Lincoln College
CANTERBURY AGRICULTURAL COLLEGE

SCHOOL OF AGRICULTURE

UNIVERSITY OF NEW ZEALAND

SCIENTIA ET INDUSTRIA CUM PROBITATE

FOUNDED 1873

RURAL EDUCATION BULLETIN

Vol. I No. I MARCH 1, 1946

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EDITORIAL

This Rural Education Bulletin is being published for the teachers of New Zealand as the result of many requests for assistance in the implementation of the new post-primary instruction regulations. We feel that our interest in agricultural education in its widest sense qualifies us to assist in certain problems facing the teachers of General Science, Biology, Horticulture, General Agriculture, Animal Husbandry and Dairying. The success of the Bulletin will depend largely on the teachers themselves. While it is designed primarily for those in District High Schools and those other post-primary schools with courses in agricultural subjects, it is hoped that it will also find a place in city schools especially in connection with sections of the social studies.

We will have to rely on teachers to let us know their problems and to make suggestions for articles in future numbers. We are prepared to answer questions on any matters connected with the subjects mentioned. If of general interest the replies will be published in the Bulletin. We will welcome brief contributions on any matters dealing with the teaching of agriculture and allied subjects and with rural problems generally.

All correspondence should be addressed to

THE EDITOR,
Rural Education Bulletin,
Lincoln College P.B.,
Christchurch.

The Bulletin will be issued monthly from February to November. The annual subscription is five shillings post free.

SOME FACTORS WHICH HAVE INFLUENCED OUR AGRICULTURAL DEVELOPMENT

R. H. Bevin, B.Agr., Dip. C.A.C., Lecturer in Agriculture.

We are essentially a British community, homogeneous in our origin and in our traditions. The first settlers from the British Isles and those that followed in the emigrant ships brought with them not only their worldly goods and their household goods but also their traditional way of life which remained fundamental to them even though their everyday manner of living was drastically modified to meet the needs of a pioneer existence. Throughout the development of the Colony can be seen the efforts of these early settlers directed towards creating "Home" conditions amidst their antipodean surroundings. The primary needs of these settlers were those of the average Briton: wheat for milling, barley for malting, oats to feed the livestock and provide the meal for the breakfast porridge, wool for clothing, potatoes, meat, eggs, milk, butter and cheese for the table. All these were the essential products of their agricultural efforts; and as they were introduced 100 years ago so they have remained to give the basic pattern to the New Zealand farming which we know today.

The needs of the community provide the foundation on which the producer must establish his industry. Initially those needs were limited to the few who created the local demand which grew and expanded gradually as the population increased. Later, with the introduction of refrigeration and the acceleration of transport as steamers replaced sailing ships, the same essential needs in the "Old Country" provided a market which in absorptive capacity far exceeded the local demand and so opened up the possibilities of agricultural and pastoral development on a scale which to the first settlers would have seemed fantastic. At first a small isolated community, the buying public had in a few years been infinitely extended to the densely populated British Isles 13,000 miles away.

In studying the story of our agricultural expansion one is struck by the way in which our geography has determined the path followed over the years, for geographical factors in the widest sense determine the practicability or otherwise of any farming system. For a start the temperate nature of our climate enabled the settlers to apply those methods which were familiar to them, coming as they did from a country where seasonal conditions were similar to those which they found here. They had a virgin field to develop—one to which they might introduce their own familiar plants and livestock which readily acclimatised themselves to grow and reproduce and yield the customary harvest.

At first, settlement was determined by the accessibility of the chosen location. Coming from overseas with water transport as their principal means of travel these colonists chose the natural harbours as their first landing points; the river estuaries and valleys were their early farming lands—the bases from which later they might move overland to extend their holdings. The settlements at Russell, Auckland, Thames, New Plymouth, Wanganui, Wellington Napier and Gisborne in the North Island, like those of Nelson, Christchurch and Dunedin in the South, had all provided a landing place for the ships coming to these shores. Around them the settlements were established and until coastal shipping had grown to adequate dimensions each community was to a greater or lesser degree self supporting. In the North there are still traces of those early farming days. Disused flour mills on the rivers where the locally grown wheat was ground into flour for local consumption show how at one time arable farming was practised where now few traces remain of the furrows once ploughed on land which today is almost wholly given up to stock farming.

