

Annual Address to the National Institute of Sciences of India,

BANGALORE, 1946.

By D. N. WADIA.

PROGRESS OF SCIENCE IN INDIA.

I greatly appreciate the privilege of addressing this the 11th anniversary of the foundation of the National Institute of Sciences, on the occasion of its Annual General Meeting. Looking back on our brief history, the year that has gone by must give to the founders of the Institute, several of whom are happily with us to-day in this House, real satisfaction that the organisation, which was founded in 1934 and inaugurated in January 1935 with eight well-defined pregnant¹ objectives, has, after passing some difficult years of growth and edification, entered upon that stage of its career which they had chalked out for it as the National Scientific Society of India. From its very inception, the aim was to form a body suited, by its constitution, rules and methods of work as well as by the representative character and scientific eminence of its Fellows, to occupy the position similar to that of the National Academy of Sciences of Washington or the Royal Society of London. The recent announcement by the Education Department of the Government of India, that Government have decided to recognise the National Institute as the premier scientific organisation of the country, is a significant event and will remain the most notable landmark in the early history of this society, which, we confidently predict, is destined to play a most significant rôle in the scientific progress of the Indian nation. In a separate communication, we are informed that the Government of India have agreed to make a budget provision for the National Institute of Sciences of India for the year 1946-47 for a non-recurring sum of Rs.2,20,000 for a building grant and a recurring sum of Rs.1,17,000 for the expenses of the Institute under the items of the Institute Secretariat, National Research Fellowships, grants-in-aid for publications, library, travelling expenses, etc.

The Board of Management of the Imperial Chemical industries, London, headed by Lord McGowan, have, in a letter to the President last July, offered a sum of Rs.3,36,000 for endowment of four Research Fellowships in India to be administered by the Council of the National Institute solely at its discretion. The Council has selected, after advertisement, post-graduate research workers for the award of three of these Imperial Chemical Industries (India) Fellowships, commencing

¹ The objects of the National Institute of Sciences of India are—

- (a) The promotion of natural knowledge in India including its practical application to problems of national welfare.
- (b) To effect co-ordination between scientific academies, societies, institutions, and Government scientific departments and services.
- (c) To act as a body of scientists of eminence for the promotion and safeguarding of the interests of scientists in India: and to represent internationally the scientific work of India.
- (d) To act through properly constituted National Committees in which other learned academies and societies will be associated, as the National Research Council of India, for undertaking such scientific work of national and international importance as the Council may be called upon to perform by the public and by Government.
- (e) To publish such proceedings, journals, memoirs and transactions, and other publications as may be found desirable.
- (f) To promote and maintain a liaison between Science and Letters.
- (g) To secure and manage funds and endowments for the promotion of Science.
- (h) To do and perform all other acts, matters, and things that may assist in, conduce to, or be necessary for the fulfilment of the above-mentioned aims and objects of the Institute.

from December last: for the fourth award, it has decided to ask for fresh applications after re-advertisement over a wider circle. It is to be hoped that the example of this British firm's munificent donation for scientific advancement in India will be emulated by some of our wealthy Indian firms whose recent acquisition of wealth from surplus war profits cannot be more profitably invested than in endowments for scientific research for industrial application. This alone will ensure to our industries continuance of the hard-won prosperity of the last few years, by increasing all-round efficiency through the application of new and better methods. Few of our industrial magnates have fully realised the direct benefits laboratory research brings to their business. So far the only Indian firm which has worthily emulated the example of the million sterling donations of some of the great United Kingdom and American business houses for pure scientific research, is the House of Tatas which has made public-spirited donations for research in various branches of science during recent years that have passed the five-million Rupee mark.

During the last two years, the Rockefeller Foundation of New York has given to the National Institute a grant of Rs.15,000 per year, which is being distributed to some 23 different scientific societies and academies in India in aid of their publications. This is one indication of the rôle played by the National Institute in Indian science even before any formal recognition was accorded by Government.

