THE VALUE OF RESEARCH

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Director.

I HAVE undertaken to talk to you to-day on a subject about which whole books have been written ; nevertheless I hope to be able to convince you, in the short space of half an hour, regarding the fundamental importance of research to the future welfare of Ceylon and of all mankind. To those who are already quite well aware of the value of research, I hope that the expression of my views may be of interest. I propose to deal mostly with agricultural research although I want first to make some general observations by way of introduction.

In this Age of Science, the gap between the scientist and the layman is growing, wider and wider. With every fresh advance, scientific literature is becoming increasingly unintelligible not only to the layman but also to scientists working in other fields. It is becoming increasingly necessary for scientists to work in limited fields in order to make such advances, and the fundamental branches of science and dividing and sub-dividing and then breaking down into specialist fields which in effect have become secret and water-tight compartments.

Atomic Research

Atomic research is a new and secret field of science, which people dread and fear, even as children fear the dark. It will be remembered that when Columbus first crossed the Atlantic, people said fearfully he would fall over the edge of the Earth and at one stage his crew mutinied and would not go on. To-day we span that same ocean in a few hours and think nothing of it ; equally, in time to come, so also will there be excursions to other worlds.

When I was a student, chemists and physicists were disputing the structure of the atom, the then so-called smallest particle of matter. To-day its structure is known and understood ; more than that, the enormous energy stored within an ultra-microscopic particle of matter has been released . . . and we have the Atom Bomb, which has been developed by scientists on the orders of the soldiers and the politicians.

To the true man of science however, the purpose of atomic research on which thousands of millions of rupees is being spent is to release and harness nuclear energy for the benefit of mankind and not for his destruction. It is scarcely realised or even suspected by the layman that the oil and coal resources of the world are running out. It is beginning to be dimly realised that the World is becoming over-populated but nothing really effective is being done about it.

Nuclear energy will therefore need to be harnessed to provide more power and light, more heat and cold, and even to manufacture synthetic food for more and still more people. It will be needed to provide energy in small compass for explorations into space so that we may find new worlds to populate and to develop. The dreadful alternative is to destroy,—to restrict birth, to kill in prison camps and on the battle-field, to neglect the sick, the starving and the aged. In short to reduce population by every possible means.

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You may think this an alarmist picture, but I ask you to consider what is already happening in India and in China—those two vast over-populated areas. Here in Ceylon too the problem of human existence is becoming increasingly more difficult due to the rapid increase in population and we urgently need to apply all the resources of scientific research to increase the productivity of this Island. To do this, scientists must explain their work to the people and make them their allies. It is futile for scientific research to develop rapidly while the mass of the people remain resistant, distrustful, unconvinced, and even in open revolt against the new ideas. It is, I consider, as important now to educate and to interpret the results of research as it is to press on with research, but so few scientists are willing or able to explain themselves in simple language.

The Coffee Disaster of 1870

I have generalised long enough I propose now to consider the question of the cash value of agricultural research. Let us first go back to the year 1870 which was indeed a disastrous year for Ceylon. At this time there were no less than 160,000 acres of coffee under cultivation on a plantation scale, and the exports then exceeded 50,000 tons per annum. To-day there are at most only a few hundred acres under this crop, and coffee to the value of over Rs. 3 millions is actually being imported into Ceylon. Furthermore the coffee which was exported in 1870 would to-day be worth Rs. 250,000,000 per annum. This then is the value of research expressed in terms of money, because this would not have happened, if they had known then what we know to-day.

The coffee industry was wiped out by coffee blight or fungus leaf disease (*Hemelia vastatrix*) because nothing was known botanically about disease-resistant varieties and about soil exhaustion and also because the modern science of crop protection had not even been conceived. A mycologist, one Mr. Marshall Ward, was sent for, but it is said he arrived too late to save the Industry. The truth is he could not have saved the industry because of the lack of scientific knowledge at that time.

Chemo-therapy or Crop Protection

To-day diseases like oidium disease of rubber and blister blight of tea, pests like stem-borer of paddy, boll-worm of cotton, and eel-worm of tobacco, and noxious weeds in pastures and among grain crops can be studied, controlled or suppressed because new equipment, the necessary chemicals and the " know-how " is available. This is the new science of Crop Protection, in which chemical and biological control is combined in the word Chemo-therapy. This is a conglomerate and practical science requiring a knowledge of biology, botany, plant physiology, plant nutrition, plant diseases, plant pests, chemistry, chemical engineering and toxicology, or the effect of poisonous substances on human beings, animals, fish and insects and also on bacterial and plant life.

A knowledge of each science is required in order to deal successfully and completely with any particular problem involved in crop protection; there must be a complete understanding of each problem, of the repercussions which may be expected from a particular treatment and its inherent dangers and difficulties. A host of new complex chemicals with patent names, designed to conceal their identity, are being offered by various firms and the simple farmer cannot possibly differentiate between them or know their relative values and efficiency. Generally, he will be afraid to use them.