As transport conditions improved—the coastal shipping, the bush tracks later to become formed roads, and finally the railway system—it was found in the North that it was cheaper to buy grain from the South than to carry on the struggle of producing it under climatic conditions which were unsuitable for grain growing yet were ideal for the production of first class grazing. The arable farming of Auckland and the Waikato, of Taranaki and the Manawatu gradually disappeared and in its place grew a thriving pastoral industry based on grass pasture.

With the extension of transport facilities came the moving out of settlers from the river valleys to the hill country beyond. The native bush which for long had been a massive barrier to further expansion was now accessible and the work of felling and burning began. Much of the timber was milled out to provide for the needs of the expanding community but the greater portion was burnt "in a face" to be grassed down and turned over to grazing stock. Here again we find the pattern of farming practice governed by geography. First, accessibility had been a limiting factor in our land development. Roads and railways had overcome the early difficulties, but the hill country presented other features which were in those days largely disregarded. These were associated with the aspect, the angle of slope, and the nature of the land on which the forest grew.

The forest clad hills, subject to heavy rainfall, had through the centuries reached a climax in natural stability. Because of their cover they were able to absorb the rain showers so that the earth received a steady gradual soaking. The forest floor had such an absorptive capacity that the soil beneath was blanketed from the downpour and even the steeper slopes remained stable. With the removal of the forest, the destruction of the accumulated leafmould and litter by fire, and its replacement by a relatively thin cover of grass and clover the earth itself was exposed to the attack of water as an eroding agent.

Where the slope was such that it exceeded what we now call "the critical angle of stability" the land became subject to slipping and gullying; the rate of run-off was accelerated so that steadily-flowing "well behaved" streams changed, as the rains fell, to raging torrents carrying huge quantities of soil, flooded the valleys below, raising their beds and tending to change the whole nature of their lower reaches.

The aspect of hill country causes the climatic conditions on northerly and southerly faces to be strikingly different, particularly at higher altitudes, and these differences are evident in the quality and type of herbage which they carry even when they have been sown down with the seed of the same grass and clover species. These differences have a profound effect on the stock carried, both in numbers and in type. While the warmer faces are suitable for ewes and lambs or the raising of hoggets, the colder back faces have often to be reserved for the more hardy wethers.

The soil types found on our hill country are not constant. We have pumice, sandstone, papa, limestone and volcanic rock as the underlying basis on which the top soil has been built. They differ in their character and fertility. While papa, limestone and volcanic rock normally give rise to soils which are inherently fertile and capable of maintaining a good grass sward, the pumicious and sandstone soils "fade" rapidly once the initial fertility of the ash from the bush fire is used up. Unless careful management is employed they revert to second growth—bracken fern, tauhinu, manuka and so on—to such an extent that they no longer serve our pastoral purposes.

We know now that much of our steep, back facing or poorly fertile soils should never have been cleared; millions of acres have "gone back" and more will probably follow. It is easy to criticise those who acted as they did 50 years ago or more with no knowledge of what the effect of their action would be. Our part now is to study the factors—geographical, geological and botanical—which govern the nature of our land cover and decide how in the future we can best handle those areas of reverted bush country.

One can see how, with experience. the farmers of the North Island have gradually modified the original practices of their forefathers to suit the new conditions created in this new land. Dairy farming on specialised lines unknown elsewhere has developed on the better grasslands of North Auckland. Waikato, Taranaki and Manawatu. Nowhere has the art of grazing been so highly developed; in the manipulation of pasture for feed production and in the breeding up of milking stock to efficiently utilise that feed we see a remarkable example of the farmer working in with the climatic, geographic and soil factors which determine the course he may follow.