But, Gentlemen, such recognitions bring with them duties and responsibilities on your shoulders—duties which entail much more than paying your annual dues or reading an occasional paper on your especial line of study or research. The conduct of an institution of this nature, which encompasses all sciences and draws its members from all over the geographical bounds of India, involves on every single constituent member an undertaking for diffusion of science in the social and national life of India, its positive application in our educational system and in our industrial economy and for enhancing the dignity of India's intellectual contacts with the world. To discharge these obligations effectively, we will have to take upon ourselves definite tasks immediately and strive to make our voice heard by the governing political parties for their assigning to science its rightful place in the educational, technical and industrial life of the country.

Consequent upon the acquisition of the new status, your Council, after due deliberation, has accepted the following routine duties and responsibilities:—

- (a) To act as advisers to Government on all scientific matters.
- (b) To co-ordinate the activities of scientific academies, societies, institutions.
- (c) To distribute grants-in-aid to scientific publications from funds provided by the Rockefeller Foundation and by Government.
- (d) To administer funds for award of Research Fellowships founded by the Imperial Chemical Industries (India) and also those founded by Government and other public bodies and arrange for the supervision of the work of Research Fellows.
- (e) To do such other things as may be necessary for organising scientific work in India.

Scientific meetings are held regularly at present and symposia and discussion meetings on current problems are arranged from time to time. A series of *Transactions*, *Proceedings* and *Indian Science Abstracts* are being published. A consolidated report on the progress of science in India will be published according to our programme. During the war emergency years, due to difficulty of printing and paper, our publication programme has been inadequate and out of time; but it is now proposed to entrust our publications to an Editorial Board to help the Editor or Editors in producing the Journal in two fascicles: (A) Physical Science, (B) Natural Science. A Sub-Committee of the Council is now considering the details of this programme which will considerably improve our position in respect of publications.

At a very early date the work of the National Institute of Sciences of India will assume more and more the nature of the work of a National Research Council, whose functions may be defined as follows:—

- (a) To plan and watch over the main lines of research and technical developments in accordance with national needs to see that the application of science to public welfare is adjusted to some consistent plan, to advise Government on a common policy and to ensure that available resources for research and developments are distributed to the best advantage of the country.
- (b) To advise and help relevant authorities and institutions regarding the training and supply of scientific personnel for pure and applied research.

- (c) To distribute grants for promoting approved researches for the maintenance of selected research scholars, for scientific publications and other purposes.

For the efficient performance of this work, the National Institute, in consultation with non-official scientific organisations, universities and prominent scientific institutions, the scientific Surveys and Departments of Government and Chambers of Commerce, will, from time to time, constitute Committees of Research for particular science or groups of sciences. Also the Institute will, in future, have to constitute a permanent Research Grants Committee. More important duties will henceforth devolve upon our Sectional Committees which will be the proper bodies out of which various Research Committees will have to be formed 'to settle the objects of research in their respective sciences, indicate individuals or organisations which could undertake several component parts of enquiry, receive and co-ordinate the information, make it available to those who will turn it to advantage to form a national plan into which all who are in a position to contribute information can fit the particular lines of research'. A provisional Research Grants Committee has already been established and early in the New Year, the Council will take up the constitution of the new Research Committees.

During the year, our Institute has suffered grievous loss by the premature death of four brilliant Fellows, three of them were Foundation Fellows: Dr. H. K. Sen, a Foundation Fellow, a distinguished chemist and scientist of wide versatility, died in harness as the Director of Industries, Bihar; Professor H. Chaudhuri and Professor S. L. Ghose, Foundation Fellows, both were Professors of Botany in the Punjab and distinguished representatives of Indian science in their field of studies. We also mourn the death of Dr. S. N. Chakravarti (elected 1935), who was the Chemical Examiner to the U.P. Government. The National Institute has duly recorded its sense of loss in its register and conveyed its condolences to the bereaved families.

