

Foreword

In these days of super specialization, it is heartening to find a super specialist who remains concerned with the primary aim of super specialization and the objective of all medical research to improve generally the standard of healthcare. An integrated scheme for application of advancement in any field of medical sciences is necessary for better healthcare of all humanity. Every dimension of research and advancement in the medical sciences requires study and synthesis to determine the efficacy of every individual effort. Unless the personality of the researcher and the medical administrator has these traits, the optimum benefit of any study and research cannot be achieved.

The effort of Dr. J.S. Bajaj in this direction has to be commended. His contribution in this collection of papers depicts the understanding of the various facets essential for the optimum utility of the knowledge acquired from the study of, and research in different branches of medical sciences. It is significant that even the socio-economic dimensions of the medical education and research have been appreciated and adverted to, in the evaluation made on each topic.

The real object of Medicare and research is the improvement of quality of life and the life span. Improved health of each individual is an addition to the quality and quantity of Human Resources of the nation, nay the international community. Human resources are the most valuable asset. Directive Principles of State Policy in Articles 39 and 47 lay particular emphasis on improvement of public health. The principle of sustainable development has assumed greater importance to balance the ill-effects on human health of development projects and advanced technology. The very existence of future generations is at stake. Men of vision who can plan to reconcile public health with the cause of sustainable development without any deleterious effect on human health are needed.

I have no doubt this collection of papers on topics so varied, and, yet integrated is a valuable contribution in the desired field of sustainable development with improved healthcare. I am sure this work would benefit and enlighten everyone, irrespective of the field of his activity.

I wish the endeavour all success.

New Delhi

J.S. VERMA

November 9, 1997

Chief Justice of India

Introduction

In October 1994, Professor J.S. Bajaj delivered the second Radhakrishnan Memorial Lecture of the Institute. The topic of the lecture was: *Education in Health Sciences—Relevance and Excellence*. It was delivered in Delhi at a time when the city was just emerging from the great fear of a plague epidemic. There was, therefore, a peculiar poignancy associated with Professor Bajaj's lecture.

The Institute normally publishes the Radhakrishnan Memorial Lecture in the form of a booklet. But considering Professor Bajaj's enormous contribution not just to the medical profession as one of the country's most eminent teachers and practitioners of medicine, but—even more importantly—to the planning of health care and medical education of the country—we decided to publish Professor Bajaj's lecture in a volume which brings together some of his other important writings in the area. This explains, to a certain extent, the delay in the publication. Making the right selection from the fairly large corpus of Professor Bajaj's writings took some time. Also Professor Bajaj's extraordinarily sharp eye for detail made us pause every now and again in the course of the book's production.

This introduction is by way of a brief response to the main concerns of Professor Bajaj in the lecture delivered for the Institute in Delhi. These are also concerns, which, in one way or another, inform much of the other writings brought together in the volume. The key words around which facts and arguments are marshalled with great effect are 'relevance' and 'quality' (or 'excellence') in the field of medical education and health care.

One way of understanding the idea of quality or excellence relating to human activity is to think of it as intrinsic to a particular form of activity or practice. This means—among other things—that the idea of excellence can be spelt out not in general terms, but only in terms of a particular form of activity. Thus, for instance, the excellence achievable in music can be articulated only in terms which can broadly be regarded as the language of music—and—at-least to the extent that this is so—such excellence is intrinsic to the form of human practice known as music. Of course, there are other good things which can be achieved through music, e.g., wealth and fame. But these are obviously not intrinsic to music; they can be achieved by means totally unconnected with music and to acquire a grasp of these ideas requires no knowledge whatever of the language of music. These may be called external goods in contrast to excellence which is intrinsic. Excellence in theoretic science or academic research generally, may similarly be thought to be intrinsic to these practices. Achievement of excellence in—as we say— 'pure' scientific pursuit or in the pursuit of academic research can be spelt out adequately only in terms of the language of science or in terms of the language of a tradition of theoretical research.

But music, 'pure' science and academic research generally are, as it were, autonomous human practices—that is, they do not need any justification for their continuance other than the fact that they exist although, of course, frequently many other kinds of justification can be cited for their continuance. But with practices like medicine and law, and agriculture, things are somewhat different. The study of medicine is not autonomous in the way that 'pure' scientific enquiry may be autonomous. Its justification lies, as it were, outside the field of medicine itself—that is, in the physical and mental well-being of man. The idea of physical and mental well-being can, in principle, be spelt out independently of any reference to the practice of medicine. Similarly, the justification of the practice of law lies not in law itself, but in something that lies outside of the practice—that is justice. It might sometimes be tempting to suggest that justice cannot be defined

except in terms of law or legality and, therefore, that the idea of justice is internal to the concept of law rather than external to it. But this, of course, will be a mistake. Quite clearly, the idea of justice is logically prior to that of law; in fact the substantial debate about justice takes place outside the field of jurisprudence; and, of course, laws themselves can be just or unjust which could not be the case if justice were capable of being defined in terms of law or legality. In the same way, the justification of the practice of agriculture lies quite clearly outside agriculture itself.

The significance of all this—at least as far as the medical sciences go—is as follows: Excellence in the medical sciences or medical education must be judged in a substantial way by reference to something which is recognizable independently of the practice of these sciences—and this something, as we have already indicated, is man's physical and mental well-being. There is, of course, frequently a powerful urge, on the part of these sciences, to *appropriate* the concept of physical and mental well-being—good health, to put it simply—that is, to define good health in terms which are internal to the practice of medicine itself. And this is dangerous, because medicine will then acquire an autonomy which will give it unlimited manipulative power over human life—such autonomy will challenge human freedom itself apart from eliminating our basic good sense about our own well-being. It is this fear that at least partly lies behind Gandhi's indictment of modern western medicine in *Hind Swaraj*. It also informs much of the criticism of modern medicine by western thinkers like Ivan Illich. It seems to me that Professor Bajaj's concern for *relevance* and his deep worry about the neglect of the traditional Indian system of medicine in the mainstream medical education of our country also spring from a similar fear of the medical sciences appropriating to itself the concept of good health. If good health—physical and mental well-being—is recognizable independently of the practice of medicine and if the idea of it can generally be spelt out without necessarily referring to terms which are internal to the discourse of medical science, then medical education which is *relevant*, is qualitatively superior to a kind of education which does not much concern itself with relevance, but is centred—somewhat narcissistically—on itself, on, for instance, achieving greater and greater sophistication in both the medical discourse and on the technology which is parasitic on this discourse.

All this is not to say that the idea of good health is an easy notion to grasp. Apart from our native good sense about it, cultural and civilizational elements enter into the idea. It is this latter that gives the idea of relevance an importance that is somewhat peculiar to our nation. We are the inheritors of a highly sophisticated ancient system of medicine which developed in the context of ideas of good health or well-being largely specific to our particular civilization. The relevance of this system has therefore—one might say—withstood the test of time. To ignore this system is, therefore, to ignore something which could be of extraordinary value to us.

The Radhakrishnan Education Commission of 1948—a Commission which included among its members Dr. A. Lakshmana-swami Mudaliar and Dr. Zakir Husain—took serious note of this and said in its report: 'Our modern medical schools would do well to incorporate a course of the history, methods and philosophy and content of indigenous medicine. This would help to preserve the values existing in these system' (quoted by Professor Bajaj, p.5), and Professor Bajaj's comment: 'Even fifty years after the submission of this report such a vital recommendation remains unimplemented, with the result that a wide hiatus continues to grow between the practitioners of the modern system of medicine and those of the Indian system' (p.5). The 'hiatus' in effect means that, because of the enormous power and reach of modern western medicine, the indigenous system of medicine is being reduced to an insignificant precarious presence. Apart from the loss of valuable knowledge and the diminution of a once flourishing discipline that this has meant, it has also ensured that what could have been a fertile arena for debate about two great traditions of thinking and practice relating to healing and caring for human well-being,

did not even receive the *minimal* definition. At least one beneficial effect of such a possible interplay might have been to make it extremely difficult for any particular system of medicine to appropriate unto itself the very concept of human well-being. And this would have served as an abiding reminder of the limits of any particular system.

But relevance has other important aspects. Medical education and health care in India must obviously address itself primarily to the health needs of India. And here one must ask questions of the following sort: Have we been able to develop in the last fifty or so years of our national history a medical education and health care infrastructure which is both adequate and effective? India is a country of vast cultural and sociological differences and enormous economic disparities. Frequently, health is a function of these differences and disparities. Does our medical education take sufficient account of such determinants of health? Do we make the right kind of distinction—by this I mean the right kind of ethical distinction—between the *basic* health care needs of the vast majority of our people and demands—emanating basically from the wealth and power of a miniscule minority—for increasingly more specialized and technologically sophisticated treatment? Unfortunately, the answer in each case is a depressing ‘no’—in some cases the ‘no’ may be somewhat qualified, but it is a ‘no’ nonetheless. Take, for instance, the last question, and Professor Bajaj’s comment on it: ‘With increasing demand for post-graduate studies and the elitist pressures succeeding in eliciting a positive response, we are producing today more specialists than primary care physicians’ (p.14). ‘But are these post-graduate specialists, trained at enormous cost to the nation, available to serve in the national health care system? A study of our community health centres...shows that of the specialist jobs sanctioned for these centres, a significant proportion continues to remain unfilled...obviously, most of the graduates who qualify in medicine today prefer to undertake post-graduate studies, and following the successful completion of such studies, prefer to settle in large towns. The rural communities are deprived of the services of general practitioners as well as specialists on whom the nation spends large sums of money, as the undergraduate and post-graduate medical education remains highly subsidized’ (pp.14-15).

In 1986, an Expert Committee under the Chairmanship of Professor Bajaj took serious note of these and other issues and made recommendations for ‘radical changes regarding health, manpower planning and production’. The report of the Committee—even after it was approved by the Central Council of Health and Family Welfare and the Central Advisory Board of Education, remained—primarily owing to the vagaries of political arrangement—in cold storage until its recommendations were transformed into an action-plan during the Eighth Five-Year Plan period—no doubt at the initiative of Professor Bajaj himself—now a member of the Planning Commission.

Professor Bajaj’s lecture brings home forcefully—and at the same time with great elegance of presentation—our predicament in relation to medical education and health care and the steps that need to be taken to come to terms with this predicament. There is hope—with someone like Professor Bajaj himself lending a substantial guiding and helping hand in the task.

The other papers included in the volume deal with themes ranging from population, quality of life, science and technology, multi-professional education to the *art* of medical practice. The volume brings together the sustained thought of a marvellously intelligent, creative and critical mind on issues absolutely crucial to the well-being of our nation. That the Institute should be the vehicle of communication of this thought is a matter of great satisfaction to us.

Education in Health Sciences *

Relevance and Excellence

The invitation to any educationist to deliver the Radhakrishnan Memorial Lecture is as much a matter of pride and honour as also a challenge and a tremendous opportunity. Radhakrishnan's was a pluri-potent personality, in which were interwoven the strands of history and philosophy, religion and culture, education and ethics, statesmanship and scholarship, and above all, profound humanism of a sublime dimension.

It is indeed rare in the history of our civilization that symbolic representation of Plato's vision of philosopher-kings has been transcribed into real life. Although Marcus Aurelius in the West, and Rajarishi Maharaja Janak in the East, could well be the embodiments of Plato's vision—they were king-philosophers, not philosopher-kings. In contrast, Radhakrishnan was a philosopher par excellence who on his election as the President of India in 1962 brought to fulfillment the cherished hope and the intuitive prophecy of Plato.

There have been two earlier occasions when, directly or indirectly, I was subjected to the profound impact of the personality of Dr. Radhakrishnan. The first was on the 4th February, 1963 when Dr. Radhakrishnan delivered the address at the First Convocation of the All-India Institute of Medical Sciences when I received my doctorate in medicine having graduated five years earlier from Medical College, Amritsar. Emphasizing the responsibilities enjoined on those who received their degrees at the First Convocation, Dr. Radhakrishnan highlighted the primacy of health and the responsibilities of the Institution towards its achievement. He said:

Health is a prime necessity. People who are lacking in health are enslaved by diseases and other consequent factors. We, therefore, should do our utmost to promote the health of our people. We are doing our best and yet we have a very long distance to travel; and an institution like this, which specializes in quality, will certainly help to spread the advantages of medical sciences and surgery in this country.