Our beef cattle brought from their original homes in England and Scotland are being used not only to produce meat but also to control our hill country so that the pasturage is maintained. Sheep are thus carried where, without such specialised management, second growth would take control and render the country worthless.

With experience accumulated over the years the sheep farmer has gradually discarded the numerous breeds of sheep which were originally introduced—Leicesters, Lincolns and Merinos—until today our flocks are almost exclusively Romneys; not the Romney as it was brought from England but a sheep which, through breeding and selection, is of a type best suited to our requirements. The studmasters have worked to produce within the breed an animal whose constitution, conformation, and wool favour the requirements of our type of farming on the hill country. At the same time it is useful for the "low country" men who, by using the Southdown ram on the Romney ewe, produce fat lambs for the overseas market. This simplification of our sheep breeding policy, and the adaptation of one or two breeds to meet our requirements is another example of the skill in specialisation which is characteristic of our farming in New Zealand.

In the same way our concentration on grass as the main source of stock food has brought our methods of pasture management to a much higher standard than that of almost any other country. We have by drainage, topdressing and liming, and by utilising the best of perennial species, turned poor or useless country into first class grazing land where the only natural asset was the climate—adequate rainfall. moderate temperatures and ample sunshine. One has only to consider what has been done on the Waikato swamps, the gum lands of North Auckland or the light pumice soils to realise how energy, enterprise and imagination have transformed the appearance and productivity of the land.

In other ways local geography has wrought changes in farming policy. The building up of large cities—clearing houses for our primary production—has created specialised markets which are supplied locally. The perishable foods—milk and vegetables—are generally produced on the outskirts of the city. The supplier of city milk is a specialist who, by virtue of the fact that he must keep his herd in production throughout the year, follows a different policy from his fellows who milk for factory supply; the market gardener farming on a small holding must select his land with greater care than the farmer insofar as aspect and soil type are of immediate and vital importance. Nowhere is this so vividly illustrated as on the Pukekohe Hill where the free working, fertile volcanic soil is admirably adapted to intensive cultivation while the northern sloping faces ensure warm, early soil conditions favouring rapid growth.

Modern transport has made it possible for these suppliers to the city to farm further afield than was once possible, but there are still marked limits and so the districts in which the city milk suppliers operate are usually well defined. So, too, though in a more flexible manner, are the areas defined in which market gardens can be profitably operated.

Another example of geographic determination of farming policy is that of maize growing in the Gisborne area. Here the climate is relatively mild and damage to the crop from late frosts rare, while the fertile soil of the alluvial plain is ideal for the growing of the crop. In the same way the East coast is one of the few districts in New Zealand where the growing of pumpkins for stock feeding in winter is carried out.

In the Bay of Plenty and in North Auckland citrus fruit culture is possible through the mildness of the climate and the relatively high soil temperatures throughout the year. It is of interest, too, that in these districts the pastures contain, in addition to our European grasses and clovers, the exotic sub-tropical Paspalum dilatatum, rarely met as an important species South of the 39th parallel.

(To be continued.)

PATTERNS IN MOTHER EARTH

Dr. M. M. Burns, F.N.Z.I.C., Lecturer in Soils and Fertilisers.

Man doubtless began to recognise differences in soil from the time he began to use it to produce crops. In the 7th century before Christ, soil descriptions were already in existence. The early writings of Cato deal with the utilisation of soils, and Columella sought to define the quality of a soil by the sweetness or fatness of plants grown upon it. This basis of soil classification along practical lines, using productivity and suitability for crops, was continued right up to the 19th century towards the end of which scientists first really recognised that soil characteristics were developed as a result of the operation of many natural factors.

All sciences seem to have had similar beginnings; that is: in the first stage they develop along practical lines because of the struggle of man toward the utilisation of Nature; and then at a much later stage they develop through studies devoted to the interpretation of the laws of Nature.

The first attempts to classify soils scientifically were based on the geological origin of the parent soil material and upon natural vegetation. To overcome the shortcomings of such classifications chemical analyses were undertaken and later allowance was made for textural differences in the topsoil.

