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The Farrer Memorial Oration, 1962

The Social Responsibility of Agricultural Science

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Towards the end of the last century when William Farrer helped to usher in modern plant breeding, the pioneering phase of agricultural science was coming to an end.

The 19th century had been a period of discovery. Towards its end so many facts and principles relating to agriculture were known that a coherent scientific picture was clearly in sight. In 1802 de Saussure had found that the carbon in plants came from the air and not from the manure. Forty years later von Liebig had laid the foundations to scientific plant nutrition, and within the next decades Lawes and Gilbert in England and Boussingault in France had conducted the first scientific experiments with fertilizers. The assimilation of atmospheric nitrogen by both free living and symbiotic organisms had been discovered. Plant diseases and pests began to be understood and controlled. Kellner and others had laid the foundations of scientific animal feeding. And right towards the end of the century, William Farrer was among the small group of imaginative plant breeders who were introducing the last of the main branches of agricultural science, plant breeding.

It had been a century of discovery by individual scientists—often of 'amateur status' like William Farrer or, indeed, Gregor Mendel himself. But now what began to be called agricultural science was becoming a co-ordinated, integrated subject stretching from soils and plants, insects and animals to engineering, management and economic policy. It was becoming a subject for experts, for teams, for organizations. Agricultural experiment stations, research institutes, academies, university departments were being established throughout the world.

In the half-century which followed agricultural science has become a world force. It has helped to conquer the earth for man's use. It has played a crucial part in what C. P. Snow has called the scientific revolution. It has helped to bring about the population explosion. To paraphrase a passage in Aldous Huxley's *Brave New World Revisited*, death control is something that can be provided for a whole people by a few medical technicians; but it takes a great many agricultural technicians to save from starvation those who have been saved from disease. Indeed, without the achievements of agricultural science, our standards of living, our whole way of life would be unthinkable.

So, like other applied sciences of our day, agricultural science has assumed a social importance which, we must recognize, involves social responsibilities. No longer can we afford to drift along the currents of invention and discovery without examining the social implications for the individual, the nation and the world.

I propose to examine the social implications of agricultural science, firstly in Australia, which is our most immediate concern; secondly, in the less developed countries across the Indian Ocean, whose development is perhaps the greatest problem of our time for the world at large, and for Australia as their neighbour in particular; and, thirdly, I shall attempt to examine some of the implications which our development in scientific agriculture may have for the life and well-being of our children and theirs.

In broad terms, agricultural science has three spheres of activity: basic research, regional research, and extension or advisory activities. Basic research establishes principles; regional research adapts and modifies them to the conditions of specific ecological regions; and extension transmits information to the producer. Each of these areas is essential, the weakest determining the strength of the whole. There can be no effective extension service without the practical knowledge which comes from regional and local experiment and trained observation; and basic research to play its part must be translated into farm practice.

It is the social responsibility of agricultural science to see that these three areas, their functions and their needs, are clearly defined and widely understood, just as it is the recognized responsibility of the medical profession to define and make known the needs for medical services, or of the engineering profession to set standards for bridges and roads harbours or power supply.

Basic research scarcely needs definition. It seeks out the application to agricultural problems of scientific principles, and therefore must work at the frontiers of knowledge. Having drawn within its orbit every biological and physical science, agricultural science has frontiers in all of them. The discovery of the

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genetic code or the elucidation of the biochemistry of nitrogen assimilation must have profound implications for agriculture, as have a thousand and one other discoveries. It is the responsibility of agricultural science to be alert to basic discoveries, to take part in them, and to adapt them imaginatively to application in agricultural processes.

In this field of research we in Australia are not faced with major problems of philosophy or of organization. Indeed, our research activities in Commonwealth, State and University express the wish of governments, industries and the community to sustain basic research at high levels. Indeed, there is a widespread recognition that applied research, and the industries it serves, cannot prosper and advance without a strong backing on the part of the more fundamental types of research.

Needless to say, there is always scope for new fields, new ideas and for greater resources. One may feel, for example, that university research in biology and agriculture should be strengthened; and one may well wish that the scope of research in some primary industries be re-examined—I, for one, should be a warm advocate for a review and strengthening of research in forestry and in horticulture, neither of which, I believe, has had the share of both basic and applied research that these important industries deserve. Let us also remember that research is, and must remain, a dynamic process, advancing into new domains, reaching out for new horizons; hence it will always need new men and new—and, I am afraid, ever more glamorous—tools. But in general, a country with world renowned laboratories in many fields of agricultural and biological science need not feel that its basic research in the primary industries is far off the right level.