It was the first time ever that the concept of quality in medical education and learning as well as in the practice of specialty of medicine dawned on me. In a way, it initiated me into a career of medical education and research, in which I spent almost thirty years on a full time basis, before accepting my present assignment. It is this experience that constitutes the backdrop of today's Radhakrishnan Memorial Lecture. It reflects my conviction that quality of medical education and the interdependent practice of medicine intimately relate to the relevance and excellence of such education.

However, to maintain the continuity of historical perspective, let me mention that about a fortnight following the convocation at the AIIMS, I had the privilege to listen to his speech on the 20th February 1963, at the inaugural session of the 7th International Congress on Chest Diseases. Pointing to the universality of health as a shared human need, Dr. Radhakrishnan observed: 'What we need is not merely political arrangements or economic alliances but an understanding in creative arts, in healing processes.' Sharply focusing on the social dimensions of health, he stated: 'Poverty, hunger and disease go together. If we want to combat diseases, we have also to remove the conditions which are

responsible for the spread of these diseases.’ The national health planning, during the Eighth Plan, for which I have the assigned responsibility, is an amplification of this thesis, and is based on the recognition that health is not only an indicator, but also a determinant of the quality of life, thus linking it directly with the quality of education in health sciences and the delivery of health care.

Health Care and Medical Education:

The Essential Interlink ages

Since the dawn of Independence, rapid strides have been made in improving delivery of health care services to the people. There have also been some spectacular successes such as eradication of small pox, and a significant decline in morbidity and mortality on account of malaria, cholera, and several other communicable diseases. The infant mortality rate has shown an impressive decline, more so in the recent years; from 114 in 1980, it is less than seventy-four today. More importantly, in some of the states such as Kerala, it has already reached seventeen and some of the other states, e.g. Punjab and Maharashtra have a rate below sixty. The crude death rate has declined to below ten and the life expectancy has risen from a mere thirty-two years in 1947 to almost sixty years today. A vast network of health infrastructure has been created with a three-tier system of sub-centres, primary health centres, and community health centres in the rural areas. As of today, there are about 1,40,000 sub-centres, approximately 25,000 primary health centres, and more than 2,000 community health centres. Finally, an impressive indigenous capability has been established for the production of drugs, pharmaceuticals, vaccines, diagnostics, and other technical equipment.

In the backdrop of such an impressive array of facts, also lurk some of the stark realities. A quarter of the total number of people afflicted with tuberculosis in the world, and a majority of those with leprosy, live in India. Five to six million children (1-5 yrs.) annually suffer eye damage because of vitamin A deficiency. Maternal mortality is still unacceptably high. About 100,000 women die of maternity-related causes every year. There are a large number of districts in the rural areas of states like Orissa, Madhya Pradesh and Uttar Pradesh where the infant mortality rate even today is between 100 and 120, along with a high child mortality rate (CMR). Indeed, there are wide interregional and inter-state differences. Above all, we are still trying hard to achieve a breakthrough in our efforts aimed at population stabilization.

How effective is this vast health and family welfare infrastructure? Several studies have indicated that the utilization of facilities by the people at various levels of this infrastructure is only about 50 per cent of the capacity created and made available. There are various reasons for such poor utilization. Nonetheless, what is important is to realize that the efficiency and effectiveness of this infrastructure can be considerably improved by ensuring provision of complimentary equipment and other necessary inputs, by improving the knowledge, skills and attitudes of the health manpower who are involved in the day-to-day management of the services, and most importantly, entrusting a majority, if not all, of the managerial functions to the people and their institutions. The latter is likely to be achieved in a substantial manner, if not entirely, through the Panchayati Raj for which legislation has recently been enacted.

National Health Policy

The National Health Policy affirmed that the effective delivery of health care services would depend very largely on the nature of education, training, and appropriate

orientation towards community health of all categories of medical and health personnel. It is, therefore, of crucial importance that the entire basis and approach towards manpower development in terms of national needs and priorities are reviewed and training programmes restructured accordingly. Besides there is an urgent need to reassess appropriate health manpower mix to deliver health services at primary, secondary and tertiary level and for the purpose of training and research.

As much as approximately two-thirds of the total expenditure on health services is spent on personnel. Yet, health manpower planning, production, and management, which constitute key elements for effective implementation of health programme, have not received adequate attention.

Medical Education in India: Historical Retrospect

Medical education in India embodies both antiquity and continuity. Even in early strands of the corpus of knowledge enshrined in Vedas, there are elaborate and descriptive references not only to the practice of medicine but also to its theoretical basis. Treatises such as *Charak Samhita*, *Sushruta Samhita*, and *Vagbhata Sangraha* have been translated into English and are generally available to scholars of medicine. However, much of the core of ancient medical literature is still in the form of manuscripts, available only in the archives of certain libraries or in private collections.

The University Education Commission, constituted in 1948 under the chairmanship of Dr. S. Radhakrishnan and including amongst its members such men of distinction as Dr. Zakir Husain, Dr. A. Lakshmanaswami Mudaliar, and Dr. Meghnad Saha, referred to the need of imparting knowledge about history of medicine specially with reference to the traditional systems.

In its report submitted in 1949, the Commission observed: 'Our modern medical schools would do well to incorporate a course on the History, Methods, Philosophy and content of indigenous medicine. This would help to preserve the values existing in these systems.' The operative recommendation was that 'history of Medicine with special reference to Indian systems be taught, in the first degree course in medicine'. Even fifty years after the submission of this report such a vital recommendation remains unimplemented, with the result that a wide hiatus continues to grow between the practitioners of modern system of medicine and those of the Indian systems.

Foundations of the western system of medicine were laid in this country by the Portuguese with the establishment of a Royal Hospital in Goa in 1510. In 1703 education and instruction of obvious. Thus, new institutions to educate and train such professionals were provided for in the first three Five Year Plans, and established in several states. However, Radhakrishnan Commission, while taking cognizance of increasing demands of medical education, also highlighted the inherent danger of falling standards in its unplanned expansion:

Some of the Provinces have increased the number of students admitted to medical colleges to sometimes double the number with the result that the training that is imparted to such alumni with inadequate staff can hardly be said to meet the minimum standards required. The Commission is not aware of any positive steps taken by the Indian Medical Council to rectify these serious defects. It would hurt all standards if such increased admissions are allowed to medical colleges which have neither the personnel nor the clinical or laboratory facilities to cope with the increased numbers.

Accordingly, the Commission suggested to the universities and to the Indian Medical Council in particular that 'they should limit the number of admissions in any medical college to a maximum of 100, provided the conditions laid down are satisfactorily fulfilled'. It may come as a shock that the Medical Council did not act on this recommendation for almost forty years and did not put any ceiling on the annual intake in any medical college, including those which were given recognition in recent years. It was only in 1990 that the Executive Committee of the Medical Council resolved to take remedial action and stated: '...the Committee, keeping in view the minimum requirements for admissions to medical colleges in respect of accommodation, staff, equipment, hospital bed strength, library, hostel facilities, residential quarters for the teachers and other supporting staff, and other amenities for students, decided that the minimum number of admissions to a medical college should be fifty, optimum number 100, and maximum number 150, annually'. This decision was communicated to the Ministry of Health, Government of India, to seek their approval so that this could be incorporated as a regulation of the Council. It took four years and several reminders for the Ministry of Health to respond, and that too in a negative manner, stating that 'the recommendation of the Medical Council of India for fixing minimum, optimum and maximum number of admissions to medical colleges has been carefully considered in this Ministry. However, it has not been possible to agree with the suggestion of the Council'. It has been, and continues to be, the bane of medical education that bureaucratic decisions have an overriding jurisdiction over professional judgment.

What has been, and shall perhaps continue to be the consequence of such a gross inaction, earlier on the part of the Medical Council and now on the part of the Ministry of Health? At the time that the Radhakrishnan Commission was constituted, there were less than twenty medical colleges in India. Today there are more than 150 medical colleges functioning in the country of which 130 are recognized by the Medical Council of India, another nine are under consideration for such recognition, and seven colleges are in the process of securing recognition. In addition, since the promulgation of the Indian Medical Council (Amendment) Ordinance, letters of intent have been issued to four medical colleges. The annual admission capacity to MBBS course in the country, which was less than 1500 in 1948, is today approximately 16000.

In spite of a vast increase in the number of medical colleges as well as in their admission capacity, no concerted effort seems to have been made to ensure parallel growth and development of requisite infrastructure such as laboratories, libraries, hospital beds, etc., to respond adequately to even the minimum educational needs so as to fulfill the essential prerequisites for ensuring quality of professional education. No wonder that there is a lamentable decline in the standards of medical education as well as that of medical practice. Is it a situation which could not be foreseen by our planners and educationists? To the contrary, Radhakrishnan Commission deliberated on these issues and stated:

We place emphasis on these principles, because in a professional subject like Medicine, where practical training is of importance and close touch of the professional element with the student population is of vital importance in the hospitals and the laboratories, excessive numbers admitted definitely lead to deterioration of standards, and make it exceedingly difficult for adequate supervised training to be given. In all medical colleges there should be an adequate number of large and small lecture rooms, halls, laboratories, preparation rooms, library and reading rooms, common rooms, and departments of research with special facilities. In our experience some of the colleges are lacking in these essential prerequisites.

It was to foster 'a close touch of the professional element with the student population' which was considered of vital importance by the Commission, that it was decided to have only full-time teachers in medical colleges, and to dispense away with

the system of part-time and honorary teachers howsoever professionally eminent they may be. Even this decision is yet to be fully implemented, in spite of a plethora of resolutions by the Central Council of Health and Family Welfare as well as of the Medical Council of India, over the last two decades. As per the latest resolution of the Council, 'the appointment of honorary/ part-time staff for teaching and administrative positions has been extended up to 1995, and not beyond'. Whether powerful influences shall be able to ensure a further extension, remains a distinct possibility. The medical profession cannot apportion all the blame to either the Government or the University system, or the Medical Council, nor can the medical educationists absolve themselves of what has been happening in medical colleges or in Medical Council in recent years.

Health Manpower Planning

The increase in the annual output of medical manpower, besides resulting in the declining standards already referred to, has also brought in its wake major distortions in the manpower mix available in the country. It is generally recommended that the ideal doctor-nurse ratio in a country is 1: 3. With approximately 465,000 graduates of modern medicine on the rolls of the Medical Council of India, and another 561,000 qualified practitioners of ISM and Homoeopathy on the registers of their respective councils, the country is required to have about three million nurses. The tragedy is that we only have about 300,000 nurses, and that the number of practitioners of medicine in India today is about three times that of the qualified nurses. The same applies to other categories of para-professionals. Thus we have a gross health manpower imbalance, i.e. a discernible discordance between the numbers, types, functions, and distribution of available health manpower and the nation's need for their services. In addition, there is a striking dissonance if we consider the capacity of the country for their employment and sustenance. Not only do we lack the requisite manpower mix, there is also an inequity of distribution: between the rural and urban areas, amongst different states of the country and within certain regions of the larger states.

It is ironical that even those states and union territories where the population-doctor ratio is most favourable, and sometimes comparable to that in the industrialized countries, pressures by urban elite result in the opening of new medical colleges. Part of it is due to commercialization of medical education wherein considerations other than merit continue to play a major role in determining admissions to a large number of private medical colleges, judgments of the Supreme Court of India notwithstanding. I need not elaborate further.