But these classifications were never wholly satisfactory for they failed to explain the regularity of distribution of distinct soil groups in which similar soils were apparently produced from widely different classes of parent material. It was not until soil development had been studied in a broad way that it was recognised that the production of different soils was due to the interaction of many factors of which the climatic factors were the most important.

It was this recognition of the part played by climate which was first applied in 1883 by Dokutschajeff to the grouping of soils of European Russia. However, this concept was not made available until the Russian papers were translated into German in 1914 and did not reach the English speaking countries until after 1920. By this time the Russian workers had co-ordinated the factors controlling soil development so well that Glinka was able to present at the 1927 Congress of the International Society of Soil Science held in the U.S.A. a map of the main soils of that country which had been prepared in Russia almost wholly from publicised geological and climatological data. Moreover, the distribution of the major soil groups was found to match closely that which had been charted by the field surveyors of the U.S. Department of Agriculture.

Soil is often described as the weathered mass of material derived from minerals together with the decomposition products of plants and animals. This definition is scarcely adequate since it makes no allowance for changes in development produced by the continuous natural processes associated with the influence of water, air and living and dead organic matter.

The factors which are regarded now as interacting to produce distinct soil types are:

1. The nature of the parent soil material, especially with regard to its rate of weathering and its content of the bases, calcium, magnesium, potassium and sodium.

2. The climatic conditions under which soil development occurs as determined by rainfall, evaporation and temperature.

3. The type of natural vegetation which may be forest, grassland or desert scrub.

4. The topography, especially in its relation to the rate of removal of the products of weathering by erosion.

5. The movement of ground water whether free, impeded or seasonally fluctuating.

6. The utilisation of the land for farming, which may accelerate soil development or soil destruction.

Before we consider the part played by these factors it would be well to note that the first factor tends to fall into a different category from the others.

It may be said that all soils have characteristics obtained from two sources: those inherited from the parent material and those acquired as a result of the influence of environmental factors. In this respect soils may be compared with the child which has in its early infancy characteristics inherited mainly from its parents. As it grows up the influence of its environment becomes increasingly important. Thus a group of children on reaching maturity will have both inherited and acquired characteristics and the relative importance of each group will depend, in part at least, upon the parents and the environment.

Soils, too, tend to go through a life cycle starting from the weathering of the parent material and passing through the sorting and migration of the resultant products under the influence of soil water and vegetation to the production of a distinct type which is in equilibrium with its environment. The completion of the cycle occurs only when destruction of the soil by erosion exposes a new face of the parent material.

The rate of movement through the cycle is determined by the composition and the intensity of weathering of the parent material, the rate of decomposition of the organic matter, the effectiveness of the sorting processes and the difference between the rate of synthesis of new soil material and the rate of its removal by erosion.

Recent soils or young soils tend to have characteristics closely allied to the parent material while soils which have developed to a stage where they are in equilibrium with the environment have marked acquired characters and are classed as mature soils. The intermediate stages are designated as immature or semi-mature.

NATURE OF PARENT MATERIAL.

Soils may be developed from many materials ranging from rocks broken down in situ to their products which have been sorted and transported by ice, water or wind, to produce coarse textured deposits or fine textured silts and clays.

Soils produced from parent material which weathers readily and is high in plant foods will tend to be fertile, while those produced from hard rocks with a low content of plant foods will tend to be poor and unfertile.

Characters inherited from the parent material often influence the utilisation and treatment of soils for farming to a marked extent. Thus, more than three-quarters of the pre-war importations of potash fertilisers into New Zealand was used for application to the potash deficient soils of Taranaki derived from a volcanic rock with particularly low content of potash minerals. The cobalt deficient soils of the central North Island and the rich fertile papa soils of the East Coast are other examples.

Soils in which inherited characters are almost wholly dominant are represented by the alluvial deposits and the skeletals of the mountain faces.

CLIMATIC CONDITIONS AND VEGETATION.

The climatic pattern of the world is a pattern of heat and cold, moisture and dryness, weathering and soil distribution. The connection is intimate and world maps showing climatic, vegetation and soil regions are markedly similar.