Much the most important event in the Science Year Book for 1945, which will live in history as having brought the end of the greatest war in history, was the surprising rapidity with which research on the use of the energy of atomic disintegration was completed. This is likely to prove one of the greatest revolutions of science and through it of the World Order. Amidst the pious declamations of horror and detestation the use of this discovery has aroused in many parts of the world, scientists should not be deterred from welcoming this new achievement of science which has far more potentialities for good over evil than the majority of the scientific discoveries of the last century. We stand close to further great discoveries in this direction: the transformation of elements into other more coveted elements in great quantities is within sight. But, what the ancient alchemists never imagined, we shall also be utilising at the same time millions of horse-power of energy generated in these transformations. It is a matter of no small pride to us that, in this great research, India has not been a mere idle spectator. Our four eminent physicists have for many years past taken a creditable share in researches on nuclear and atomic physics and on borderline subjects.

At the end of this meeting there will be a special Convention of Fellows of the National Institute of Sciences of India to express their opinion on the solemn need of the time—viz. international control of atomic energy by a World Peace Organisation, restricting its use for the benefit of mankind in general and preventing its vast destructive potential from being employed for nationalistic military ends or for anti-social purposes by any nation or group of nations.

The successful splitting of the uranium atom and the employment of the energy liberated thereby for explosive purposes have so upset the popular imagination that outbursts of wild reproach against the aims of scientific knowledge are heard daily from all sides, mostly from the scientifically advanced countries. It is amusing to hear that there is a vague but growing fear amongst a section of the educated population that if science is not now controlled it will 'wipe out the world and the human race in time'. A mass observation report in the Press, taken in 1941, but published lately, states an intelligent citizen of England having confidently declared his belief that 'all scientists should be hanged by the neck until dead' and that in

his opinion this procedure had become a public necessity now 'to stem the spate of horrid things which flow from their laboratory benches'. This same intelligent citizen advocates a similar fate for 'aeroplane inventors, technicians and other science-mongers'.

The repercussions of these events in India have not been so vocal or demonstrative, but there is no denying the fact that the advancement of scientific knowledge arouses no enthusiasm in the average mind in India and is at times even received with suspicion, if not dislike. For a country that has an enormous leeway to make up in fighting chronic malnutrition, insanitation, disease and food scarcity, this mental attitude about the most potent weapon that can fight these evils and work for 'the relief of Man's estate' needs to be changed. Missionaries of science are needed for this task, both in the ranks of Government services and among the public-spirited citizens working for the social welfare of the masses. Scientific societies and academies in India have therefore an extra mission to perform of spreading the gospel of science in all the corners of India. They should, besides their legitimate functions towards their avowed branches of specialised science, ungrudgingly take upon themselves the task of raising science to the level at which it flourishes amongst all ranks of the people in culturally and industrially advanced countries.

Scientific research in India, both in what has been called its 'pure' and 'applied' branches—though, in reality, no such distinction exists—is of late introduction and much lament has been made on its slow growth on the Indian soil. Physico-chemical, mineral, metallurgical, engineering and electro-chemical industries have been slow to take root in India, but, with a fine range of raw products yielded by abundant natural resources of the organic as well as mineral kind, their possibilities are becoming manifest.

I. THE BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

These possibilities scarcely explored even in the initial stages before the outbreak of the war gave a rude awakening to the authorities. Government and especially the War Department found themselves bereft of commodities essential for the prosecution of the war. It was during this emergency of insistent demands for defence and security that the Board of Scientific and Industrial Research was born in April 1940. Planned industrial research on the vital, chemical, engineering and metallurgical industries being non-existent, the new organisation under the stewardship of Sir S. S. Bhatnagar had before it the difficult task of making India an effective source of a number of urgent war supplies. By the end of 1941, India had to occupy a key position as a supply centre for the whole of the Eastern theatre of war. The country's hitherto untapped or indifferently exploited mineral, agricultural and forest resources could not be harnessed all at once. But the technical machinery set up by the Board of Scientific and Industrial Research for the prosecution of industrial research has fulfilled during the past six years expectations and produced results which should be heartening to science workers in India. The Board consisting of leading scientists and industrialists has functioned in multiple capacities, both advisory and executive (Council of the S.I.R.), in very trying circumstance. Besides instituting specific laboratory researches on a large number of new products, it offered expert advice on proposals for helping scientific institutions to study problems affecting particular industries and trades and on proposals for the establishment of Research Institutes, studentships and fellowships. The Board has financed schemes of research in universities and other institutions possessing facilities for research in the subjects concerned. Altogether there are over 125 such research schemes in operation to-day.