The Expert Committee on Health Manpower Planning, Production, and Management constituted under my chairmanship in 1986 took a serious note of these issues and made some candid observations in its Report. The Committee observed that the growth and development of health services and manpower over successive Five Year Plan periods showed that (a) health services and health manpower have been developing in isolated manner and without any proper linkage in temporal and spatial dimensions, (b) the process of health manpower development has not been as rational as it should have been, due probably to less concern for appropriate manpower as compared to concern for physical, technical and technological facilities, (c) there has been far less a concern, almost amounting to negligence, for the planning and production of allied health professionals, as compared to that for medical manpower. Indeed, the primary reason for this being the medical bias in the entire process of health system planning and health manpower development. Coupled with the fact that there has been a dichotomous growth of health services and health manpower, the quality and outreach of health services delivered to the community have also declined.

Bajaj Committee recommended radical changes regarding health manpower planning and production. The need for a quantum increase in the number of para-professionals was highlighted, and it was recommended that health-related vocational courses need to be introduced at the +2 level of the 10+2 system. By so doing, the existing infrastructure of higher secondary schools as well as of primary health centres would be utilized in a cost-effective manner, for imparting components of general education and vocational education respectively. In addition, realizing the need of a foundation course for all health care functionaries at that level, it was recommended that a module of sociology with the broad objectives aimed at the acquisition of knowledge of basic sociological principles and processes as they relate to the individual, family, and community with a view to gaining understanding of the social factors that affect community health, welfare, and life, must be introduced. Such a core curriculum for all para-professionals was expected to constitute the base and basis of multi-professional education.

The Report was approved both by the Central Council of Health and Family Welfare as well as the Central Advisory Board of Education; this was mainly because of the fact that both the ministries, i.e. Human Resource Development and Health, were at that time under the charge of Shri PV Narasimha Rao. About six months after the acceptance of the Report, Shri Narasimha Rao delivered an Address at the 8th Commonwealth Health Ministers Conference at Bahamas and succinctly highlighted the situation arising out of gross manpower mismatch:

It is no doubt true that in India, as perhaps in several other countries, various factors have resulted in the turning out of large numbers of doctors, about 13,000 annually, but unaccompanied by the requisite corresponding ratio of nurses and para-medical personnel. While the situation in this respect, as of today, could be termed unsatisfactory, I do not see any particular benefit in bemoaning it at this moment, since one part of it cannot be undone anyway.

He also outlined the proposed remedial measures by stating:

What we are planning to do, and will certainly do, is to bring about the required mix by planning in a big way in the next few years, the creation of middle level medical and health personnel on the base of the massive infrastructure of general High School and Higher Secondary education already available.

Finally, he made the most pertinent observation:

I am also of the view that this effort will not entail any appreciable cut in undergraduate medical education built up already; *what it will certainly entail, however, is a determined bid to contain the further proliferation of medical colleges, (emphasis added)*

Within a few months, in February 1988, the Central Council of Health and Family Welfare, which was convened under his chairmanship, took the necessary policy decision and resolved as under:

No new medical college should be allowed to be opened in any part of the country, or no additions to the existing admission capacity in the medical colleges should be permitted, as the qualified medical practitioners made available from the existing medical colleges are sufficient for the near future.

However, while the Council was still in session, there was a Cabinet reshuffle and he

took charge of the Ministry of External Affairs, and six Ministers of Health followed him in quick succession over a period of about three years. Not surprisingly, this firm policy could not be followed consistently and convincingly, with the result that there was a further increase of about 25 per cent both in the number of medical colleges and the number of qualifying graduates in medicine during the period 1988-1992. The remedial actions could only be taken by the present Government and the Planning Commission. Thus, the Eighth Five Year Plan which became operational on 1 April 1992 recognized the need for a National Educational Policy in Health Sciences, and stated a precise action plan in this context:

(i) The distortions created in the past on account of overemphasis on training of doctors, often at the cost of other categories of personnel, and also the undue emphasis on specialization/super specialization will be checked.

(ii) Starting vocational courses as part of vocationalization of general education at the +2 level of the 10+2 system will be supported to expeditiously bridge the gap in the supply of paramedical personnel.

(iii) The existing facilities for training of medical graduates have out stepped the needs. No new medical college or an increase in the admission capacity of the existing colleges will, therefore, be supported during the Eighth Plan. Instead, resources will be utilized to strengthen the hospitals, laboratories, and libraries of the existing medical colleges so that the standards of training are maintained.

(iv) Training facilities for epidemiology and health management, the two disciplines which contribute to the maximum extent to efficient functioning of health services including hospitals, will be augmented in medical colleges and created in specialised institutions where training of teachers for these disciplines can be undertaken.

(v) Continuing education for all categories of staff will be given high priority.

A simplistic argument generally advanced to support expansion of medical education is based on the surmise that just by overproducing doctors, some of them would have to take up service in the primary health centres. But have we succeeded in ensuring their presence in the rural areas of the country? Not so. Even while the number of doctors goes on increasing on the registers of employment exchanges in the country thus indicating a growing unemployment, the dispensaries and health centres in remote rural areas in several states continue to remain unserved by the doctors as indicated by the data in the Planning Commission.

The state of Maharashtra, which accounts for almost one-fifth of the total national out-turn of doctors annually, has about one-fourth of the sanctioned posts of doctors at primary health centres lying vacant as on 1st of January 1995. Uttar Pradesh with seven medical colleges has forty per cent of similar posts lying vacant.

One of the reasons often cited for such a state of affairs is that there has also been a large increase in the number of postgraduate seats available in medical institutions as well as in other hospitals which are not affiliated with the university system but are accredited for the purpose of postgraduate instruction and training. It is true that for about 15,000 graduates, who qualify every year, there are more than 9,000 seats available for postgraduate studies. This in itself is a distortion because the general recommendation with respect of the proportion between generalists and specialists in any country is

approximately one specialist for every two primary care physicians. With increasing demand for postgraduate studies and the elitist pressures succeeding in eliciting a positive response, we are producing today more specialists than primary care physicians. This is likely to create its own problems at a future date, as it has done in other countries which followed a similar pattern.

But are these postgraduate specialists, trained at enormous cost to the nation, available to serve in the national health care system? A study of our community health centres—each centre catering to a population of 150,000 to 200,000 people—shows that of the specialist jobs sanctioned for these centres, a significant proportion continues to remain unfilled. Once again the states such as Maharashtra and Gujarat, where the opportunities for post graduation are maximal, are also the ones with the highest number of vacant posts at the specialist level in the community health centres. A similar trend is discernible in other states also. Obviously, most of the graduates who qualify in medicine today prefer to undertake postgraduate studies, and following the successful completion of such studies, prefer to settle in large towns. The rural communities are therefore deprived of the services of general practitioners as well as specialists on whom the nation spends large sums of money, as the undergraduate and postgraduate medical education remains highly subsidized.

Furthermore, such a quantitative expansion has been at the cost of quality of postgraduate education. This is a situation not entirely unforeseen by the Radhakrishnan Commission which explicitly stated in their report:

The Commission has noted with regret that universities are competing with each other in framing regulations so that the maximum number of postgraduate degrees and diplomas are available, and in many cases students are allowed to appear for these degrees or diplomas without proper facilities being available for them to get a thorough practical training before qualification.

It is interesting to note that the two major issues I have highlighted so far, namely overproduction of graduate physicians along with an overproduction of postgraduate specialists, are also the ones causing major concern in advanced countries such as the USA and constitute an important area for health care reform, as proposed by President Bill Clinton. In summary, the annual out-turn of graduates in the USA increased from 8000 in 1965 to almost 17,000 in 1980. The ratio of one doctor for 650 people in 1960 has now come to one for 400 and it is expected to further come down to about one for 350 during the next decade. Despite a substantial increase in the number of doctors, the number of primary care physicians has not grown significantly. In fact the specialist/generalist ratio of about 1:1 in 1960s has now undergone a substantial transformation with about only one-third of American doctors serving as primary care providers, the remaining two-third having acquired higher specialization. Ours is an almost identical situation.

In a recent paper¹ by Dr. Mullan of the Department of Health and Human Services, US Government, the relevant issues are succinctly summarized:

Is medical training producing the right number of doctors, the right mix of specialists and primary care doctors, and the right distribution of doctors geographically and a doctor workforce representative of the American population? In the eyes of most analysts the answers to these questions are all negative.

In these statements, you may find a resounding echo of our own problems and predicaments, although I shall not venture to suggest that the similarity may have resulted

through some of the professed leaders of medical education in India who have always been keen to replicate western models, and who generally feel at home at Harvard and Oxford.

Dr. Mullan further adds:

The deliberations of the Health Care Reform Task Force assembled under the leadership of President and Mrs. Clinton, as well as such formally sitting national bodies as the Council on Graduate Medical Education and the Physician Payment Review Commission, have derived similar conclusions from the respective analyses of the data and circumstances.

Lessons drawn from such an analysis indicate that an increased number of doctors generate increased health care expenditure. Furthermore, normal laws of supply and demand that tend to curtail the cost of the service if it is in surplus seems to be far less effective in the case of doctors who play significant role in generating their own demand. Therefore, the size of the future doctors workforce does have a bearing on anticipated future costs of the medical system.

Quality of Professional and Paraprofessional Education

Having dealt mainly with the quantitative aspects so far, and their indirect effect on the quality of education and of health services, and having highlighted the distortions that have crept in because of lack of appropriate planning, let me now focus directly on the determinants of the quality of products of such a system.

The most pertinent question is: What constitutes quality? What are the yardsticks that may be used to measure quality? Should it only be the academic excellence of the product? Should it be the ability to reach certain preset standards of scholastic achievement?

In the Lakshmanaswami Mudaliar Oration in 1986, I had critically analysed the parameters that should determine the qualitative aspects of medical education. It was pointed out that during the first two decades following Independence, there was a carryover effect from the pre-Independence days in the sense that most of the medical teachers at that time were those who had received their postgraduate training in the Western hemisphere, especially in the United Kingdom, and therefore were most concerned about the maintenance of standards of medical education which would match international acceptance. In real terms, the national academic standards were being judged with an international yardstick, and the so-called academic excellence meant in reality the approval of the General Medical Council of Great Britain. In my view, the pre-occupation with such a presumed academic excellence took precedence over the prime need of national relevance.

Within a period of two decades or so, there was an increasing awareness that the medical graduates who were products of the then prevailing system of medical education in the country, were not willing to provide a uniform geographical coverage in the country, and that the mal-distribution of medical and health care, if anything, was increasing in spite of a rapid expansion of medical education, and was thus creating a wide hiatus between the haves in the cities and towns and the have-nots in the remote rural areas. A large proportion of medical graduates were migrating. Indeed, with the professedly extremely high standards of medical education at the All-India Institute of Medical Sciences, there was possibly such a concordance between the courses of instruction at the Institute and those in the highly industrialized societies such as the USA, that of the nearly 500

graduates who qualified during the first ten years of the existence of the Institute, more than 300 migrated out of the country and majority of them have settled abroad.

What were the compelling reasons for such a state of affairs? Was it just a question of better financial incentives, good working conditions, and a wide range of opportunities that were available to attract young doctors? Or was it that the curriculum and the learning experiences in a hi-tech hospital set-up prepared them to function most effectively only in those places which had a similar or still higher level of technology? My view is, possibly both. In our quest for international standards and our emphasis on curative medicine, we sacrificed the prime need of generating sensitivity and responsiveness to community health needs. This was in contrast with what Bhole Committee had recommended in 1946 on the basis of a critique of the task analysis of the future doctor:

The doctor of the future should be a social physician protecting the people and guiding them to healthier and happier life. The training of the basic doctor should be designed to equip him for such social duties.

I firmly believe that the social relevance of education of a physician should be the *sine qua non* for judging the quality of such education. While knowledge and skills must constitute the base and basis of education, a physician must be judged in terms of the basic minimum competencies that he has acquired during his undergraduate career. The competency to articulate properly, to communicate with the people including the sick and the healthy, to motivate the community and its leaders to work for healthy living environment and healthier life styles, and to scrupulously follow the ethos and ethics of medicine, must constitute the essential core of his learning.

