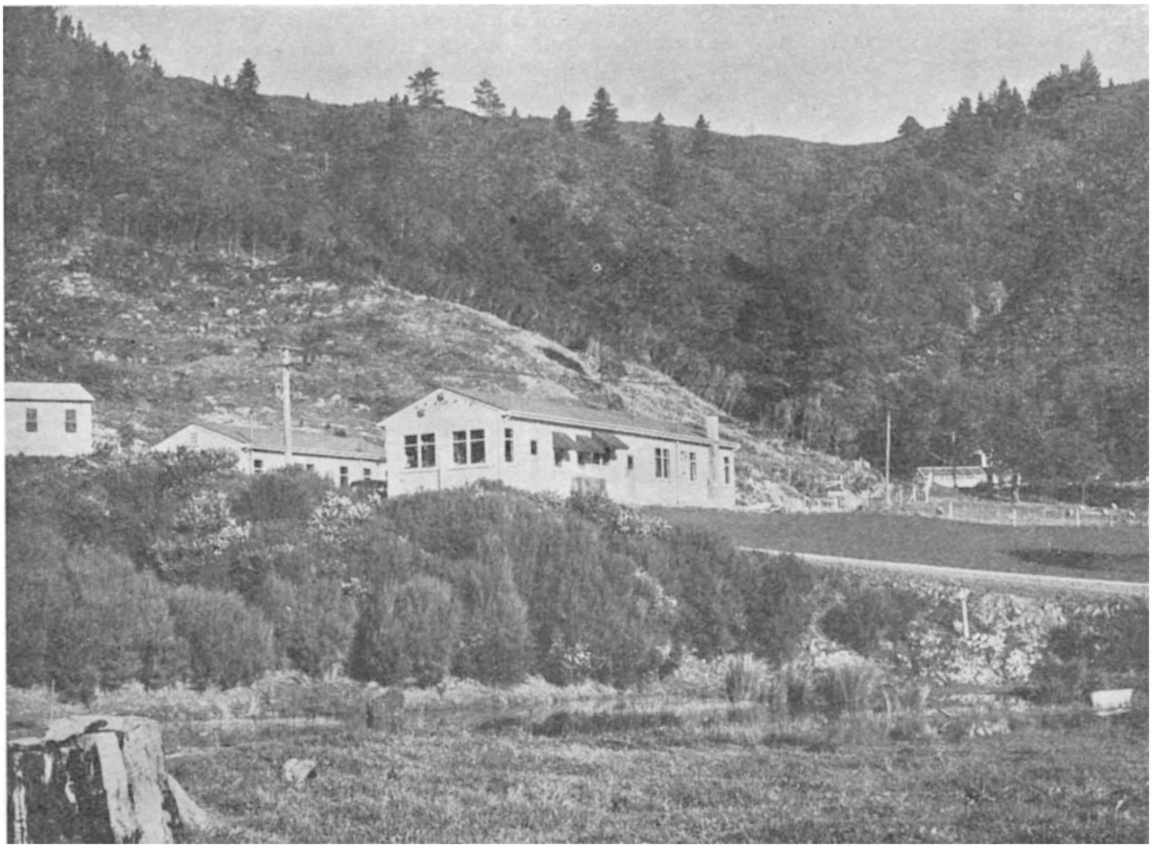

Fig. 1. The Taita Experimental Station. Biology building in the foreground, the regenerating native catchment in the background and at left centre the start of the grassed firebreak that isolates the native catchment

and scrub, will be allowed to regenerate indigenous forest. Studies are to be made on the ecology of regeneration with particular reference to the effect of fires on the vegetation. Here soil weathering and the loss of plant nutrients from soil under natural conditions will be studied. Rainfall measurements within and outside the forest will be compared with the stream outflow to find the rate of movement of water through vegetation and soil and the proportion lost through run-off and seepage. Regular sampling of rain and stream water for chemical analyses will determine the loss of nutrients, which will provide a measure of the rate of weathering. It is anticipated that, in collaboration with other soil organizations, a chain of such catchments will be formed throughout the world.

The exotic catchment of about fourteen acres is to be planted in compartments of different exotic timber trees, and studies will be made of their effects on soil in comparison with indigenous trees on neighbouring slopes. Any problems which arise can be studied in detail together with treatments.

Around the two catchments the land is being progressively cleared of scrub and replaced by grass. Areas of grassland, maintained under various levels of fertility, will enable investigations to be made on the chemical, physical and biological properties of a hill soil under a grass cover. Initial problems are associated with the establishment and maintenance of pastures on poor hill country in competition with the weed shrubs, gorse and blackberry. Fertilizer trials have shown the value of incorporating molybdenum with phosphate in obtaining grass–clover pastures on this soil type. The slow development of this class of land in the past may be found to have been due to a lack of knowledge of the importance of trace elements.

The investigations planned for the station are many and varied: examination of chemical and biological changes following the burning of scrub and its replacement by grass have been initiated; studies on soil temperature, moisture and permeability and the relationship with aspect and vegetation will be essential to investigations on run-off problems; plant and soil interactions, tree and grass litters, and associated microbiological activities; the stability of hill soils, soil loss and structure changes on slopes under the range of conditions available, are problems planned to be studied.