The finances of the Board, derived entirely from the Government Exchequer, have been, as one naturally expects in India, on a niggardly scale up till lately, totalling less than the amounts voted for scientific and laboratory research by single commercial corporations such as the Imperial Chemical Industries (London) or the Bell Telephone Corporation of the U.S.A. The success of the undertakings sponsored by the Board, both of strategic and industrial utility, has encouraged

the Finance Department to allocate more liberal grants in later years. The vote of the current year according to our information is Rs.30,00,000. These funds have been supplemented by a few donations from the public, including a very generous one of Rs.20 lakhs from the Tata's, for endowing the National Chemical and National Metallurgical Laboratories and a Fuel Research Institute. It is pleasing to mention here that no less than Rs.1,70,000 of these donations is the share of the earnings of the C.S.I.R. in the form of royalties and premia on the processes leased out for commercial exploitation, including Rs.25,000 personal royalties of Sir Shanti Swarup, true to the tradition established by himself so early in his career of devoting his royalties from research to the cause of science. The scientific work of the B.S.I.R. is carried out through some 20 Research Committees which formulate co-ordinated proposals for pursuing schemes in their respective subjects, see to the correct utilisation of the grants voted and plan systematic programmes for further work. Some of these Research Committees have already started work on projects of far-reaching utility.

- (1) *Metals Committee* under the Chairmanship of Sir J. J. Ghandy have undertaken extensive research programmes on electro-metallurgy, light and heavy metal alloys, electrical sheet steels, resistance alloys, metal powders, manufacture of metallic manganese, magnesium and beryllium. The planning and equipment of a National Metallurgical Laboratory, on a revised outlay of about Rs.50 lakhs, is one of the chief items in the programme of the Metals Committee.
- (2) *Electro-chemical Industries Committee* have a programme for manufacture of alkalies, carbides, carbon electrodes, artificial abrasives by application of electrolytic, electro-thermal and electro-metallurgical processes.
- (3) *Fuel Research Committee* have an extensive programme of research and physical and chemical survey of Indian Gondwana and Tertiary coals, their washing, briquetting, blending and low- and high-temperature carbonisation, etc. An up-to-date Fuel Research Station is planned and is to be equipped for high-level research on coal fuel.
- (4) *Heavy Chemicals Committee* have several important research schemes in operation bearing on the manufacture of heavy chemicals such as acids, alkalies, ammonium sulphate and other sulphates from gypsum, phosphatic fertilisers and other heavy chemicals. The projected National Chemical Laboratory is under active planning and construction at Poona.
- (5) *Plastics Committee* under the Chairmanship of Sir J. C. Ghosh have correctly estimated the immense importance that Plastics will play in India. Several manufactures have been developed from the indigenous sources and synthetic resins in the Board's laboratories, among which the more notable are unburstable petrol containers, laminated jute fibre-boards, electrical appliances, containers, plastics from vegetable oils, substitutes for glass, etc.
- (6) *Glass and Refractories Committee* have schemes for the manufacture of improved ceramic products, optical glass, ceramic colours and glazes and high-temperature refractories, survey and refining of Indian glass and ceramic raw materials. The foundation of the Central Glass and Ceramic Research Institute was laid at Calcutta by Sir Ardeshir Dalal.
- (7) *Dye-stuffs Committee* have over a dozen schemes on various dyes in operation now. The processes that are developed for the extraction and manufacture of dyes from vegetable products have already entered commercial exploitation.
- (8) *Radio Research Committee* under Professor S. K. Mitra have undertaken investigations on the manufacture of radio receiver sets, valves, condensers, etc., and an atmospheric research station for investigations on upper air for radio-electronic research is being established.