Social Audit of Medical Education

During the last decade a concept of medical audit has been increasingly adopted in the hospitals, clinics and even in large nursing homes. Essentially, it provides an opportunity to critically review the services rendered to each patient in relation to his needs, the cost of such service including laboratory investigations, avoidable delays in providing appropriate services, avoidable complications of therapeutic or surgical intervention that may have led to a prolonged hospital stay and optimal and effective use of manpower and material resources for a better quality of service to the patient.

I had elsewhere suggested that the time has come to introduce the concept of social audit of medical education in order to assess the impact and outcome of such education on the quality and content of services delivered by qualifying graduates. This would shift the emphasis from judging the quality of the process of education to that of the quality of impact and outcome of such a process. In a way, this corresponds to the principles of total quality management being increasingly adopted by the service sector. Only by so doing can we analyse the contributions of educators and educational programmes in terms of health impact and health outcome in an individual, family, and a community. Obviously, such a review would include the choice of the graduating physician in relation to the setting for practice, i.e., rural or urban community, type of practice, i.e., general or specialty, major professional commitment, i.e., clinical care or public health, and the ability for effective use of skills, i.e., communicative, preventive, health promotional or curative, as well as for continuing up gradation of these skills along with cognitive competence through a process of continuing education.

Health Care: A Team Concept

If indeed such a social audit of medical education has to play a meaningful role as a means of constant review and reform, it must have an essential interlink age with the other components of primary health care. It is generally accepted that primary care services which constitute the base and basis of national health care systems in most of the countries, reflect and evolve from the economic conditions and social values of the country and its communities. Therefore, the structure and content of primary care tends to follow a pattern consistent with social norms and community aspirations, and aims at utilizing health outcomes as an entry point for community and socio-economic development.

The provision of primary health care must be the responsibility of a well identified primary health care team; the success of the primary care movement to a very large extent would depend on the effective and efficient functioning of the team as a whole. Such a team approach ensures that the responsibility to perform identified task(s) is assigned at a level of vocational competence which combines the twin advantages of lowest possible costs and maximal permissible quality assurance, with demonstrable evidence of community acceptability.

Multi-professional Education

The health team is traditionally headed by primary health care physician, although the leadership role may change depending upon the individual expertise in a task-related performance. The team is generally supported by a variety of auxiliary personnel, including para-professionals and village level primary health care workers. The important functionaries in the primary health care team in the developing countries include a doctor, a nurse, a nurse-midwife, an extension educator, a laboratory technician, a radiographer, a lady health visitor, etc. In more developed countries, additional team members may include a social worker, a public health nurse, a school health nurse, a dentist, dental auxiliaries, etc. With this identified core of health care providers, additional members of the team at any time must be identified on the basis of health-related tasks. Thus, for safe drinking water and water resource management, civil engineers including sanitarians need to be included in the team. Similar would be the case for environmental sanitation. In essence, the composition of the team would largely depend on the national health policies and programmes, and the available resource-inputs in the health sector. For India and several countries in the South-East Asia region involvement of practitioners of traditional system of medicine within this framework will be most relevant and highly rewarding. While the core members of the team belong to health vocations, the additional (optional) members are inducted due to their involvement in health-related tasks. There is also an obvious role of community volunteers and leaders.

It would therefore be an obvious prerequisite for students enrolled for basic education programmes in medicine, dentistry, nursing and midwifery, nutrition and dietetics, environmental sanitation, civil engineering, sociology, social psychology, behavioural anthropology, mass communication, telematics and informatics, amongst others, that they must not confine themselves to a single compartmentalized vocational curriculum. On the contrary, specially designed instructional modules must foster a spirit of professional socialisation which would be conducive to blending biological, social, managerial, and humanitarian attributes, and would facilitate sharing of learning experiences among students pursuing courses in such diverse fields. These, and other area-specific requirements, provide the reference point(s) for development of competencies and services, and intersectoral coordination.

Multi-professional education to be meaningful in developing countries, and

possibly in the industrialized societies also, must relate to the pertinent health problems of the community and thus should be mostly or entirely community-based so that the health problems of the community are clearly and categorically analysed in clinical, social and epidemiological contexts and the education and instruction of multi-vocational health workers who constitute the health team is carried out in the settings where health and disease are constantly happening, and threatening the lives of a large number of people in most developing countries.

A competency-based education employing a task-related and problem-solving approach, and in the learning setting of the community, seems to be an effective combination for multi-professional education. The essential outcome(s) must relate to congruence of objectives and convergence of services, thus optimizing the functional output of health care delivery team, in terms of both efficiency and effectiveness.

Epilogue

I have briefly reviewed the developments in medical education since Independence, and have attempted to highlight the essential interlinkage between professional education and delivery of health services with emphasis on determinants of quality of education and health care. I am firmly convinced that health-related vocationalization of general education and community-centred, task-related, problem-solving multi-professional education, shall together emerge as an appropriate response to our twin needs of accelerating the production of paraprofessionals in the country as well as making the learning experiences relevant to the needs of the community.

The recent outbreak of suspected plague evoking reactions of either apathy or apprehension not only in the communities but also amongst some of the professionals, leading to stigmatization and even victimization of those afflicted, has reinforced my conviction that professional ethics can no longer be confined to the micro-level of doctor-patient relationship but must also be projected at the macro-level encompassing ethics of health policy and planning and generating a holo-political action from the community grassroots to the state and national levels. Social dynamics of today demand a new definition of quality of education in health sciences and the performance of the institutions and universities must be measured in terms of their ability to generate not only responsiveness but social consciousness amongst their alumni.

*Radhakrishnan Memorial Lecture, delivered on 17 October 1994 at Nehru Memorial Museum & Library, New Delhi.

¹Mullan, F., Health care reform in the United States: The critical role of medical education, *Medical Education*: 28, Supp 1, 71-4, 1994.

Population Stabilization: A Continuing

Evolution of Perspectives and Policies*

There is a growing concern about increase in population as reflected in the 1991 census report, which places the population of India at 846.3 million. The rate of population growth during the eighties, though marginally slower than that during the seventies, was still of an order of magnitude to add annually eighteen million people to the existing population. Clearly, vigorous and effective steps need to be taken to cope with this challenge.

Taking cognizance of the fact that population stabilization is critical and crucial to achieve sustainable development, the country's Eighth Plan included this as one of the six priority objectives. To reinforce the sense of urgency and priority, along with the Directional Paper of the Eighth Plan, Population Control was also included as an agenda item at the meeting of the National Development Council, held in December 1991, and an additional paper prepared by the Planning Commission on this subject was submitted as the background document. The Prime Minister, in his opening remarks, reiterated that the country would be able to achieve a balanced growth of population only if a sound population policy was accepted as a national commitment by all.

Although rough estimates indicate that the population of undivided India was approximately 150 million around 1850 A.D., the first-ever census in 1871-2 recorded a population of 206 million. A decade later, census with better coverage confirmed a population of 253 million, a figure which may still be amenable to correction. However, further improvements in the methodology have considerably enhanced the validity of the data generated. Complete records are available of the decennial censuses taken since 1891 and up to and including the data of the last census in 1991. However, there have been large changes in the territories included at the time of each census, due to alterations in the national boundaries. For example, between 1931 and 1941 census, Aden and Burma ceased to exist as parts of India. Similarly, the dawn of Independence on 15 August 1947 also witnessed the formation of Pakistan, with the erstwhile provinces of North West Frontier, Sind, Baluchistan, parts of Bengal, Punjab, and Assam along with former 'Native States' of Bhabha-walpur and Khairpur and States and Agencies in Baluchistan transferred to Pakistan. In contrast, during 1951-61, the French territories of Chandernagore, Karaikal, Mahe, Pondicherry, and Yanam as well as the Portuguese territories of Goa, Diu and Daman were liberated and became parts of the Indian Union.

In order to draw meaningful conclusions from a study of demographic trends over the last century, it is therefore important not only to focus on the number of people enumerated at any point of time, but more importantly, to adjust the figures of all censuses conducted in India to the same territories and areas. Analysis of decadal growth rates (or exponential growth rates) provides a better insight into the demographic shifts (Table 1). Indeed, a perusal of the data clearly points out the decade 1921-30 as the period when a major increase in population was first recorded. Prior to 1921 (1911-21), the population of the country was stable at 'high fertility-high mortality' levels: the birth rate being 48.1 per thousand, with a death rate of 47.2 per thousand. However, in the following decade, there was the largest-ever decennial decline in death rate (from 47.2 to 36.2 per thousand), resulting in a rising trend in the population growth rate.

Table 1: Demographic Trends in India, 1891-1993

Census Year	Total Popn (in Million)	Annual Average exponential growth Rate(%)	Sex Ratio (female per 1000 male)	Density of popn per sq.km.	Birth Rate per 1000 popn. for the decade	Death Rate per 1000 Popn. for the decade
1891	236.7	—	—	—	—	—
1901	238.39	—	972	77	45.8*	44.4*
1911	252.09	0.66	964	82	49.2	42.6
1921	251.32	-0.03	955	81	48.1	47.2
1931	278.97	1.04	950	90	46.4	36.2
1941	318.66	1.34	945	103	45.9	37.2
1951	361.08	1.26	946	117	39.9	27.4
1961	439.23	1.98	941	142	41.7	22.8
1971	548.15	2.24	930	173	41.2	19.0
1981	685.81	2.25	933	216	37.2	15.0
1991	846.3	2.11	929	267	29.5	9.8
1992	—	—	—	—	29.2	10.1
1993	—	—	—	—	28.5@	9.2@

* Validity of data equivocal

@ SRS estimates (1993 - Provisional)

This historical narration, with clear demarcation of 1921-31 as the watershed decade in the demographic history of India, is important as it provides the contextual perspective for the early organized attempts to generate a social climate and political commitment in favour of population stabilization. Thus several actions were initiated at that time. These include the community awareness campaign introduced by Karve in 1921, the organization of Indian Birth Control Society by Ahluwalia in 1922, the establishment of Birth Control League in Bombay in 1923, and of a similar organization in Poona in 1929, as well as another organization under the banner Neo-Malthusian League in Madras in the same year. The Maharaja of Mysore established the first birth control clinics in Bangalore and Mysore in 1930. In 1932, the Senate of Madras University accorded approval for initiating education and instruction in contraception, and in the following year, birth control clinics were opened in the Madras Presidency.

National Concerns and Perceptions

Delivering the Presidential address at the Tripura Session in 1939, Subhas Chandra Bose highlighted population stabilization as the foremost task of Indian National Congress in free India. He said:

With regard to the long-period programme of a free India, the first problem to tackle is that of our increasing population...I would urge that public attention be drawn to this question.

The National Planning Committee of the Indian National Congress in 1935, under the

chairmanship of Pandit Jawaharlal Nehru, provided major support not only for the community-oriented programmes of family planning, but also for establishing birth control clinics in various states in India. A Population Sub-Committee of the National Planning Committee was constituted with the assigned task of recommending remedial measures with regard to the population problem in India. The Sub-Committee, with Dr. R.M. Mukherjee as its convener, submitted the final report in May 1940 wherein it not only provided a strong endorsement of the earlier initiatives, but also exhibited a holistic view, taking into consideration such socio-demographic determinants as age of marriage, social security, food security, nutritional status of the population etc., thus linking strategies for population stabilization with those for overall socio-economic development of the country. It may be of interest to recall the resolution of the National Planning Committee on Population which stated:

While measures for improvement of the quality of the population and limiting excessive population pressure are necessary, the basic solution of the present disparity between population and standard of living lies in the economic progress of the country on a comprehensive and planned basis.

It was therefore a natural extension of such a thought process as exhibited by the Congress leadership that the Central Government, under Pandit Jawaharlal Nehru as the first Prime Minister of India, initiated a state-sponsored population control programme as a part of the First Five Year Plan (1951-6). Although there have been major changes in the programme content during the subsequent five year plans, the essential commitment to the goal of population stabilization has been remarkably consistent over the years.