With equal satisfaction one can regard the type of organization we have evolved. Australian basic research is constantly exposed to the impact and challenge of the practical problems of our day, without being unduly subjected to their pressures and demands. It is that freedom from immediate economic pressures which creates the atmosphere in which C.S.I.R.O. has flourished and has produced its most fruitful results.

We have the degree of concentration in major research centres which is necessary for long-range basic research on complex problems; yet we have avoided — and must continue to avoid — a research monopoly in a single organization. Indeed, a strengthening of research in the universities will help towards the greater variety of outlook and freedom of enterprise without which research cannot prosper.

We come now to the second sphere, *regional research*. Regional research is concerned with finding answers to the agricultural problems of an ecological region, in terms which can be directly applied in agricultural practice or which should, at any rate, require no more than relatively simple adjustment.

Clearly, much basic research, whether Australian or overseas, has little meaning to agricultural practice until it is 'coded' for local environments. This may require more, or less, experiment or testing, depending on the nature of the information, the range of environments, etc.; nor would the need be equal in all fields. A therapeutant for an infectious disease in animals may require no re-coding; drought feeding may require little; but the use of new crop varieties, pasture mixtures, herbicides, fertilizer treatments, almost invariably requires intensive local study and testing.

Many problems in agricultural practice can be, and are being, tackled successfully with little basic knowledge available or needed. Without empiricism agriculture would never have arisen. There still is a good deal of scope for shrewd observation linked with an awareness of scientific principles. On the other hand this very empiricism opens the field for more basic thinking. A regional centre, therefore, must be solidly rooted in agricultural practice but must also have strong links with basic research.

Such regional centres should be staffed with representatives of the main fields of agricultural science impinging upon the industries and problems of the region. We have come to appreciate the value of interactions between the various disciplines, as we begin to view our problems not in isolation from each other, but as parts of a system or pattern in which climate, soil, plants, animals, parasites, diseases, weeds are interrelated components, a system with thresholds of efficiency set by the available knowledge and the technical and economic efficiency of its application. Obviously, the economist becomes as indispensable a member of the team as the statistician.

While one may view with some concern the current trend to establish specialist research stations financed by industry research funds, rather than linking new research to existing activities, a regional research organization does not exclude specialization where it is called for by special local problems, special crops, infectious diseases, locally distributed pests, etc.

There can be no generally applicable blueprint for regional research. An intensively cultivated region like the Low Countries presents different problems from the large-scale farming in the Canadian prairies or the American Middle West. Irrigation agriculture or horticulture have their own peculiar requirements. Relatively undeveloped areas, like many parts of Queensland, differ in their needs from well-developed areas like the western districts of Victoria. However, there is no 'developed' region or system: all systems are dynamic in the sense that none is in complete

equilibrium with the natural, economic or social environment, if only for the reason that any or all of these are subject to constant change. At all levels of development there is scope for more.

It seems to me that regional activities of the kind I have outlined are, and should be, predominantly the domain of State institutions. Many reasons come to mind — constitutional, scientific and operational. But let me mention only one of the latter.

Regional research is not, and cannot be, confined to a single laboratory or experiment station. It requires extending into environments with different conditions of soil, climate, management, etc. In fact, these centres must have their seeing, listening and testing posts throughout the countryside, not only on their own experimental or demonstration areas, but, through the eyes and ears of extension staff in every district, on every farm in their region. Indeed, regional research and extension are, and must remain, inextricably linked; neither could be effective without the closest contact with the other.

This has brought us to the third sphere of agricultural science, *extension*. The function of extension is to communicate information and advice to farmers at a level directly applicable to the farm. Its scope depends on the information available for extension, and the resources available for communication. It is, therefore, in a sense multi-dimensional: it encompasses any or all agricultural techniques relevant to an area or farm system, methods of management appropriate to that system, and means of communication appropriate to the community it is assigned to serve. Obviously extension is a field so large, so complex and so important that I can do no more than record it as the foremost social responsibility of agricultural science. Indeed, the extension officers are the 'general practitioners' and the 'specialists' of the agricultural profession, with responsibilities as essential as are those of the medical equivalents in their respective spheres.

If this discussion so far has served to define the three spheres of agricultural science in their social setting, we must now advance to an appraisal of the manner in which we discharge our responsibilities in each of them.