There are some who will say that the use of chemicals in agriculture is unnatural and artificial, but all agriculture is artificial. There is nothing more unnatural than a carefully cultivated field of rice. What is agriculture after all but the removal of wild mixed flora and fauna from the earth's surface in order to reserve the land for a crop of plant prodigies produced from special selected seed, often of foreign origin.

Protection of Hawaiian Pineapples

Although primitive methods of pest, disease and weed control have been practised by horticulturists and agriculturists for many years, the development of the new science of chemo-therapy is due primarily to the work of Dr. Walter Carter of the Pineapple Research Institute of Hawaii who, by exhaustive trials of thousands of chemical products, studied, fought and conquered the mealy bug wilt of pineapples and subsequently nematode or root-knot disease of this plant, and in so doing twice saved the industry from complete and total extinction. What this has meant to those dependant on that industry and to Hawaii can be appreciated by a simple calculation. His work reached its climax mainly between 1931 and 1935. In the succeeding years, exports of pineapple products have averaged 20,000,000 cases a year, valued at say Rs. 10 per case ; thus the gross cash value of his researches to date amounts to the truly colossal sum of Rs. 4,000,000,000. Although other research workers also contributed in important ways to the maintenance preservation, and development of that industry, without Carter's work, theirs would have been in vain.

Dr. Carter is as sincere, devoted, and unassuming as he is distinguished in the world of science. Unheralded and unannounced, he has come to Ceylon under the aegis of the F.A.O. primarily to help us solve the problems of swollen shoot disease of cocoa. He has also found time to visit the Coconut Research Institute and has given us the benefit of his wide experience and knowledge and he has made a number of recommendations, regarding the future development of our work.

This is what he says regarding one aspect of our activities : " Crop protection research is weak. I doubt whether your present advisory service can do much more than repeat the platitudes with which the literature abounds, unless some real research is done. It is clear that pest control on coconut plantations from the modern ecological and chemical standpoint is a virgin field." I would add that this too is my own view but because of our restricted budget nothing more can be done, unless and until our cess is increased. In actual fact we have no Crop Protection Officer and no Crop Protection Division, we merely pass on the advice of the Department of Agriculture.

Crop Protection and Coconuts

The need for research on the particular pests, diseases and weeds which affect the coconut palm in Ceylon may not appear to be so very urgent but there is little doubt that the loss of crop is far greater than is generally supposed. Serious and devastating outbreaks, such as have occurred in the Philippines, in India and Zanzibar, in the South Seas and on Singapore Island, are, I consider, sooner or later inevitable. Modern transport spreads pests, once confined to particular localities, and it is necessary to have the men, the equipment and the knowledge of how to deal with the situation at once and without delay, when the emergency arises. This knowledge must be based on research.

Unfortunately it is not possible to obtain exact data regarding the cash value of the damage done to coconuts by destructive agents, such as coconut beetle, red weevil, leaf scale, grey blight, bud rot, termites, nutfall and various fungus diseases, but even placing it at the low figure of 5 % of the crop this will amount to an annual loss of Rs. 12,000,000. A figure worth pondering over and one which it is hoped will show the need for the setting up of a Crop Protection Department in the Institute.

The results of research in this field of study would be obvious and apparent and could easily be evaluated in terms of money. The value of long-term research is less easy to determine, but plant breeding in relation to coconuts will undoubtedly be of tremendous importance to the future of our great Industry. This is a field of work in which Ceylon leads the world and to quote the words of Major Owen Jones, an international Visiting Agent, who is an expert on coconuts. "There is nothing as good in any other coconut-producing country as the work you are doing here." Increased productivity of the coconut industry is essential to the future prosperity of Ceylon and this work must go on. It must not be checked or curtailed now, because of lack of funds, when we are within sight of success.

According to the estimates of production, the average overall production of coconuts in Ceylon is now in the neighbourhood of 25 nuts per palm per annum. There are some palms which yield over 200 nuts per annum and there are many thousands which yield less than 10 nuts. Between these extremes and even allowing for the fact that some of the areas in which coconuts are grown are in fact unsuitable for coconut-growing, it is quite apparent that there is enormous room for improvement.

It is, I consider, quite possible ultimately to establish production at an overall average level of 100 nuts per palm per annum when seed-nuts are available from our isolated seed-garden of palms produced from seednuts, obtained by the method of artificial pollination of known high-yielding parent palms. The value of our exports of coconut products in 1952 was Rs. 259,000,000; If to this is added an equal amount for domestic consumption, it is apparent that the value of research in plant breeding, when crops are quadrupled, will exceed Rs. 1,000,000,000 per annum. This then is work of major national importance.