An essential element of the contours of population policy, namely a major consideration for the related social determinants, was a part of the Nehruvian model. In a letter addressed to Smt. Dhanawanthi Rama Rao, Prime Minister Nehru wrote on 18 October 1959:

You know that I am wholly in favour of family planning. Certainly one of its principal objects is to lessen the rate of population increase. This is very important. *But there are other aspects also.* To give a fuller life to the family and more particularly to the mother and children. The standard of living, education, etc., in a large family is likely to be lower than that in a somewhat smaller family.

In the same communication, Nehru displayed an intuitive foresight by stating: 'In everything that we do in India, it must be remembered that the organizational structure should not be top heavy and expensive. Otherwise it is limited in scope.'

Health and Family Welfare in post-Independence

India: A Critical Overview

The period after 1951 witnessed a rapid increase in population growth—the annual growth rate of 1.25 in 1951 escalating to 2.25 in 1981. This was basically due to a rapid decline in mortality resulting from better medical care and health facilities and overall improvement in socio-economic conditions brought by development under the Five Year Plans. During the last four decades, the mortality has declined from 27.4 in 1951 to 9.2 per thousand in 1993 while life expectancy has nearly doubled from just below thirty-two years to nearly sixty years during the corresponding period (Table 2). Average increase of life expectancy has been, and continues to be, about 0.6 years for each calendar year. This welcome decline in mortality is the result of elimination of famines and epidemics.

During the last three decades, the nation has witnessed the usual number of droughts but no deaths have been recorded due to famines. At the same time, mortality from pestilence has been minimal, epidemics like small pox have been eradicated and deaths due to malaria have been brought down significantly. Besides, the quality and outreach of health services have improved to a large extent along with a general improvement in living standards, thus increasing the chances of survival at birth.

India's population continues to remain young, since the beginning of this century, with about twenty-five per cent of the total population comprising of children below the age of 10. Because of the persistence of high fertility there is very little change in this proportion, though since 1961 there has been a declining trend. In 1981 Census the percentage of population below the age of fifteen was estimated at 39.6 per cent. This is expected to decline to 29.4 per cent by the year 2021 as per the projections of the International Institute for Population Sciences. On the other hand, the proportion in the older ages, i.e., sixty-plus has continued to rise over the years because of decline in mortality. In 1981, it was computed to be 6.5 per cent and is expected to increase to 9.3 per cent by the year 2021. The dependency ratio in the population, i.e., the ratio of children below age fifteen and older people above age sixty to the population aged 15-59 was estimated at 85.3 per cent in 1981. It is expected to decline and rise again consistent with future declines in fertility and mortality.

The 1991 Census report places the population of India at 846.3 millions. The rate of population growth during the eighties though marginally lower than during the seventies was still alarmingly high at 2.1 per cent a year. With such a rate of growth, approximately eighteen million people are now added every year to the Indian population. Thus, despite clear recognition by policy makers in India that rapid population growth retards and obstructs development and in spite of the fact that India was the first country in the world to have embarked on a Population Control Programme as early as 1951, population growth remains a formidable challenge even today, demanding urgent and concerted effort to achieve population stabilization.

Table 2: Life Expectancy at Birth

State		1970-75	1976-80	1981-86	1986-91
1. Andhra Pradesh	M	48.4	52.2	56.10	59.10
	F	49.3	54.2	59.98	62.23
2. Assam	M	46.8	50.4	51.98	55.23
	F	44.8	50.4	51.21	58.21
3. Bihar	M	NA	NA	55.21	58.21
	F	NA	NA	52.90	57.00
4. Gujarat	M	48.8	51.6	52.90	58.34
	F	48.8	53.2	58.30	61.49
5. Karyan	M	59.0	56.7	61.41	63.41
	F	55.6	52.5	59.55	61.97
6. Karnataka	M	55.4	56.2	60.15	62.15
	F	55.1	56.6	61.06	63.31
7. Kerala	M	60.8	63.5	65.23	67.60
	F	63.3	67.6	69.87	73.80
8. Madhya Pradesh	M	47.6	49.4	53.24	56.24
	F	46.3	48.7	51.46	54.71
9. Maharashtra	M	53.3	55.6	59.85	62.00
	F	54.5	57.1	60.66	64.30
10. Orissa	M	46.0	50.0	54.13	57.13

	F	45.3	48.4	51.90	55.15
11. Punjab	M	59.0	60.9	64.31	65.61
	F	56.8	60.2	64.34	65.30
12. Rajasthan	M	49.2	51.0	54.80	57.80
	F	47.5	53.0	55.44	58.69
13. Tamil Nadu	M	49.6	53.5	58.25	60.85
	F	49.5	53.4	57.85	60.80
14. Uttar Pradesh	M	45.4	48.5	51.14	54.14
	F	0.5	43.8	46.89	49.64
15. West Bengal	M	NA	NA	56.95	59.95
	F	NA	NA	56.28	59.93
ALL INDIA	M	50.5	52.5	55.6	58.1
	F	49.0	52.1	56.4	59.1

Source: (i) For column 2 & 3: *A Hand book of Population Statistics*, Census of India, Registrar General of India.

(ii) Figures in column 4 & 5 are the projected figures as given by the Expert Committee on Population Projections and Standing Committee of Experts on Population Projections respectively.

Demography and Democracy

It is in the context of the history of the last two decades, especially the period 1975-77 and the subsequent changes in the perception of the people as well as the policy planners, that the election manifestos of major political parties as issued prior to the general elections in 1991, need critical examination:

Indian National Congress (I): Congress first pioneered the Family Welfare Programme at the national level, in view of the importance of limiting population. Despite the severe setbacks that the programme received during 1977-9 there has been discernible progress. But for this progress, the country's population would have been around ninety-three crores as against the present 84.4 crores as per the 1991 census. The rate of increase in population has also come down slightly, thus reversing the trend of increase. These gains will be further consolidated. The Family Welfare Programme will be implemented as a voluntary mass movement with the full participation of the people, linking family welfare with larger programmes of female literacy, women's employment, social security, access to health services, immunization, and mother and child care.

The Congress will vigorously pursue the implementation of women's welfare programmes which encourage smaller families and the spacing of children. Special incentives will be provided for the education and health of the girl child.

The National Front (NF): In response to the alarming growth of India's population, the National Front commits itself to removing the basic causes of high rate of population growth and, in particular, to eliminating rural poverty, which is proving to be the main stumbling block to regulating family size. It is only by tackling this issue as part of a comprehensive approach to equity and fulfillment of basic needs of all the people that rates of growth of the population can be brought under control.

The National Front Government will take urgent steps to expand family planning

knowledge and services as part of a social movement linked to the broader approach to equity and basic developmental needs towards a higher quality of population.

Furthermore, there is emphasis on services to promote 'mother and child health', and a commitment to implement 'a time-bound programme of action towards basic inter-linked goals in nutrition, health and education in a holistic approach to mother-child life cycle', with a view to 'breaking the negative nexus between female illiteracy and ill-health on one hand, and early marriage on the other'.

The Bharatiya Janata Party (BJP): Highlighting the need of stabilization of population growth, and the quality, physical and mental, of the population, there is a commitment to:

(i) Adopt a National Population Policy, if necessary through legislative measures;

(ii) Make Family Planning information and facilities available to the people. Involve all voluntary, social and cultural organizations in creating awareness for adopting family planning as a way of life;

(iii) Integrate the family planning programme with other community welfare programmes; and

(iv) Pursue vigorously the voluntary adoption of the 'two children' norm through adequate incentives, and dis-incentives for achieving the long-term demographic goals.

The Samajwadi Janta Party (SJP): The election manifesto advocates 'a new approach to population growth by clubbing together awareness campaign, health facilities, nutrition, and family planning'.

These relevant excerpts from the election manifestos of political parties amply reflect a near unanimity as regards the need of initiating urgent action directed at the broad framework of population-related issues.

Translation of Perceptions into Action

The data of the 1991 Census, which became available in the summer of 1991 synchronized with the installation of the new government under the Prime Ministership of Shri P.V. Narasimha Rao. The demographic data once again brought to the fore the central issue of population explosion. Given the near consensus amongst the political parties prior to the general election, the time was ripe to launch a new and vigorous initiative through the Eighth Five-Year Plan; the appointment of a biomedical scientist as a Member of the Planning Commission may have also provided the additional critical ferment. It was, therefore, imperative to bring population stabilization on the agenda of the National Development Council which met in December 1991 to consider the 'Directional Paper' to the Eighth Plan. A background document 'Population Control: Perspectives and Planning', prepared in the Planning Commission, and referred to earlier, provided details of a multipronged strategy, emphasizing the need of a decentralized, area-specific micro-planning, within the general directional framework of a national policy aimed at generating a peoples' movement with the total and committed involvement of community leaders, and linking population control with larger programmes of female literacy, women's employment, social security, access to health services, immunization, and mother and child care.

Eighth Five Year Plan: Objectives and Policy Framework for Population Stabilization

Human development has been recognized as the ultimate goal of the Eighth Plan. It is towards this end that population control, literacy, education, primary health care, provision of adequate and safe drinking water, employment generation, and basic infrastructure are listed as priorities. The Eighth Plan clearly recognizes that if the present trend of population growth is not halted, it will never be possible to render social and economic justice to millions of our masses. The commitment to make vigorous efforts to contain population growth during the period of Eighth Plan, is therefore total and absolute.

Although there are likely to be commonalities of approach in the general contours of the population policy for the country, it is critical that the programme content must relate to decentralized area-specific planning at the district, sub-district, and the panchayat levels, and must be based on an in-depth disaggregated analysis of a constellation of socio-biological indices and demographic determinants.

Decentralization Planning and Differential Strategies

A critical and in-depth analysis of the available data indicates the need of target-free decentralized planning and differential approaches not only for different states but also, and more importantly, at the district level micro planning. States like Kerala, Tamil Nadu, and Goa which have achieved (or are nearing achievement) demographic goals recommended in National Health Policy should further improve the quality of services and internalize the family welfare infrastructure into general health services for initiation of newer activities/services related to maternal and child health care. States like Karnataka, Maharashtra, Andhra Pradesh, Gujarat, and Punjab, which have fairly well developed health care infrastructure but have yet to achieve the desired demographic goals, need to review their programmes, if necessary with the help and assistance of the Planning Commission, identify the areas of and reasons for low performance and address them suitably through formulation of state and district plans, so as to achieve the demographic goals expeditiously. In case of remaining states with poor family welfare performance, including Uttar Pradesh, Madhya Pradesh, Bihar, and Rajasthan, a multi-pronged approach of accelerating the pace of socio-economic development, removing or minimizing the gender gap in literacy and health care, and strengthening the quality and outreach of family welfare services through an efficient delivery system has been formulated. Revised strategies and area-specific plans of action which have potential to work within the limitations existing in these states need be evolved. The states in this category shall receive priority for Area Projects, special support for mobility, IEC (information, education, communication) and training programmes, as well as for encouraging and strengthening the state level NGOs. States have been advised to draw district and block level differential programmes, keeping in view their special requirements.

National Development Council: Committee on Population

While generally endorsing the need to mount intensive efforts to stabilize population, the NDC in December 1991 constituted a Sub-Committee on Population* with the following terms of reference:

(i) To review the social and demographic dimensions, existing and requisite infrastructure at the community level, and the needs of technology development, relevant

to the formulation of the National Population Policy;

(ii) To identify intervention strategies for population control, both at the macro and micro levels, on a holistic and intersectoral basis;

(iii) To suggest mechanism for securing commitment and support of leadership of all denominations, and at all levels, for the National Population Policy and the implementation of population control programmes;

(iv) To recommend ways and means of achieving participation of the people, particularly women and youth, and through people's institutions such as NGOs, voluntary organizations, professional organizations, of all categories of health care providers, trade and industry, labour, organized and cooperative sector and media etc.;

(v) To outline policies and programmes for raising the social status of women, bridging the gender gap in literacy and health care, and promotion of health and welfare of the mother and child, as essential inputs into population welfare programme;

(vi) To review and recommend appropriate changes in system of financing family welfare programme;

(vii) Taking into cognizance the above recommendations, to suggest appropriate formulations for a National Population Policy;

(viii) To identify and recommend suitable mechanism(s) for a continuous review and monitoring of the implementation of National Population Policy and the intervention strategies, recommended therein; and

(ix) To make any other recommendations that may be appropriate either for the formulation of National Population Policy or for the implementation of population control programmes.

