DEVELOPMENT OF NORTHERN AUSTRALIA

IN his presidential address to the Section of Geography and Oceanography at the thirty-seventh annual congress of the Australian and New Zealand Association for the Advancement of Science, Prof. R. H. Greenwood (University of Queensland) analysed the conditions for accelerated development in Northern Australia (*Australian Journal of Science*, 26; April 1964).

The first point which he emphasized was the necessity for an enlarged market for Australian goods. Since the largest domestic market is in the south-east, and, since Australian transport costs are high, there is no purpose in seeking to replace existing production in the north. Additional markets may be created in four sectors—two domestic and two foreign. The domestic market is being constantly enlarged to keep in line with the increasing Australian population; however, it could—with benefit to the economy—be increased still more by replacing imports by home-produced goods. The latter offers the more appealing prospects, but in the main it depends on the ability to pioneer new techniques for the production of tropical crops that are normally labour-intensive (rubber, coffee, tea, copra, etc.) and to intensify the search for minerals and oil (which constitutes a particularly large item on the import bill). Overseas markets can be expanded either by seeking new buyers for the conventional products of the north (mainly beef, sugar and minerals), or by innovations such as exploiting newly discovered minerals, or by the large-scale production of tropical grains and other food crops and raw materials for Asian markets. In theory, there is a substantial potential in each of these market sectors. The major problem is high costs, and this is of such significance to the basic proposition that the second condition for accelerated development is the ability to reduce overall production costs, or (and this is not by any means the same thing) to reduce the price charged for goods produced in the north.

There are some ways in which small savings can be made. It would be an advantage to increase productivity in those parts of the Australian Commonwealth that are nearest to her customers. It is unsatisfactory that Australia should, in a geographical sense, face away from her customers. It is a significantly shorter haul from Darwin to Hong Kong, Madras or London than it is from Melbourne, and the shorter time of the sea voyage may be important for technical reasons as well as cost (for example, in the ability to deliver chilled beef to the United Kingdom). Land would be comparatively cheap and every advantage of large-scale commercial production could be reaped in agriculture. The largest element in the higher cost margin, however, relates to the establishment of essential services—water, power, transport and building—in areas remote from the main centres of production. The capital costs involved in setting the productive machine

in motion are high and the benefits derived would be long-period, rather than short-period, benefits of a kind which reduce the attractiveness of the proposition to private enterprise. Moreover, public funds available for such capital developments are not unlimited.

This leads to the third condition for development. The benefits of capital investment in the north must be maximized. It would be essential to extract the utmost value from each project. In an area as big as tropical Australia, there is likely to be a measure of regional dispersal of public expenditure, each item adding different amenities in widely separated districts. The main item of public investment in the north should, however, be carefully planned to provide as many of the prerequisites for diversified development as possible. An ideal model would be the provision of a water storage that could be used both for irrigation, town supply and power generation to a nearby area with suitable conditions for the cultivation of an industrial crop which could be processed—at least in part locally—with road access to a not-too-distant port. The anticipated benefits would include the capacity of the original investment to bring about growth of ancillary and dependent activities in an exponential manner and, in particular, to stimulate the growth of small urban communities, the increasing needs of which would create opportunities for additional use of local land, water, power and other services. Such a deceptively simple model is not by any means easily created. For example, there is the temptation to start with the selection of a suitable dam-site and see what can be done with its surroundings. Governments in many parts of the world have been prone to build dams first and think of ways of using the water they retain afterwards.

The starting-point should be the selection of a crop with carefully evaluated market prospects. The next stage would be the location of one region in which market surveys indicate that the production of the crop is justified on a large scale. This should be a region with maximum nodality, with country capable of complementary rural production in different districts, with maximum access to a port, roads, railways and other services or with optimum means of creating such access. The logistics of geographical location are of immense importance, and the districts around Rockhampton and Darwin have great possibilities as regards the polarization of new developments. They are natural nodes to which easy lines of communication converge and around which varied resource patterns are disposed. They are of particular significance, as notably Australia lacks such naturally endowed nodal districts. Dam sites should only be looked into after the purpose has been satisfactorily defined of the new developmental scheme and the optimum location for its introduction agreed.

A GREAT PATHOLOGIST AND NATURALIST

ADOLPH LUTZ, one of the world's greatest medical zoologists, was born in Rio de Janeiro in 1855*. His parents were Swiss, and when they returned to Berne in 1865, Adolph was educated in Switzerland. When his parents later returned to Brazil, Adolph was left behind to go to school in Basle. He had by then already decided

to spend his life studying natural history, and in 1874 he began to study medicine at the University of Berne, taking courses also at Leipzig, Strasbourg and Prague, and studying biology as well. In 1879 he received his licence to practise medicine. Already he had published papers on the Cladocera of the neighbourhood of Berne and Leipzig. He went to Vienna and Paris for post-graduate studies, and then returned to Brazil, where he practised medicine from 1882 until 1892 in the province

* Adolpho Lutz (1855–1955): *Vida e Obra do Grande Cientista Brasileiro*. Pp. 55. (Rio de Janeiro: "Comissão do Centenario de Adolpho Lutz", Conselho Nacional de Pesquisas.)

of São Paulo and elsewhere. In 1885 and 1886 he went to Hamburg to study dermatology. In 1887 he moved to the city of São Paulo until the pandemic of yellow fever in Campinas in 1889, and he was later summoned to Hawaii to investigate leprosy. Although he was busy as a country doctor, Lutz found time to publish papers on helminthology and medicine, among which was a monograph on *Ankylostoma duodenale* and ankylostomiasis, and others on ascariasis and the mode of infection with the tapeworm *Taenia*. On the latter subject he experimented on himself. In 1886 he published a paper on the structure of the organism that causes leprosy, proposing to include it in a new genus called *Coccothrix*, including the causal organism of tuberculosis in the same family, but the name *Coccothrix* was not adopted, although the relationship of the two organisms is nowadays recognized. In 1885 he discovered a new disease of children, now known as pink disease, and he published further papers on leprosy, based on his observations made in Brazil. Working in Honolulu he published papers on dermatology, and in 1891 a paper in which he separated amoebic from bacillary dysentery.