The remaining 12 Committees of the Board are engaged in equally important programmes. Additional grants-in-aid made by the Council of Scientific and Industrial Research during the financial year 1946-47 are:—

	Rs.
(a) Recurring grant to the Tata Institute of Fundamental Research for research in theoretical physics	75,000
(b) Recurring grant to the University of Madras towards the establishment of an Institute of Leather Technology	60,000
(c) Grant for conducting Building Research at Thomason Engineering College, Roorkee	90,000
(d) Grant for setting up a Road Research Institute at an estimated cost of Rs.17.5 lakhs. The amount required during 1946-47 for capital and recurring expenditure is Rs.9.5 lakhs	9,50,000

An interesting offspring of the activities of the B.S.I.R. was the institution of the Industrial Research Planning Committee, under Sir R. K. Shanmugham Chetty,

in December 1943. This Committee, after a comprehensive survey of the existing facilities for scientific and industrial research in India, presented a report early in 1945, on measures necessary for enhancing these and the co-ordination, direction and development of scientific research in general on modern lines in post-war India. This report deserves careful attention on the various recommendations that it has made, rather than on the features which have been omitted from its purview and which have come in for unnecessary criticism. Its most notable suggestion is the organisation of a National Research Council for India with the following nine functions:—

- (i) To organise and maintain National Laboratories.
- (ii) To establish and maintain specialised research institutes.
- (iii) To stimulate pure and applied research in universities by grants-in-aid.
- (iv) To provide for dearth of technical and research personnel by inaugurating scholarships.
- (v) To stimulate and encourage research activities by Indian industry.
- (vi) To co-ordinate the research activities of the existing Institutes and Government Departments and plan research programmes.
- (vii) To function as a National Trust for Patents.
- (viii) To set up a Board of Standards and Specifications.
- (ix) To function as a clearing house for scientific and technical societies in the country.

II. A PLAN OF AGRICULTURAL RECONSTRUCTION.

But in the re-building of the new India, industrialisation alone, without agricultural reconstruction and development, may produce retrograde effects on its economy. The country's lifeblood is agriculture; throughout the ages this industry has sustained its vast population and only by a gigantic effort in increasing agricultural production can we quicken its metabolism so as to help the rise of other industries demanded by modern times and conditions of living. It is heartening to Indian scientists to record here a second momentous advance in the last two years, viz., a plan for building up of India's agriculture through the application of scientific knowledge. The 'Memorandum on the Development of Agriculture and Animal Husbandry in India' by Sir P. M. Kharegat, commonly known as the *Kharegat Plan*, published by the Imperial Council of Agricultural Research, embodies a far-reaching plan of agricultural reconstruction that should receive the widest attention from Indian scientists and the educated public. The salient features of this 'Plan', which envisages the optimum utilisation of all national assets, in the shape of land, water and live stock and their maximum exploitation by all means known to science and technology, are given in brief outline below:—

The United Nations' Conference on Food and Agriculture places in the forefront of its recommendations the improvement in the level of nutrition and the raising of the standard of living of the people. It considers it an obligation and a primary responsibility of civilised countries to see that their own people have the food needed for life and well-being. The Kharegat Plan tries to determine the extent of action necessary to discharge the above obligations and fixes minimum targets in the production of various foodstuffs from 10 to 300 per cent in excess of the present meagre standards.

The low level of average production per acre in India has been stressed and reasons for that given, the most important of which are: precarious and badly distributed rainfall over $\frac{2}{3}$ of the total cultivated land; inadequate or entire absence of manuring; low standard of cultivation; use of primitive implements; absence of provision against soil erosion; absence of control against pests and diseases; and poorly nourished and managed live stock.