The report of the Committee was submitted in November 1992, and was deliberated upon at the meeting of the NDC in September 1993 where it was generally endorsed. The NDC directed the nodal ministry, viz., Health and Family Welfare, to initiate further action while resolving that a meeting of the Chief Ministers and opinion makers be convened for wider consultation regarding the future course of action needed for the implementation of recommendations contained in the report of the Committee on Population.

As a follow-up, action has been initiated to formulate a National Population Policy, the essential framework of such a policy having been already delineated in the report of the NDC Sub-Committee. More importantly, the Committee during the course of its deliberations over a period of eight months, also made several significant contributions through some of its members who, as Chief Ministers, initiated in their respective states major action plans, some with far reaching consequences. Thus, the necessary approach to the type of disincentives that need to be considered for population control, was demonstrated by the state of Rajasthan through the amendment to Section 11 of Rajasthan Panchayats Act by an Ordinance issued by the Governor of Rajasthan on 17 Jun 1992. This has subsequently been enacted by the State Legislative Assembly which in addition has also passed the Rajasthan Municipalities (Second Amendment) Bill, 1992, introducing identical legislative measures dealing with the disqualification of a person who is elected to hold office provided that he has more than two children and after one

year of election, begets another child. Similarly, several innovative schemes have been introduced in states such as Rajasthan and Haryana which provide special incentives and aim to project the image of the girl child as an asset to the family rather than a liability. Some of these schemes for promoting family planning and welfare are similar to those already being implemented in other states, viz., Tamil Nadu.

The unanimity with which the final report of the Committee was endorsed, was commented upon in an Editorial in the *Indian Express* on 19 October 1992. Under the caption, 'Commendable Lead', the editorial highlighted the following:

The decision of the National Development Council to debar those with more than two children from holding any elective office needs to be welcomed. Charity must begin at home and those who choose to lead the Indian electorate with promises of development and better life must first set an example themselves by demonstrating that they are doing their bit to control population growth which is the biggest impediment to development. Just how the modalities, legal and otherwise, of implementing this decision of the NDC will be worked out remains to be seen. But what is significant is that the very fact that there was consensus in the NDC on this issue shows that the leadership of this country is demonstrating the necessary political will to bring population growth under control. It also shows that the negative connotations associated with any mention of the term 'family planning' since the mid-1970s are finally being shed.

The Prime Minister, reflecting major national concern regarding population growth, provided a unique privilege and opportunity to the Chairman and Members of the Committee to make a presentation of the major recommendations included in the Report, in a meeting specially convened for the purpose. Equally and perhaps more significant, were the directions of the Prime Minister to initiate urgent action on some of the recommendations. As a result, The Constitution (Seventy-ninth Amendment) Bill (No. LXXX), 1992 was introduced in the Rajya Sabha on 18 December 1992. The Bill seeks amendments to the articles 47 and 51 of the Constitution by incorporating articles 47A and 51 A. While the former makes it incumbent on the state to promote population control and small family norm, the latter enjoins the citizens to promote and adopt the small family norm. Equally important, the Bill seeks to add the thirteenth schedule to the Constitution by proposing the following:

Disqualification on ground of violation of small family norm:

A person shall be disqualified for being chosen as, and for being, a member of a House if he has more than two children:

Provided that nothing contained in this paragraph shall apply to any person—

(a) Having more than two children on the date of commencement of the Act or, as the case may be, within a period of one year of such commencement, unless he begets an additional child after the said period of one year;

(b) Having one child on the date of commencement of the Act or, as the case may be, within a period of one year of such commencement, if a subsequent childbirth results in the birth of more than one child.

Explanation—For the purposes of this paragraph, a person shall not cease to incur disqualification merely by reason of his giving his child in adoption.

Programme of Action: Multidimensional Approach

As a part of activities aimed at population stabilization, the Eighth Plan emphasizes programmes directed towards the guarantee of survival and sound development of children. Universal Immunization Programme (UIP), Diarrhoeal Diseases Control (DDC), Control of Acute Respiratory Infections (ARI) have been given special consideration both at Policy and Programme level. Similarly nutrition support and supplementation programmes, particularly Integrated Child Development Scheme (ICDS) and Special Nutrition Programme (SNP) are being strengthened. All these activities are aimed at reduction of infant and child mortality.

It has been observed that as the infant mortality levels decline, the rural-urban differentials tend to narrow down. For example, in Kerala in 1990 the infant mortality rate in the rural areas was estimated at seventeen compared to fifteen in the urban areas while in Orissa the rural rate was 127 compared to sixty-eight in the urban areas. The reduction of differentials in mortality levels between rural and urban areas seems to be an indicator of the extent of dispersion of basic health services across the country. It is worth mentioning here that in the developed countries, in the eighteenth and nineteenth centuries, the crude death rate as well as infant mortality rates were higher in urban areas as compared to rural areas, because of higher level of poverty and insanitary conditions prevailing in the urban areas. However, in India and many other developing countries, the opposite is the case, since there is a higher density of medical and health care facilities in the urban areas compared to the rural areas. Also the number of physicians and para-medical personnel working in the urban areas is disproportionately higher than in the rural areas.

It needs to be reiterated that congruence of goals at the policy planning and convergence of services at the community level, constitute the most critical and crucial inputs to ensure a successful outcome of these programmes. Thus, irrespective of the denominational' affiliation of the nodal ministries which act as programme managers for education, female literacy, women and child development, rural development, health and family welfare, information and broadcasting, small scale industry, labour, there must be 'funneling' effect to ensure target-oriented convergence of the services through village level workers who are a part of the community and enjoy a close rapport with the people.

A similar integrated approach is emphasized for health systems research to evolve suitable models for the integrated delivery of maternal and child health care (MCH), nutrition, education, rural development and family welfare services. In spite of major investments in bio-medical research for fertility regulation, the results in terms of development of safe and effective agent(s) for reversible fertility regulation both in the male and the female do not support either the claims or the optimism displayed by some of the scientists. Not only is it important to critically review such research projects, it is equally necessary to make investments for research in social and behavioural sciences as well as in the fields of informatics and telematics in order to identify methods, and develop models of communication for different target groups at the household or even at the village level.

Human Resources for Health

The Eighth Plan emphasizes the need to mount an intensive effort for population stabilization by effectively mobilizing *all* human resources for health. Generally, the professionals and paraprofessionals within the health system are considered as a resource for this purpose. There is a need to change this perception, and involve others who can

play a meaningful role in this direction. In addition to about 430,000 practitioners of modern system of medicine, there are approximately 550,000 practitioners of other systems including Ayurveda, Siddha, Homoeopathy, etc. Most of these half-a-million physicians of ISM are practicing in villages and *talukas*; it is estimated that at least one such practitioner is possibly available at every alternate village or its neighbourhood. They have a high degree of community accessibility and acceptability, as they are considered close to the socio-cultural milieu of the communities that they serve, and are therefore a major influence on the people. They are intimately aware of the traditional beliefs and health practices of the people to whom they provide care in response to their every-day health needs. Several studies in India have shown that at times they enjoy a higher order of ranking as a 'first-choice' of service users, when compared to the state-organized health service infrastructure. It is planned to pool this major resource of one million primary health care providers so as to make it an effective force for the motivation of population and for the delivery of services. Even if each practitioner motivates one eligible couple every week, fifty million additional couples can be protected annually.

Nearly 30 per cent of the population in the country is in the age group of 15-35 years. This group is designated as 'Youth'. This is also the age group which is most active in terms of reproductive behaviour. Population stabilization is basically an issue which almost exclusively concerns youth. Any programme for the control of population will have to be, therefore, heavily dependent upon their support. If these young people have to be organized so as to mobilize them to take decisive action on population front then village level programmes for organizing them are essential. As the Member (Health) in the Planning Commission has also been assigned the portfolios of sports and youth affairs, meaningful programmes for population stabilization have been developed for this target group.

About 40,000 youth clubs are currently active in about 574,000 villages in the country. They are being actively involved in population control activities, on the same lines as 16,000 literacy centres of National Literacy Mission were made operational in 1988-9 through village youth clubs. The literacy programme operated through the youth clubs was well received by the community. Leadership among youth may be developed by training and encouragement, and by providing recognition and by giving responsibility. For family welfare, the youth can act both as agents for imparting knowledge and information as well as depot holders for distribution of conventional contraceptives. Micro level studies have demonstrated immense potential of the youth in population control activities. Such programmes, however, have to be flexible, open and non-hierarchical as well as task-oriented.

Approximately one-half of the population of India is constituted by women. Their contributions to the corporate life and culture of the nation have been phenomenal. A large number of schemes and programmes have been initiated by the Government of India, either with a specific focus on development of women, or with a major component targeted in this direction. A cohesion and coordination amongst these programmes is urgently needed with the aim of harnessing all such efforts to generate a new momentum, and to ensure an efficient and effective utilization of resources invested. Population control and mother and child care must constitute an important component of all such programmes, and realistic efforts need to be made to integrate all essential service components, through a well considered performance-related coordination amongst village-level functionaries. The policy for development of women aims at educating them, employing them and empowering them, to enable them to exercise individual rights and appropriate choices.

Role of Women

Fertility is not only influenced by the couple's practice of contraception but by a variety of other factors like age of girl at marriage, overall literacy in the population and especially literacy among women as well as women's status in the society. Unfortunately, population control in India has always been exclusively identified with contraception and worse, sterilization, with the result that other factors did not receive adequate and appropriate attention. Needless to say, these strategies at times were counterproductive.

Age at marriage

Total Fertility Rate* (TFR) is essentially linked to two factors: the reproductive life span and the use of contraception. There is an inverse relationship between age at marriage and the number of children born to a woman as shown in the following study carried out in Rajasthan:

Age of women (in 1981)	Age at marriage	No. of Children ever born
30-34	17- 18	4.5
	19-20	3.4
35-39	17- 18	5.9
	19-20	3.8

Later age at marriage implies a shorter period of reproductive life exposed to the possibility of pregnancy. It may also mean longer stay in schools and acquisition of skills for income generation and the women entering the marriage and pregnancy with greater physical and emotional maturity to meet the challenges of family life. On the other hand, early marriage virtually closes all opportunities for women for enhancing their status. Low age at marriage also influences mortality and health of the mothers and children. The incidence of child loss is more in women who marry early as seen by the data of Registrar General of India which reports that 46 per cent of maternal mortality relate to the age group 16-24 years. Similarly, younger the mother, higher the infant mortality as shown below:

*TFR: The number of live births an average woman would have if during her lifetime her childbearing behaviour were the same as that of the cross-section of women at the time of observation. A total fertility rate of 2.1 is equivalent to replacement-level fertility.

	Girl's age at marriage	IMR (1978)
Rural India	Below 18	156
	21 and above	90
Urban India	Below 18	88

The importance of age at marriage further becomes clear when the situation in India is compared with other developing countries like Indonesia. For the comparable contraceptive prevalence rate, India's TFR is substantially higher than that of Indonesia (India, 4.0, and Indonesia, 3.25; in 1990); this difference is almost exclusively due to earlier age at marriage in India. Table 3 shows the present and projected TFR in some of the countries of South-East Asia region.