The establishment of an isolated seed garden of high-yielding coconut palms is nothing more nor less than the establishment of a perfect estate, solely for the production of seed nuts by the free cross-pollination of those high-yielding palms. Our records of high-yielding mother palms have been carefully maintained over a long period of years, we now have an escalator ladder and with the return of our geneticist after a special course of study abroad, we are at last ready to begin work. We shall require immediately a sum of Rs. 250,000 to establish this estate in remote virgin jungle and we shall require an additional research officer to carry out this work. This is only a small sum to pay for the application of the results of research but will it be forthcoming? I sincerely hope it will.

Value of Manuring

Another field of work in which we lead the World is the manuring of coconuts. The results of our researches have been published from time to time and it will be seen from the last issue of the *Ceylon Coconut Quarterly* that, over the past five years, coconut crops have been increased by 70 per cent. as a direct result of the increased use of fertilisers and this at a time when certain areas in the dry zone have been severely affected by a succession of devastating droughts. Our exports of coconut products in 1947 were valued at about Rs. 100,000,000; our exports in 1952 were worth Rs. 260,000,000. This again demonstrates, in hard cash, the value of research. I need hardly add the slogan "It pays handsomely to manure!"

Coconuts and Cattle

I want next to refer to our work in the field of animal husbandry. Here we are basically studying the inter-relationship of coconuts and village cattle *i.e.* the effect of keeping such livestock, either controlled or uncontrolled, on the condition of coconut palms on estates and small holdings. We are also studying the correct management of tree-shaded pastures, the correct intensity of grazing, and the grazing habits of the indigenous low-country cattle in order to be able to maintain palms and pastures without deterioration.

We have already found that the condition of our village cattle can be improved and that they can become profitable milk producers on small holdings if only they are correctly fed and managed.

This work is important not only, to the food problems of Ceylon but also because if ever the price of copra again recedes until it hardly pays to harvest nuts or produce copra, then coconut small-holders will still have a means of livelihood in the production of milk and eggs to tide them over the bad period.

When one considers the vast numbers of unproductive and useless village cattle that there are, the cash value of this field of investigation can be appreciated but owing to the resistance to change of farmers, not only in Ceylon, but all over the world, it is not possible to estimate even approximately the cash value that this research will have to Ceylon. It is probable that milk production on coconut estates can be increased by crossing the village cattle with imported stock, such as Jersey cattle, but cattle breeding is the work of the Department of Agriculture and is outside the scope of our activities.

Research on Coconut Products

Finally there is the question of research on coconut products. It does not appear to be appreciated how much work was carried out by my predecessor and that results of commercial and practical value, such as his work on soap, shell distillation products, and double-distilled arrack have all been applied industrially. Work was also done on coconut shell charcoal, copra, coconut oil, toddy and the chemistry of coconut water.

We are now engaged on studies of the utilisation of coir refuse, a problem which has remained so long unsolved. There are, it appears, possibilities of producing a light-weight, heat-insulating, sound-proof brick from this material as well as compressed board and similar materials. We are also carrying out fundamental investigations on the fermentation of sweet toddy under various conditions of oxygen supply leading to the development of a new, continuous, quick-generation process for the production of vinegar on a factory scale. At present most of the vinegar produced is of varied and poor quality and in some cases there is even adulteration with acetic acid.

We are at present confined to laboratory-scale research. Our purpose is of course to further the economic interests of the coconut industry and so improve the lot of the hundreds of thousands who depend on it for a living. We can only do this if the results of our work are applied ; if they remain still-born, they are valueless.

Laboratory-scale research alone then is not enough ; it cannot establish any new industry successfully. It is necessary to carry out middle-scale research with small-scale plant and it is essential subsequently to exercise scientific control in the factory and to study factory operations in close detail so as to reduce the cost of production, improve the quality of the products, and make the fullest use of any waste products. All such research needs to be properly linked and co-ordinated if new coconut industries are to be successfully established.

Cost of Research

In this brief review of our research activities, I have no time to touch on the questions of education and propaganda. I have shewn that some of the results of research can be evaluated in terms of money and that the cash value is often very considerable. Now what of the cost?

Generally industries spend between 1/2 to 6 per cent. of their revenue on research, the amount depending on the nature of the industry. The coconut industry is spending $\frac{1}{6}$th of one per cent. of the value of its export products only and so about one-tenth of one cent of the gross value of its total production. Otherwise expressed, our present income is about Rs. 450,000; half of one per cent. on the value of our products would be about Rs. 2,000,000.

It is apparent therefore that the Coconut Research Institute is under-financed and when that is the case, a disproportionate amount is spent on salaries overheads and maintenance, rather than on research. I hope I have said enough to convince you that the cash value of research is considerable. I would conclude that the cost of research is an insurance for the proper maintenance and the future prosperity of the coconut industry—an industry on which so many thousands depend.