Having already expressed broad agreement with the scope and organization of the 'basic' wing, I must leave criticism of this area to others and concentrate upon the 'applied' spheres, where, in my judgement, a review would be most rewarding, and where a gathering of strength and purpose could not but make a powerful impact on the efficiency of Australian primary production. Let us then bend our thoughts to the needs and the potentialities of regional research and extension.

My earlier remarks may have given a hint that my vision of regional research and extension owes a good deal to the American State Colleges of Agriculture. These university institutions are responsible for teaching, research and extension within a state, and while they conduct a good deal of basic research — the best of them at the highest level — they have the full responsibility for experimentation and extension at the regional level. Sited in country towns, with laboratories, experiment stations, sub-centres, testing and demonstration plots, and linked with a network of county advisory services, they are in a very real sense the hub of progress and efficiency in agriculture and allied rural industries.

Clearly this is an impressive structure, backed as it is by many years of solid achievement. And while it would scarcely commend itself to our own universities with their tradition of freedom for academic research, many of its features could be visualized within the framework of our Departments of Agriculture. Indeed, germs, and in places more than germs, exist today, though not as a concerted and fully developed system.

If I be permitted to pursue this vision for a brief moment, it leads me to a series of regional centres for research and extension, perhaps up to five in the larger States, with the kind of facilities and functions I have already sketched, and with a staff of sufficient strength and diversity to make it an efficient, self-relying team. They would have local technical direction and a minimum of centralized control. They would maintain close contacts with research in C.S.I.R.O. and the universities.

I cannot go much further, though it might be tempting; for your question is only too patently obvious: 'How are desperately pressed Departments to find the resources?' And though one might argue that some of the existing staff and facilities could be reorganized and consolidated, others re-deployed, clearly there would have to be a substantial overall lift, indeed, for years to come a constant stream of laboratories and equipment, of trained staff, and, the supreme hurdle, of real leadership.

And so we must face reality. Whether you like my particular vision sufficiently to wish me to fill in the gaps; whether you have a different one altogether—anyone who feels that he has a share in the social responsibility of agricultural science will have some vision of strengthening and developing our agricultural efficiency. And everyone's vision is bound to lead to a new deal for our regional services. But all of us visionaries can agree that we need a good, hard look at what is good and what should be better; and, I feel convinced, a drastic lifting of the sights.

No one could fail to appreciate the tremendous efforts on the part of the Departments

of Agriculture to use their resources to the best advantage; nor the great developments which have taken place in the post-war era, thanks not only to new ideas and resources, but also to the success of the Australian universities in turning out what probably are the best trained agriculture graduates in the world. It is in the light of these efforts that one feels that the time has come for a review of our agricultural services.

Even without such a review, the need for strong additional resources for regional services is all too evident. But it would not be enough to add something here and something there, an extra experiment station or a new laboratory or extension centre. One may have to reconsider the entire structure and organization of regional research and extension. What is needed is not only a new deal *for* the States, but an inspired new deal *by* the States themselves.

For let me say it again: I believe that whatever is done in this area must be done on the basis of State organizations. Geography alone, quite apart from tradition, leaves little choice. Yet if once again we turn to our American vision, we cannot leave out of our considerations the very material contribution which is made by the Federal Department of Agriculture to the regional research and extension activities in the United States. Many State colleges derive not only substantial financial assistance from Federal sources, but a good deal of their competence derives from groups belonging to the United States Department of Agriculture, working hand in hand with their State employed colleagues. Specialist laboratories of the United States Department of Agriculture play their part; but it is my impression that with the exception of the central research station at Beltsville, and what essentially are national laboratories in agricultural technology — the four great Regional Laboratories — the majority of the research and extension activities of the Federal organization are conceived in integration and supplementation of the activities of States.

We have yet to discover whether there should not be an Australian equivalent; whether the Commonwealth should be more actively and helpfully engaged in what is essentially a national problem; whether this help should be in the shape of funds far more commensurate with the needs, or whether one should contemplate a participation more akin to that which has proved its worth in the American scene.

Some eight years ago, in an oration in commemoration of the centennial of this University, the late Sir Ian Clunies Ross shed the thoughts which, very largely, led to the appointment of the Murray Committee on the Australian Universities. It would be extreme conceit were I to hope for anything like the same effect, but perhaps the time is not so far away when the problems I have discussed may call for similar action.

But now we must turn from the responsibilities of agricultural science within our own community to those that face us in the world around us, and especially in those parts of Asia which political, economic, technical and social developments are bringing closer to us every day.