Table 3: Fertility rates in some of the South-East Asian countries

Country	Fertility rate			
	1965	1990	2000	2025
Bangladesh	6.8	4.88	3.20	2.28
Bhutan	5.9	5.53	3.53	2.38
Cambodia	6.3	4.56	3.20	2.20
India	5.7	4.00	2.68	2.14
Indonesia	5.5	3.25	2.27	2.10
Malaysia	6.3	3.65	2.46	2.08
Myanmar	5.8	3.87	2.79	2.10
Nepal	6.0	5.71	3.76	2.27
Pakistan	7.0	6.55	4.30	2.21
Philippines	6.3	3.63	2.53	2.10
Singapore	4.2	1.85	1.87	2.04
Sri Lanka	4.9	2.42	2.10	2.07
Thailand	6.3	2.43	2.12	2.08
Vietnam	6.0	3.94	2.56	2.09

Thus overall reduction in fertility is critically dependent on raising the age at marriage among women. In states like Kerala, Tamil Nadu, and Punjab where the age at marriage among women is around twenty-one years the birth rate has shown a significant decline. Raising the age at marriage of women can best be achieved by generating awareness through a social movement in which the role of leadership at different levels, viz., NGOs, public opinion leaders, youth and women organizations, among others, is

vital. But this must be supported by additional measures like vigorous implementation of Child Marriage Restraint Act, provision of better opportunities for education and employment for girls, incentives (including financial) for delaying the age at marriage of girls, etc. A number of states, viz. Rajasthan, Tamil Nadu, and Haryana have launched programmes aimed at one or more of such approaches including motivation of girls for delaying the marriage and the first child birth, adoption of small family norms, etc. These programmes need careful evaluation to explore their explicability and wider applicability.

Literacy among Women

In India literacy among women even after four decades of Independence is quite low. As per the 1991 Census the literacy rate among women (above seven years) is just about 40%. It is much lower in states like U.P., Bihar, M.P., and Rajasthan. Both non-enrolment and high dropout rate from school are the reasons for literacy rate among women. Dropout rate is also high on account of early marriage among girls. Desired family size and sex preference for the child have been shown to be negatively associated with educational status of women. According to a study two children norm was acceptable to only twenty per cent of families with an illiterate wife, but this increased to thirty-one, thirty-nine, fifty-four and sixty-two per cent as the educational level of the wife increased to primary, matric and higher levels of education. Educational level also plays an important role in overall level of use and choice of method of contraception. Not only contraceptive prevalence is higher among educated couples but the use of spacing methods is also more widely prevalent among them. School is the first step in the process of social familiarization of a girl with outside world. This helps the girl child to come out of the cloistered environment of the household and the village, thereby generating the necessary will to acquire new knowledge and perception about a variety of subjects including health and family welfare. This knowledge enables her to effectively participate in the decision-making process and thus take rational decisions about nutrition of the family, health and education of the child, the need to delay the age at marriage of her children, and the ability to seek and utilize health services for the children and for her own use and benefit (including family welfare services). Education also helps her to acquire skills considered essential for getting better paid jobs or enabling her to follow occupations which offer better earning opportunities. All these factors work in tandem, thus providing a synergistic effect and leading towards better quality of life both for her and for her family. Strengthening of primary education system in the country, particularly in rural and tribal areas and in the states with low literacy rate will be, therefore, an important step for achieving population control objectives. Special financial assistance to the states with low literacy rates should be provided to achieve hundred per cent literacy. Education is one of the six important objectives of the Eighth Plan also, and girl literacy is an important yardstick for performance audit.

Status of Women:

Economic strength of women is crucial in enhancing their social status which, in turn, will enable them to exercise their right in the decision-making process for the family and themselves, including the right to determine the size of their family. This empowerment of women is a cross-cutting intervention and it is expected to bring about all round change in the socio-economic status of the communities. At present there is wide gender gap in the areas of education, employment opportunities, utilization of health services, nutritional status, etc. Concerted efforts are needed to remove this age old, and perhaps continuing, exploitation of women. Specific action programmes with a major focus on young and adolescent girl need to be intensified to bridge the gender gap in literacy, employment, and health service availability and utilization. Reservation of seats in

educational institutions, in employment, and in Panchayats and other elected bodies including at all levels of legislative needs to be vigorously pursued and implemented. The recent decision of the Government of Orissa to reserve thirty per cent of all government jobs for women is a step in right direction and may be adopted by other states also. Special programmes for adolescent girls in rural and slum areas to increase their educational status and for providing skills for income generation should be undertaken on large scale. In this connection, importance of inter-departmental cooperation and coordination, discussed earlier, becomes obvious. Strong son preference, which is deep-rooted in our society, is often a reason for large family size besides discrimination against girls. A strong social movement against son preference in the Indian society requires to be launched. Increasing the educational level among the community and raising the social status of women are two important measures which ought to be undertaken concurrently for this purpose.

Role of Voluntary and Non-governmental Organizations

A critical element for the generation of momentum, and for accelerating the pace of progress in any mass movement such as population control and management, is the role of community-based voluntary organizations. Unfortunately, in the rural areas there are very few such organizations which have a deep and abiding commitment and proven track record in rendering family planning services. This is more so especially in those states which have the poorest demographic indicators. There is a felt need to incorporate family planning as a major objective of all self-help groups and voluntary organizations concerned with health and/or education-related activities. A review of, and a relaxation in, the rules and regulations governing grant of financial support to such voluntary organizations shall facilitate the extension of this important resource, and lead to the creation of a network aimed at sharing experiences and exchanging appropriately validated packages of information, education and communications. Major steps are being initiated in this direction.

Role of Corporate Sector

About 225 million people are members of the labour force in the country, sixty to eighty per cent of whom are in reproductive age group. The labour force which is working in the organized sector constitute about twenty-five millions. With their families this would amount to eleven to twelve per cent of the country's population. Labour employed in organized sector is easier to reach because of the concentration in defined work areas. They are better informed, being better educated, and have exposure to process of organization and modernization. The organized sector also has better infrastructure and resources to serve their workers and their families.

Support to Family Welfare Programme must be seen as a vital factor for improvement in productivity which is intimately linked to improved health and happiness of workers, the economic stability of the family and reduction in the burden of anxiety to which the head of a large-sized family is subjected to. There is sufficient evidence to suggest that investments in health and family welfare for workers yield rich dividends in terms of collective success and financial gains to a company.

The corporate sector should make family welfare an integral part of their planning and it should get priority in its budget. To succeed, Family Welfare Programme should be provided as an integral part of a package of labour welfare activities so that it goes beyond rhetoric observed in different types of programmes. Tax benefits are available to the industry for providing family welfare services to the employees and also to the

general public and as such finances should not be a constraint for organizing good quality educational and contraceptive services. A National Tripartite Committee for Family Welfare comprising representatives from INTUC, AITUC, HMS, etc., Employees Organizations and Apex Chambers of Commerce and Industry and Government Departments exists. The Committee can be used as an important instrument to motivate the industry and labour to join the family welfare mass movement in a bigger and more positive way.

A number of industrial concerns and public sector undertakings namely TISCO, Escorts, SAIL, UPASI (United Planters Association of South India), L&T (Larsen & Tubro), etc., have done excellent work in the field of family welfare, extending services not only to their own employees and their families but to the neighbourhood communities where the industry is located. Other industrial concerns may be motivated by the government to launch similar activities. 'Adopt a district' approach by the industries located within the area needs to be explored for the development of a district model where the government and the industry may combine their family welfare efforts as a 'joint sector' approach. Such motivation and combined effort should be done by all government departments including Commerce and Industry, Defence, etc. While in large industrial/business houses special cells/units may be formed for family welfare services, the small and medium industry can adopt a cluster approach in forming cooperatives for organizing family welfare activities. A senior level officer in each industrial unit may be nominated by the management to look after the family welfare activities. There should be annual budget, target setting and monitoring and evaluation of the programme.

To be effective and viable, the family welfare services in the organized sector will have to be organized with an understanding of people's aspirations and obtaining the cooperation from all sections, i.e., the management, the workers, the trade unions and the voluntary agencies including NGOs working in the field. With their excellent management capabilities and flexibility of approach the organized industrial sector—both public and private—can evolve working models of family welfare programmes which can serve as training grounds for government and NGO organizations, as is indeed the case with social advertising and social marketing endeavours.

Social Marketing

The organized sector can also play a vital role in extending their expertise and organizational infrastructure for such activities as social marketing, publicity and programme management. The Social Marketing Programme which was launched in 1968 to promote use of condoms is the oldest in the world. Twelve leading consumer goods, pharmaceuticals and oil companies, both in public and private sector, are participating in Commercial Social Marketing Programme (C.S.M.). These companies, which have a wide network of marketing force and capabilities, are operating in their earmarked territories through over 0.3 million outlets spread over both in rural and urban areas. It has been observed that if the C.S.M. Programme is well managed, well publicised and well adopted to local conditions they can reach about five to fifteen per cent of all couples of reproductive age group. The C.S.M. Programme plays supplementary and complementary roles to other family welfare programmes of conventional commercial sales in a more cost effective manner than other delivery systems namely hospitals and clinics. However, the problems being faced by the commercial organizations in the timely supply of contraceptives, pricing, promotion of brand names and other aspects will have to be addressed effectively by the Family Welfare Department to attract larger number of commercial firms in the social marketing network. It also requires to be emphasized that marketing is a highly professional job and social marketing should be handled by

professionals rather than generalist administrators. The Family Welfare Department should seriously consider this issue and act accordingly.

Unorganized Sector and Cooperatives

In unorganized and semi-organized sectors, several programmes have been initiated by the government, notable amongst them are Comprehensive Family Welfare and Income Generation Programmes for working women, through the working women's forum in slums of Madras and rural areas of Tamil Nadu; Family Welfare Programme for Bidi workers in the cities of U.P., M.P., Orissa, and West Bengal; a Comprehensive Family Welfare and Income Generation Programme for tribal population in Gujarat; family welfare activities for village dairy cooperatives in thirty villages of Khera district in Gujarat and tea plantation workers in Jalpaigudi district of West Bengal, etc.

A large number of villages (nearly ninety-five per cent) are currently covered under different cooperatives namely Dairy Cooperatives, Sugar Cooperatives, Fishermen Cooperatives, and Khadi and Village Industries. These cooperatives are federated at National level by Apex organizations, e.g., National Cooperative Union, NAFED, National Cooperative Consumer Federation and at state levels by similar Apex organizations. At the grassroot level there are primary agricultural credit cooperatives covering almost every village in the country. These cooperatives with their linkages at grassroot level cover about fifty per cent of rural population. They can play very active and effective role in not only propagation of a small family norm but also establishing family welfare service delivery centres/depots and act as strong channels for social marketing. What is really needed is to understand the full potential of these organizations, approaching them in a systematic way, exhorting them to the national movement of family welfare and enlisting their cooperation and support. The cooperative sector has also a well-organized training programme for their workers at national, state and district level. This can be utilized for field activities and creating opinion leaders among public through incorporation of family welfare as part of their training curriculum. Thus, the joint sector approach referred to earlier with regard to private and public sector must also include the cooperative sector to mount the programme and mobilize the resources required for running family planning programme mostly by themselves and without posing additional burden on the Family Welfare Programme finance.

Monitoring and Evaluation Mechanism

A sound database is essential for scientific planning, monitoring and evaluation of the programme. A system of data generation and retrieval has been developed in family welfare programme. The service data from sub-centres and primary health centres (PHC), post-partum centres and other service points is routinely compiled on monthly basis and transmitted upwards to district, state and central level. Service statistics are useful for monitoring of the programme against the targets fixed. The family welfare service targets are fixed by the central government in consultation with state governments. The latter fix targets for district level performance. PHC and sub-centre level targets are similarly fixed. This leaves little flexibility to the lower level functionaries to plan and fix targets and method mix. No effort is made to fix targets differentially as per the local level possibilities/potentialities. Moreover, service data is not useful to undertake district level planning of the programme in the light of socio-demographic variables. As already discussed socio-economic indicators are very important in the community accepting family welfare. Another drawback of the present monitoring system is that it is not utilized for critically examining the reasons for the failure to achieve targets, and accordingly taking appropriate remedial measures. Feedback of the data is not promptly

provided with the result that much time is lost before attention can be paid to retrieve the situation. Further, absence of current demographic data at the district level hinders decision making for district level target fixation and deciding method mix. Pilot studies need, therefore, be undertaken to generate district level data and its utilization for programme planning, monitoring and evaluation, thus making the programme free of centrally-fixed targets and at the same time encouraging participative micro planning. On the basis of prototype so developed, other districts can be subsequently brought under the district level planning, monitoring and evaluation mechanism. Concurrent evaluation of the quality and outreach of care also requires to be undertaken and for this an effective mechanism may be developed. A system of monitoring side effects and contraceptive failure rate should also be developed. National level institutions, viz., Indian Council of Medical Research (ICMR) and National Institute of Health and Family Welfare (NIHFW), may be entrusted this responsibility. Some of the medical colleges, selected on the basis of their technical capacity can also be involved in the system. Technical improvement in data transmission, collation and analysis is also needed to strengthen management information and evaluation system. To achieve this, a strong district level Health Management Information and Evaluation System is being developed by the National Informatics Centre, under the Planning Commission.