WATER-IRRIGATION. The production of irrigated crops per acre by controlled irrigation is known to be, on an average, 50 to 100 per cent higher than that of unirrigated crops in the same locality. As $\frac{1}{3}$ of the cultivated area is unirrigated it is estimated that provision of irrigation facilities can roughly increase production by at least 50 per cent. Measures to achieve this end are: the harnessing of the water of rivers; the lifting of water by mechanical means, direct from rivers and canals; the utilisation of sub-soil water by ordinary percolation wells and tube-

wells; construction of minor irrigation works such as tanks; and better utilisation of rain water by bunds and terraces and its conservation in the sub-soil.

The total cost of the above programme is estimated at roughly Rs.320 crores.

LAND UTILISATION. For the utilisation of land to maximum advantage, we must

- (i) bring under cultivation such of the 170 million acres classified as culturable waste,
- (ii) check soil erosion by contour bunding, proper alignment and embankment of fields and control of the water in the catchment area from carrying away rich upper surface of agricultural soil,
- (iii) provide one scientific experimental farm in every division or district,
- (iv) obtain higher crop yields by improved manuring and scientific husbandry, such as, use of pedigree seeds, control of pests and diseases, etc.,
- (v) popularise the use of chemical fertilisers, ultimately aiming at the target figure of one million ton of nitrogen per year for the whole of India, at an estimated cost of Rs.40 crores, and
- (vi) improve land tenure system and try out the relative merits of consolidated holdings, consolidated farming, co-operative farming and collective farming on the Russian plan.

IMPROVEMENT OF LIVE STOCK. Increased production from Indian flocks and herds depends upon the degree of improvement in both the quantity and quality of their food supply and also on bettering the routine of village management. There should be adequate increase in the production of fodder, straw, cereal by-products and concentrates, especially oilcakes.

A development scheme should be drawn up for each large grazing area for proper grassland management, including rotational grazing, re-seeding, hay-making, etc.

Growing of trees of fodder species in minor forests, construction of water troughs and the supply of minerals and salts to cattle should be undertaken.

Systematic scientific breeding from pedigree stock of farm animals for their economic characteristics, such as, disease resistance, economic feeding, longevity and milk and draught quantities, should be undertaken. For this purpose, some 60 cattle, buffalo and sheep farms are proposed, each of 12,000 acres, or a greater number of proportionately smaller size. Similar breeding farms are proposed for sheep, goats and poultry.

Provision of dairy farms near towns with facilities for the production of milk and milk products by improved methods and with adequate control of adulteration.

The fisheries of the country are to be systematically tapped by provision of rapid transport of fish, their cold storage, processing, development of inland fisheries by planting of suitable stocks in ponds, tanks, reservoirs, canals and rivers and grant of facilities in the shape of boats, nets and implements to the fishermen.

ORGANISATION. The plan emphasises that 'the Central Government must take the lead in many matters if progress is to be rapid. On the research side, it must accept the main responsibility for fundamental research and must advise on policy in regard to agriculture and animal husbandry matters of common interest and must arrange adequate co-ordination of effort, if overlapping is to be avoided and maximum achievement is to result in the shortest time. It cannot remain entirely aloof from the extension of the results of research into farm practice throughout the country, even though the practical extension of those results must primarily be the function of Provincial or State Departments of Agriculture. It must also be in a position to assist financially when funds are needed for encouraging and promoting research, extension, or other action in the Provinces'.

For achieving the above end, the reconstruction plan proposes the following organisation:—

- (i) Creation of a Federal Department of Agriculture which would be charged with the duties of fostering agriculture and animal husbandry on scientific lines in their broadest sense and in all their phases. Its activities would include investigations of production and marketing and utilisation of crops and live stock, and the control of diseases and pests to which they are subject.