Almost overnight most of us have become alive to the problems of food for the rapidly growing populations of the less developed countries. Much of this awareness springs from F.A.O.'s 'Freedom from Hunger Campaign', designed, in the words of its guiding spirit, F.A.O.'s Director-General, Dr. R. B. Sen, 'to make the peoples of the world aware of the hungry among us'. Such is the power of the word and the urgency of the facts that in this aim he had succeeded even before the campaign itself was fully under way.

I shall turn presently to my subject, which is the part and responsibility of agricultural science in meeting what many of us feel is the greatest challenge not only of our age but perhaps in the history of mankind. But for the sake of clarity we must define the problem in terms which lead us back to our main theme.

Many authors in recent years have drawn attention to the uncertainties of the information on food requirements and food supply; yet, as has recently been shown by Sukhatme,[1] a critical examination of available data may not only highlight these uncertainties, but lead to meaningful though by no means precise estimates of present deficiencies and future requirements. Anyway, though the economist and the statistician, the sociologist and the administrator have a natural desire to derive accurate projections, the agricultural scientist does not require such precision for defining his targets. To him it is not really relevant whether the proportion of people who are now hungry is 15 or 50 per cent; whether the world's population in 1990 will be 5,000 or 5,500 million people; whether the minimum supply of protein per day should be 15 grams or 25 grams. The agricultural scientist thinks of economic problems in terms of technical solutions. The magnitude of the problem adds to the power of the challenge; but the challenge itself is defined, not by parameters of statistics, but by parameters of nature.

Let us then, with a good conscience, evade these uncertainties and restate the problem in those more general terms which suffice for our background and target.

Of the 3,000 million people now living, about one-third live in communities which are adequately supplied with all the elements of food that humans require for a healthy and active life. These include the highly developed and industrialized parts of Europe, America,

Asia and Oceania. Over a short number of years these countries have achieved a position 'which has been the substance of man's dreams since the dawn of time and dwarfs into insignificance all achievements in outer space'. . . . 'Barring destructive wars, the industrialized North now has the technology and science, facilities and services, industrial and agricultural plant, financial resources, management know-how, and, finally, the forward thrust and dynamism to assure its food supply *permanently* on existing resources.'[2]

In the less developed countries—including large parts of Asia, Africa and Central and South America—there has, as yet, been no equivalent development in productivity. In this area there is today, as there probably has been for many centuries, a great deal of what Sukhatme (*l.c.*) calls under-nutrition, caused by deficiencies in energy supply, usually measured in calories; and an even greater amount of malnutrition—deficiencies in protective foods, principally protein, vitamins and minerals. Sukhatme, in a critical examination of available statistics, concludes that between one-third and one-half of mankind suffers either from under-nutrition, from malnutrition, or both. According to the World Food Budget, 85 per cent of the nutritional gap for 1962 will occur in the Far East, and the remaining 15 per cent in Latin America, Africa and Western Asia.

To advance the analysis of food needs to a practical level, Sukhatme proceeds to set *nutritional targets* for each of the main regions involved. These are expressed in terms of the average daily per caput calories, as a measure of total energy, and of animal protein, as a measure of dietary quality. For the Far East he sets three successive targets, to be achieved by 1970, 1980 and by the end of the century, the third of which would lift the energy supply from the present 2,070 calories per day to 2,400, and the animal protein supply from 8 g. to 20 g. per day (as against an average of 44 g. available in the developed countries):

	Calories (per caput per day)	*Animal proteins (g. per caput per day)*
Present supply	2,070	8
Low target ..	2,300	10
Medium target	2,300	15
High target ..	2,400	20

To determine *production targets*, these nutritional targets must now be combined with projections of population dynamics over the next three or four decades. On the basis of the 'medium' U.N. population forecast, which projects a decline of population increases starting in 1975, the population of the Far East is expected to grow from 1,500 millions in 1958 to 3,640 millions by the end of the century. Hence population growth alone, without any nutritional improvement, would command a level of production 2½ times the present one; but to raise nutritional standards up to the 'high' nutrition target would need an overall production increase of 3½ times the present level, equivalent to a cumulative production increase of 3 per cent per annum over the whole of this period. This is well in excess of the actual achievement of Far Eastern countries in recent years, but is of the order of the increase projected by India in its third five-year plan. Yet, under the conditions prevailing throughout the Far East, a rate of growth of this order would be hard to achieve, and harder to maintain. Indeed, for such rates of increase in agricultural productivity to be sustained over many decades requires a high degree of industrial and social development and an equally high degree of technical and scientific accomplishment—from the university and research institute right to the farm.