The main offices and laboratories of the Soil Bureau of New Zealand, at present situated in Wellington, are to be moved to Taita in the near future. For the present, temporary buildings, in addition to containing offices for the Station field-staff, and the Officer-in-Charge of Soil Surveys (North Island), contain the laboratories of the Agricultural Soil Physics Section, and the Biology Division of the Bureau. The Soil Physics Section is concerned with investigations on the general physical properties of soils, particularly structure and moisture–air relationships. Biological work at the Station includes: microbiological investigations of native and introduced grassland soils; biochemical studies on various soil processes and the organisms concerned; assay of soil copper, employing the fungus *Aspergillus niger*; role of mycorrhizæ in tree nutrition, and studies of fertilizer requirements on soils employing indicator plants grown under glass-house conditions.

In the past, soil experimental stations have been designed to deal with immediate problems, and many of the more straightforward have been successfully solved. Problems are now becoming more complex as the soils are utilized more intensively; hence there is a growing need for basic knowledge to be able to assess, solve and, in some cases, anticipate problems. This new experimental station in New Zealand is designed to supply this fundamental information and so assist the agriculture and forestry of the future.

A CHALLENGE TO COLORIMETRY

THE Small Physics Theatre at the Imperial College of Science and Technology was filled to capacity on December 12, 1956, when the Physical Society Colour Group held a symposium on "Colorimetry: its Errors and Accuracy". An assessment of the reliability of colour measurements was manifestly of great interest, and many industries were represented in the audience.

The problem basically is this: On the trichromatic system of colour measurement established in 1931 by the International Commission on Illumination (C.I.E.), a surface colour can be specified by its chromaticity co-ordinates, x and y, and its luminance factor β. Direct measurement of these quantities by three-colour matching is too inaccurate for most commercial applications, since the matching of lights of markedly different spectral composition brings out individual differences of colour vision. Other methods have therefore been developed, including (*a*) a six-stimulus visual colorimeter in which an approximate spectral energy match is established and the effect of observer differences therefore reduced; (*b*) photoelectric colorimeters employing a photo-cell in conjunction with selected colour filters to give spectral sensitivity curves approximating to the three spectral distribution curves of the C.I.E. standard observer; and (*c*) photoelectric spectrophotometers in which the spectral reflexion curve is measured through the visible spectrum, and the colour specification calculated using the colour mixture data of the standard observer as tabulated by the International Commission on Illumination. Yet none of these methods is at present capable of specifying a colour to a limit of accuracy that cannot be exceeded by the remarkable capacity of the eye to discriminate between two colours of nominally the same specification, when compared side by side in a good light.

In principle, the spectrophotometric method gives the most absolute specification, since the determination of the reflexion factor at each wave-length is unaffected by the spectral sensitivity of the observer or photo-cell. Nevertheless, the accuracy of the result may be limited by the rather small amount of light that is sometimes available for measurement, and if an integrating sphere is used for increasing this amount, then a new uncertainty is introduced because the integrated reflexion may differ from the more directional reflexion employed in visual examination of the specimen. Other possible sources of error in spectrophotometry include stray light, finite slit-width, limited accuracy of photometric control or linearity of photoelectric response, and uncertainty in the specification of the white reference standard.

The magnitude of these inaccuracies was studied by circulating six coloured tiles, supplied by the British Ceramic Research Association, to a number of research laboratories where reflexion spectrophotometry is practised, and Prof. W. D. Wright (Imperial College) presented a comparison of the results to the meeting. In all, ten different instruments had been used, including five General Electric (Hardy) recording spectrophotometers and five non-recording instruments. Two of the latter employed double monochromators and three single monochromators. The tiles chosen for the test were of various colours and, more important, various surface characteristics, described as glossy, semi-matt and matt, although the polar reflexion curve of the matt tile showed a fairly broad specular component. One of the tiles had a very low reflexion (of the order of 1 per cent) in the green part of the spectrum and it was a tribute to the sensitivity of modern photoelectric devices that in this case the differences in the results from one instrument to another were generally less than 0·1 per cent in reflexion. For the other tiles, the reflexion of which ranged from about 20 to 80 per cent, the spread was of the order of 1 or 2 per cent.

It was noted that for five of the tiles, the average readings with General Electric recording spectrophotometers were 0·5–1 per cent lower than the average of the non-recording instruments, and this difference was attributed to the inclusion in the integrating spheres of the light diffusely reflected at large angles to the normal, whereas the non-recording instruments collected the light within a fairly narrow cone centred around the normal to the surface or, in the case of a Beckman spectrophotometer, in an annular cone at 45° to the normal. On the other hand, in the case of the so-called matt tile, the General Electric spectrophotometer readings were some 2 per cent higher, apparently due to the inclusion of some of the broad specular component mentioned above, in spite of the insertion in the integrating sphere of the black cap intended to absorb the specular reflexion. Some of the other differences could be traced to errors in the values for the reference white against which the tiles were compared. The ultimate standard is, by definition, a white magnesium oxide surface, but the discussion revealed some divergence of practice in the preparation of such a surface exactly to specification

On the assumption that the average values from the five non-recording instruments were the most nearly correct, the measurements made at the National Physical Laboratory using a Müller–Hilger 'Uvisir' double monochromator were the most accurate, with the results from the Paint Research Station using a Beckman spectrophotometer a close second. While the agreement among the different instruments was regarded by the instrumentalists at the meeting as quite gratifying, the practical colour