- (ii) The Federal Council of Agricultural Research would be the instrument of the Federal Department of Agriculture for co-ordinating scientific investigations in all parts of India.
- (iii) The existing Agricultural Research Institute (Pusa) and the Imperial Veterinary Research Institute would be expanded. They would come under the Federal Agricultural Council and their primary function would be fundamental research.
- (iv) Side by side with them would be set up in appropriate regions in India a chain of Commodity Research Stations and Sub-stations, each dealing with problems connected with its own commodity, be that animal or vegetable in origin. These Commodity Stations would follow generally the organisation already existing for jute, cotton and sugar-cane. Each would be administered and controlled by an Indian Central Committee for the particular commodity.

EDUCATION AND EXTENSION WORK. This plan draws attention to the fact that 'in the past, the incorporation by the cultivator of the useful result of agricultural research in his every-day agricultural and live stock practices has not kept pace with discoveries, and neither the cultivator nor the country as a whole is deriving the maximum benefit from the expenditure which has been incurred on research and the results obtained from it. This unsatisfactory position is mainly the result of failure hitherto of Provinces and States to staff their Agricultural Department on a scale at all proportionate to the territory to be covered and the number of cultivators to be contacted. The latter have remained either unaware of the possibilities of improvement or, in the absence of local demonstration, unconvinced of their applicability. In planning for the future, therefore, a very high degree of priority must be given to the provision of staff and other facilities necessary to terminate such a position and to ensure that, for the future, every cultivator in every village not only has the knowledge of the many directions in which he can increase his yields from his holdings and live stock, but puts that knowledge to practical daily use'.

To achieve this end, it is proposed to treat the village as a unit and build up adequate organisation on it. For each village, a village guide is suggested who may preferably be an active member of its own community, who, while cultivating his own land, could give part-time service to act as a link between the technical experts and the cultivators in his own village for an honorarium. In order that adequate attention may be given in future to extension and propaganda activities, in view of their enormous importance in increasing production, it is considered that the minimum average staff in a Province or State should be:—

- (a) For Agriculture, either one fieldman per union or group of 25 villages, one non-graduate demonstrator per assessment circle and one graduate inspector per tahsil or one *Mukaddam* or *Kamdar* per assessment circle and two graduate assistants per tahsil. In either case, the gazetted staff would consist of one Superintendent or Assistant Director per Division.
- (b) For Animal Husbandry, one stockman per union, four live stock instructors, two of whom will have veterinary qualifications, per tahsil, two Live Stock Officers, one of whom would be veterinary per district; and one Deputy Director of Animal Husbandry per Division.

ORDER OF PRIORITY. As several years will be needed for the complete execution of this plan, the following order of priority of action has been suggested to ensure development in an orderly manner and to secure the maximum immediate advantages which existing scientific and technological knowledge can confer:—

- (i) Training of technical staff required for the execution of different developments contemplated in this plan.
- (ii) Technical surveys for assessing the full possibilities of various developmental schemes, such as potential irrigation resources, anti-erosion measures and wasteland reclamation.
- (iii) All important aspects of agricultural improvement, which call for practical action by the cultivator himself, would actually begin as soon as the necessary staff can be provided to guide and direct him.
- (iv) Creation of a Federal Department of Agriculture, Federal Agricultural Council, Federal Institutes of Agricultural and Animal Husbandry Research respectively and establishment of a chain of Commodity Stations.

An increased agricultural production of at least 100 per cent within fifteen years over its pre-war level is envisaged by this plan, provided the necessary finance,

services and facilities are available. A capital expenditure of Rs.1,000 crores for British India is estimated. For a widespread amelioration of 300 millions of our hitherto neglected rural population, which the projected scheme promises, the outlay in money is not beyond the means of Indian finance. The groundwork of the Kharegat Plan is that 'scientific research is the basis of all improvements and that it must be put on a sound footing at the earliest opportunity so that India may obtain the best from its major industry'. This is also the voice of all leading scientific institutions of India.