We can spare ourselves all emphasis and elaboration, for we all have become alerted to the enormity of the problem and its grave significance; not only for the welfare of the other half of the world, but for the peace and perhaps the very existence of all mankind. We have come to realize that it will be solved not by charity and hand-outs, but by development in and by the countries themselves; and that their scant resources of capital, knowledge, education and enterprise will have to be aided and augmented on a vast scale during this critical period when *development must overtake population growth.*

What is, could or should be *our* part in this historic process, perched as we are as a small, yet affluent, community on the edge of Asia? This question arises whenever Colombo Plan, F.A.O., or other assistance schemes are under discussion or under critical examination; and it will be asked more widely, more critically and, one may hope, more insistently in the coming months when the 'Freedom from Hunger Campaign' begins in Australia. And, in particular, what could be the role and responsibility of Australian agricultural science?

Here let me pause, for I sense an objection in some minds that Australia's first responsibility is towards its undeveloped north; that our resources of capital and of technical and scientific manpower should serve our own development; and that, after all, food that we produce is at the service of the world's hungry mouths.

These and similar considerations must play their part in determining Australian policies. But, whatever the development of our undeveloped regions may achieve in pursuance of our national aims and policies, its contribution to the world's food supply must be seen in the right perspective. For example, were we to treble our meat production as a result of such developments and were India in a position to buy our entire meat export, we

would add less than an ounce a week to the meat ration of the average Indian. Indeed, if it were our main objective to feed the hungry millions of Asia, it might be argued that the same investment might achieve a good deal more were it applied to the development of the Brahmaputra or the Indus Valley rather than the Ord River Basin.

But there is no need for such alternatives—real and relevant though they may be in economics or in international affairs—when we now finally return to the discussion of our own part and responsibility as agricultural scientists. Of the three levels of action we have previously discussed—'basic' research, regional research and extension—not only the urgency of the task, but the level of development, starting as it does in many instances from peasant farming, without a doubt secures the highest priority for the spread of existing knowledge. But even here, as in Australia, regional and local know-how, regional and local services, are pre-conditions of success. There are, of course, improvements which need no local examination — replacement of inefficient primitive equipment, conservation of animal, and human, manure, health services for stock, more often than not, fertilizer application, and many more. But some measure of fact finding there must be to guide and instruct extension at the village level.

In this all-important sphere, ignorance of language, of local conditions and traditions, quite apart from the magnitude of the task, restricts the limits of participation by the outside world at the operative level. But consultants and advisers, acting under the auspices of United Nations agencies and of inter-governmental, government and foundation programs, have given and are continuing to give a very large measure of assistance in the planning and organization of technical development.

In this sphere of agricultural development, where their own experience has made them adaptable and responsive to the needs and opportunities of strange and often difficult environments, Australian agricultural scientists play an important part, and could do so increasingly in the critical years ahead. Relevant fields in which Australian workers are prominent and experienced readily come to mind—the mineral nutrition of plants and animals, pasture development in Mediterranean-type, and more recently in subtropical and tropical environments, conservation of semi-arid and arid native range lands, land clearing methods, irrigation development, the strategy and tactics of controlling infectious diseases of stock, sheep husbandry for wool production, biological and ecological control of weeds, land use surveys and land development plans, rural broadcasting, and many others. Clearly there is much we can contribute; there might almost be an embarrassment of choices.

Yet, where resources and numbers are limited, could one not deploy them as enzymes or catalysts where their small mass would be most effective? Would not our impact be greatest were it directed towards education rather than towards organization, were it to act on minds rather than on matter?

Here comes to mind the outstanding success of Mexico in developing its agricultural productivity at a sustained rate of 7 per cent per annum, which has resulted in a rise of the daily calorie supply from 1,700 to 2,700 over a period of some fifteen years. In this achievement, the Rockefeller Foundation,[3] working in close collaboration with the Mexican Government, played an integral part. For the last twenty years, its activities were centred on the Institute of Agricultural Research which became a leaven for the economy as a whole. Conceived as a centre for teaching and training as much as for research, the staff from the beginning was prevailingly Mexican, with a decreasing number of American key personnel. Recently reorganized as a National Institute within the Ministry of Agriculture, it has eleven Rockefeller staff members out of a professional staff of three hundred. A remarkable feature from our point of view is the economy of the program, since a large proportion of the cost is borne by the Government. In all its agricultural programs throughout the world, the Foundation expended about 43 million dollars over the last twenty years.