In Honolulu he met and married an Englishwoman, Amy Fowler, who had gone there as a volunteer nurse. After a spell in San Francisco, he and his wife returned to Brazil in 1893, where two children were born to them. In the same year Lutz was appointed vice-director of the new Bacteriological Institute of the State of São Paulo, founded by Felix Le Dantec, and later he became its director. Here he did much work on yellow fever, malaria and typhoid fever, making possible the accurate diagnosis of these endemic diseases, and directing campaigns against them. Hearing that the transmission of yellow fever by mosquitoes had been proved, Lutz, together with his colleague Ribas, director of the State sanitary service, instituted, in spite of much opposition, measures against the mosquitoes. He also worked at this time (1899-1906) on cerebrospinal meningitis, plague and myiasis, and published papers on them. In 1897-98 he discovered the sylvan form of yellow fever in the area between São Paulo and Santos, and rightly ascribed the transmission of this to the forest mosquitoes rather than to *Aedes aegypti* (*Stegomyia fasciata*).

In 1907-08 he discovered and described two new diseases caused by fungi, namely, a sporotrichosis of man and rats, and the disease later known as the mycosis of Lutz. From 1903 onwards Lutz began to work on medical entomology, publishing papers on the technique of the study of mosquitoes, on bloodsucking Diptera and on new species of Culicidae and Tabanidae.

He also did pioneer work on veterinary medicine in Brazil, investigating among other diseases equine trypanosomiasis. Later he was asked to join the staff of the Instituto Oswaldo Cruz, becoming chief of the Division of Medical Zoology. This post gave him time for work on medical entomology and helminthology, and for work on snakes and amphibians. He also wrote papers on Tabanidae and a monograph on the Simuliidae, parasitic Hippoboscidae and the forest flies and Ceratopogonidae, contributing chapters on insects of medical importance to the *Handbuch der pathogenen Organismen*.

From 1916 onwards he returned to work on helminthology, doing pioneer work on schistosomiasis in Brazil, studying the biology and ecology of the intermediate hosts involved. Later papers were on trematodes and scorpions in connexion with his lectures on poisonous animals. His earlier interest in leprosy was retained to the end of his life, and increasingly he regarded it as a disease transmitted by mosquitoes. Lutz travelled widely in Brazil in the course of his studies, and in 1928 he warned the country of the danger of outbreaks of malaria when *Anopheles gambiae* was carried from Africa to South America. It later caused, in north-eastern Brazil, one of the most disastrous outbreaks in the history of the disease.

In the course of his life Lutz named many insects, worms, molluscs and frogs, and many species were named in his honour. He was an honorary and corresponding member of many learned societies, and received many honours. On the first centenary of his birth the Brazilian Government issued a stamp with his portrait on it, and several towns in the State of São Paulo, where he did much beneficent work, named streets after him. His research extended over 61 years, and a complete edition of his publications, of which there are more than two hundred, is being planned.

G. LAPAGE

ROTHAMSTED EXPERIMENTS

IN 1919, Sir Alfred Hall wrote that the purpose of the Rothamsted Experiments was "to ascertain the conditions under which the plant grows and the soil supplies it with nutrient". Since then agricultural research has developed in many spheres, and it is clear from the annual report of the Rothamsted Experimental Station for 1963* that at present the classical investigations, initiated by Lawes and Gilbert over one hundred and twenty years ago, form only a part of the manifold activities of the Station.

The report follows the same pattern as in previous years, consisting of reports from twelve research departments, the farms at Rothamsted and Woburn, Broom's Barn and Woburn Experimental Stations, and a summary of the work of the Soil Survey for England and Wales. In an admirable general report, the director, Mr. F. C. Bawden, has commented on a few of the subjects of research carried out, but emphasizes that his introduction is merely an indication of the range of work of the Station, and is in no way a summary. Similarly, in a short review it is possible to mention only a few of the items contained in the report, and I can only hope that the interested reader will explore the report further for himself.

Some of the most interesting and important scientific developments have come from the research of the Depart-

ments of Physics and Botany into the phenomena involved in crop physiology. Detailed investigations into the physical conditions within crops and the growth of species under different sets of conditions have been carried out to obtain information about the factors which limit the productivity of healthy crops receiving adequate water and nutrients. As the director pointed out, until such knowledge is available it will be impossible to say with certainty whether a variety is producing its maximum yield, or what conditions increase yielding capacity. The Physics Department has been concerned with the energy involved in photosynthesis, and carbon dioxide flux measurements. Already several important trends have emerged, and some earlier ideas have had to be modified. For example, the soil's contribution to carbon dioxide uptake is much less than had been thought. Evapo-transpiration studies have been continued, in particular the estimation of insolation from cloudiness records, and the calculation of net radiation from measured solar radiation, analysis of evaporation and records of heat balance. The value of these evapo-transpiration measurements as a basis for assessing irrigation needs should be fully realized when the new irrigation scheme is installed at Rothamsted. In the Botany Department, controlled environment rooms have been used to examine the effects of varying temperature and humidity on plant growth. Apart from the controlled

*Lawes Agricultural Trust. Report of the Rothamsted Experimental Station for 1963. (Harpenden: Rothamsted Experimental Station, 1964.) 15s.