In the early stages of development soils have properties closely related to those of the parent material but as time passes climatic agencies become dominant, especially where the land is level, erosion slight and drainage good. Under such conditions soils over wide areas, varying greatly as to the type of parent material, tend ultimately to develop similar characteristics. Such soils are classed as zonal soils to distinguish them from the intrazonal soils which, in spite of definite climatic and vegetational influences, reflect the influence of a local factor (such as poor drainage) and the azonal soils which are recent and have marked inherited characteristics.

We may divide the zonal soils into two main subdivisions—the humid soils and the aridic soils. The humid regions may be divided into three main groups, cold, temperate and tropical, each of which has a characteristic zonal soil associated with it. Thus the cold regions with a vegetation of moss and shrubs produce tundra soils; the temperate regions with forest or grass produce podzolic soils and the tropical regions, lateritic soils.

Under humid conditions, especially in cool temperate regions, a large portion of the annual rainfall must seep through the soil and pass into the sub-surface drainage systems. During the passage of this free water through the humus layers it collects a high concentration of carbon dioxide, a resultant end product from the decay operations, and soluble organic acids. This acid solution tends to remove lime, potash, magnesia and soda as soluble carbonates and bicarbonates while the hydrogen which is displaced from the solution enters the clay and humus. The removal of these soluble salts is termed leaching, but the term is often used to include also the downward mechanical movement of fine fractions of clay. Under these conditions the soil tends to become increasingly impoverished of bases and the soil segregrates into layers or horizons of sour humus over impoverished topsoil over enriched subsoil. It is at this stage that the influence of vegetation is most marked. Evergreen coniferous trees which are the dominant vegetation in the cold temperate zones are usually shallow rooted and have a very light annual leaf return which is low in bases. Such leaf litter tends to accelerate the impoverishment of the topsoil. Deciduous trees such as oak and sycamore, on the other hand, are usually deep rooted and have a high annual leaf return which is rich in bases. Such trees tend to offset the leaching process and may actually lead to enrichment of the soil—a result of which advantage is taken in the planting of mixed forests.

(To be continued.)

AN APPROACH TO GENERAL SCIENCE

The following outline scheme is printed in response to several requests. It is designed to fulfil the main requirements of General Science as a core curriculum subject. At the same time it provides a general background for such subjects as Animal Husbandry, Dairying, General Agriculture, Horticulture and Biology for School Certificate, all of which deal primarily with living things.

Our Environment.

What constitutes our environment? Living and non-living things.

Ideas of Matter.

Solid, liquid and gas. Change of state. The water cycle in nature.

Living Things Breathe.

Living things use oxygen. Oxygen cycle. Breathing of animals. Carbon dioxide. Heat and climate. Heat and living things. Clothing of animals. Sources of materials.

Living Things Feed and Grow.

Food as a source of energy. Main foodstuffs. Source; production; use. Fertilisers—origin and use. Carbon cycle. The cell as the unit of life. Bacteria and decay. Bt. and disease. Bt. and industry. Bt. and soil fertility. Nitrogen cycle. Humus. Soil. Earthworms. Vitamins. Hormones. Enzymes. Digestion. Circulation. Excretion.

Living Things Move and Work.

Vertebrate skeleton. Muscle, joints, levers, pulleys. Movement in plants. Locomotion in animals. Play. Living things and the surface of water.

Living Things Reproduce.

Ways of reproduction. Overcrowding. Dispersal. Migration. Heredity. Ways of improving plants and animals.

Living Things Communicate with each other.

Light. Lenses. The eye. Microscope. Sound. The ear. Sound in nature.

Living Things react to their Environment.

Influence of soil, weather, climate on plants and animals. Symbiosis. Parasitism. Biological control. Associations of plants and animals.

Living Things have Changed through Time.

Local geology. The story of the rocks. Ideas of evolution.

Conservation.

Natural resources. Human health. Human values.

Printed by Simpson & Williams Ltd., 169 St. Asaph Street, Christchurch, N.Z.