In the spirit of the practical genius we are honouring today, may I now give support to a practical proposal, and endeavour to enlist yours?

In the area under discussion, there are few University Schools of Agriculture and fewer still capable of giving an advanced training—the outstanding exception being the Indian Agricultural Research Institute in New Delhi. There is an obvious need for more, especially in those countries where there is no fully developed tertiary education in agriculture, and an obvious need for outside help; for it may take decades for the countries themselves to establish and develop such institutions on their own resources.

Can we conceive of a scheme by which Australian universities, perhaps in partnership with C.S.I.R.O., could combine in establishing one—or, to be even more ambitious, more than one—University School of Agriculture?

Let us envisage a faculty covering agricultural science and the biological and physical sciences basic to agriculture, jointly controlled by the host university and an Australian academic body, possibly set up under the auspices of the Australian Academy of Science; an initial staff of about 20, with at least 12 Australians, half from universities and half from C.S.I.R.O.; a tour of duty of from two to four years, with all rights and privileges

of the Australian position maintained; compensation for the University (or C.S.I.R.O.) to finance replacement by a temporary appointment or fellowship; financial support through a government-sponsored foundation, which is certain to attract a great deal of support in Australia and overseas. Indeed, support for such a plan might be a worthy objective for the Australian 'Freedom from Hunger Campaign'.

Ideas of this kind will increasingly feature in public discussion and, one may expect, in government action, reflecting our growing sense of urgency. We may, in fact, expect a substantial increase in aid for development where it is most needed, and the countries themselves will gain in competence and in determination to help themselves. Once the recognition of the magnitude and seriousness of the threat pervades our global consciousness, we shall be on the way to conquer it.

Attractive though it would be, can we afford to conclude on this note of optimism? Clearly, if a supreme effort is needed to provide for the now inevitable 6,000 millions, could we cope with more? Clearly, our responsibility as agricultural scientists is great; for were we to succeed in riding the oncoming wave, shall we not be relied upon to ride the next? And if so, what would be the consequences for the productivity, the resources, the very structure of the earth, what the social consequences for our species, our way of life, our liberties, our civilization? Fifteen years ago, when many atomic scientists protested against the development of the weapons that they themselves had made possible, there were good reasons for hoping that they would never be exploded. *We* evolve not weapons of death, but weapons of life, yet are they not more fatal in the end? What chance is there of arresting and controlling the chain reaction which we are helping to power and sustain?

Today we are paying homage to William Farrer, one of the pioneers who ushered in the new world of plenty. Let us recognize our own responsibility to preserve the good life he and others have made possible. Let us realize, and declare that 'not only must we increase the quantity of food and improve its quality . . . we must also expend as much effort on putting across to the populations that population growth must be controlled'.[4]

'Population increase', quoting Sir Julian Huxley in *The Humanist Frame*,[5] 'is already destroying or eroding many of the world's resources, both those for material subsistence and those — equally essential but often neglected — for human enjoyment and fulfilment. Early in man's history the injunction to increase and multiply was right. Today it is wrong, and to obey it will be disastrous. The . . . World . . . has to achieve the difficult task of reversing the direction of its thought about population. It has to begin thinking that our aim should be not increase but decrease—certainly and quickly, decrease in the rate of population-growth; and in the long run equally certainly, decrease in the absolute number of people in the world, including our own countries. The spectacle of explosive population-increase is prompting us to ask the simple but basic question, *what are people for*? And we see that the answer has to do with their quality as human beings, and the quality of their lives and achievements.'

What magic is there in numbers? Must we go on multiplying till we are a burden to each other and to ourselves? Will Calcutta and Bombay be good places to live in even if and when everyone has enough to eat? Will Sydney or Melbourne be pleasanter cities with six or seven million people? Must we retain this urge to grow, now that we have outgrown the bounds that restrain all other living beings? Will posterity not curse our century as the one which was so clever in destroying death that it destroyed life?

Must we go on impressing ourselves on every space on earth, on mountain and desert, forest and river, and now even on arctic and antarctic? Must we put our hands and our bulldozers on everything, regardless of sense and beauty? Can we discipline ourselves to direct our efforts where they are most economic and productive, not only in terms of money, but in terms of the conservation of the earth and all that it holds?

Rather than beckon us to global destruction and to self-destruction, can science, can agricultural science, lead us to a global economy? This I regard as the greatest of our responsibilities.

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