Financial Resources

Family Welfare Programme is fully centrally-sponsored scheme from its very beginning. The states carry out the activities through their health infrastructure according to the approved guidelines and norms provided by Government of India. The expenditure is reimbursed to the states by the Department of Family Welfare. The programme has also remained a plan expenditure since its inception. The allocations of the Family Welfare Programme during various Five Year Plans are shown in Table 4.

It has been argued in the past that our objectives, howsoever laudable, are seldom matched by necessary political commitment and financial investments. Even today it must be conceded that the ability to sustain the requisite level of investment for the

Table 4: Plan-wise Expenditure under the Family Welfare Programme

(Rs. crores)

Plan period	Expenditure on public sector	Expenditure on Family Welfare *	Family Welfare as % of total expenditure
First Plan	1960.00	0.14	Negligible
Second Plan	4672.00	2.15	0.05
Third Plan	8576.50	24.86	0.30
Annual Plan	6625.40	70.46	1.10
Fourth Plan	15778.80	284.43	1.80

Fifth Plan	394266.20	408.96	1.30
Sixth Plan	110971.20	1425.73	1.30
Seventh Plan	218729.60	3120.80	1.43
Eighth Plan	434100.00	6500.00	1.50
(Outlay)			

* This expenditure includes both Plan as well as non-Plan expenditure.

Fulfillment of priority objectives of the Eighth Plan, largely rests on the feasibility of mobilizing the requisite resources. It must, however, be noted that despite financial constraints the proposed outlay for family planning has been raised from Rs. 3,256 crores in the Seventh Plan to Rs. 6,500 crores in the Eighth Plan. The total Eighth Plan outlay for health and family welfare aggregates to a little more than Rs. 14,000 crores. Along with major investments in related social sectors such as education, safe drinking water, sports and youth affairs, etc., the commitment of the planners is obvious.

Although the allocations have increased substantially, particularly during the last few Plan periods, but in terms of percentage allocation to the public sector outlay, it has not shown any substantial increase and has remained between 1.1 to 1.8 per cent. It is however being increasingly realized that expenditure in family welfare sector is a real long term investment as the reduction in the population growth rate would result in a reduction in the future allocations for social sectors, e.g., education, employment, housing, health services, etc., besides ensuring larger economic benefits to the population.

Performance Audit

How does one ensure that these financial outlays are effectively utilized by the states and union territories? Again, for the first time, there is a paradigm shift in the methodology for providing central assistance to non-special category states. The Planning Commission is now committed to provide incentives to states which perform well in the social sector. The National Development Council has approved a revision in the Gadgil formula for allocation of central assistance, recognizing and establishing a parity between achievements in the economic and social sectors. Thus under the performance criteria, population control, along with maternal and child health, have been identified as specified indicators in the health sector. For this purpose, crude birth rate and infant mortality rate are given equal weightage for performance evaluation. Similarly, female literacy has been included as the criterion for performance in the education sector. Of the total weightage of 7.5 per cent assigned to performances (Table 5), a weightage of one per cent each has been assigned to population and education, on the basis of indicators mentioned.

Thus, at the time of annual plan discussion, there would be a critical review of achievements by each of the non-special category states in the specified areas of population control, maternal and child health, and literacy of the girl child. Such a review would determine the quantum of allocation of additional central assistance in the states'

Annual Plans, as per the new formula.

This is a major step forward since it not only sensitizes the states to the need of effective implementation of family welfare and literacy programmes, but also provides a clearer indication of availability of additional central assistance to those states which are rated as high achievers on the annual performance audit.

Agenda for the Nineties and Beyond

Family Planning is often perceived as a purely governmental programme, devoid of peoples' participation. It is criticized as being a techno-managerial and impersonal exercise. The analysis of demographic data of the country indicates that it is the major states like M.P., U.P., Bihar, and Rajasthan, which together account for about forty per cent of the country's population, that have not performed satisfactorily in reduction of CBR.

Table 5. Criteria and Weightage under Original Gadgil formula, Modified

Gadgil formula, and formulae as revised in October, 1990 and in

December, 1991 for allocation of Central Assistance for States' Plan.

Criteria	Weightage%			
	Original Gadgil Formula (1969)	Modified Gadgil Formula (1980)	NDC Revised Formula (1990)	NDC Revised Formula (1991)
Non-Special Category				
States (15)				
i)	Population (1971)* 60.0		60.0	60.0 55.00
ii)	On-going major Irrigation and power Projects	10.0	—	— —
iii)	Per Capita Income 25.0		10.0	20.0 25.0
iv)	Performance	10.0	10.0	5.0 7.5
of which				
(a)	Tax effort	10.0	10.0	— 2.5
(b)	Fiscal management 2.0		—	— —
(c)	National Objective 3.0		—	— —

(1) (incl. MCH)	Popn. Control	–	–	–	1.0
(2) of female illiteracy	Elimination	–	–	–	1.0
(3) pletion of externally aided projects	On-time com-	–	–	–	0.5
(4) land reforms	Success in	–	–	–	0.5
v) Total	Special problems	10.0	10.0	15.0	7.5
		100.0	100.0	100.0	100.0

*Population of the states has been ‘frozen’ on the basis of 1971 census data.

It must also be emphasized that the earlier efforts aimed at creating community awareness and political commitment (the demand-side of family planning programme) have partially succeeded. It is now the time to concentrate on ‘supply-side’ of the programme.* Thus, the essential interlink age between the quality and outreach of health and family welfare services in the community and its impact on family planning programmes and population growth needs serious and urgent consideration. Technology cannot be divested from the delivery system nor can it be a substitute for it. The inequalities in health that exist in our health care system are reflected in acceptance of family planning. The outreach and quality of care must, therefore, be addressed urgently. The availability of funds under ‘Social Safety Net’, has provided the requisite thrust and impetus to the programme for the intensification of efforts especially in the ninety poorly performing districts in the country, almost exclusively located in the four major states mentioned earlier, and identified primarily on the basis of a CBR of more than thirty-nine per thousand.

National Population Policy

There is need for a National Population Policy to be adopted and approved by the Parliament. This is under active consideration of the government. With major emphasis to debureaucratize the programme and to move it away from the tyranny of targets, it is equally imperative to humanize the base and basis of population stabilization, and to make it a peoples’ movement. It calls for national consensus as well as political commitment. The two have to go together and though there are likely to be commonalities of approach in the general contours of any population policy for the country, it is critical that the programme content must relate to area-specific planning at the district, sub-district and the panchayat levels.

The recent passage of the Constitution (Seventy-second Amendment) Bill, 1991, also called the Panchayati Raj Bill, by the Parliament, aims at creating the essential instrumentality to empower people in the planning and participatory management of health and family welfare infrastructure, and usher in a new era of social and infrastructural development. Accordingly, the health planners and administrators must not only become sensitive and responsive to the felt needs of the people but must also adapt to the instrumentality of the local self-government. The health care systems must have an inbuilt resilience and a sharply defined accountability. Till such time that the Panchayats reach an optimally operational mode, existing peoples’ institutions shall need to be strengthened, and new institutions identified or developed to provide a thrust to the population control programme.

Summary and Conclusions

The base and basis of the population control programme must be through decentralized, area-specific micro-planning, within the general directional framework of a national policy aimed at generating a peoples' movement, linking population control with larger programmes of female literacy, women's' employment, social status and security, access to health services, immunization, mother and child care and promoting male participation. Involvement of all sections of the society, the leadership, the labour and industry, the practitioners of different systems of medicine, and the voluntary organizations is critical for the success of such a mass movement.

To reinforce the optimism of those who firmly believe in the will and determination of the people of India, it is worth citing the positive achievement in bringing down the fertility rate from 5.3 to 3.9 per cent, during the period 1980-91. The recent report of the U.S. Population Crisis Committee rightly acknowledges this achievement, made possible largely through the efforts in five states: Gujarat, Kerala, Maharashtra, Punjab, and Tamil Nadu (in alphabetical order). What is needed now is a rapid replication of holistic models established within the country, rather than looking outside for further import(s) of contraceptive technology.

Epilogue

The 1991 census results were followed by a plethora of publications by journalists, demographers, social scientists and others. While some exhibit a genuine concern, most of them reflect a blend of scepticism, cynicism and what is worse, pessimism. In general, their main thesis follows the pattern of thoughts as expressed by Hegel almost 200 years ago: 'What experience and history teach is this—that people and governments never have learned anything from history, or acted on principles deduced from it.'

As the first-ever biomedical scientist appointed as a Member of the Planning Commission and incharge of health, family welfare, nutrition, youth and sports, one can only reiterate the scientific rationale of population policy and the soundness of population stabilization strategies, as included in the Eighth Five Year Plan. As to the absolute certainty regarding the ultimate success of these efforts, one may draw strength from Bertrand Russell: 'For it is not enough to recognize that all our knowledge is, in a greater or lesser degree, uncertain and vague; it is necessary, at the same time, to learn to act upon the best hypothesis without dogmatically believing it'.

While the scientists accept the validity of this thesis, it is time that the cynics and sceptics may also do likewise.

*Note *added* in proof: A recent nation-wide survey has confirmed this. It is estimated that unmet need for contraception contributes about 20 per cent to the present fertility level.

Health as an Indicator and a Determinant of Quality of Life*

Conceptual Framework

One of the major dichotomies in recent times is the disassociation of the content of life from the quality of living. While the biologists continue to struggle for evolving a better definition of what is not life, i.e., death, the sociologists and economists face an equally difficult challenge in not only giving a definition but a numerical rating to quality of life. Nonetheless, the biosciences are at last reaching some degree of agreement in defining what constitute the cessation of life, i.e., the event of death. The social scientists, however, continue to strive for an agreed definition of the quality of life that would harmonize a sense of internal tranquility in the context of environmental harmony. In contrast to a possible scale of social values, several indicators of quality of life have been proposed in the context of developmental economics. These include:

- i) per-capita income,
- ii) rate of economic growth,
- iii) physical quality of life index (PQLI),
- iv) satisfaction of minimum needs, and
- v) a holistic approach combining satisfaction of a variety of physical as well as socio-cultural needs.

Three indicators, namely, infant mortality, life expectancy at age one, and literacy, have been combined to give a numerical value to PQLI (PQLI in India in 1990 is fifty-seven; in 1970, it was forty-one). In a limited sense, the concept of PQLI is an extension of the possible role of economic parameters, as it includes the availability of essential services and goods to the weaker sections of society. Such services would include health care, shelter, and availability of food, nutrition, etc. The ability to satisfy some of the basic needs, such as that of drinking water, food, clothing and housing, along with education and health would, therefore, constitute a paradigm of primary needs related to the basic level of living. While these six primary needs can be quantified, secondary needs such as rest and relaxation, entertainment, environment, amongst others, are not amenable to such an approach.

A reference framework of these is reflected in the concept of basic needs strategy or the minimum needs strategy, which generally includes primary health care including drinking water and nutrition, primary and adult education, housing, and rural transportation. The Minimum Needs Programme (MNP) introduced in the Fifth Five Year Plan is entirely in agreement with this strategic approach which was originally propagated by Robert McNamara at the time when he was the President of the World Bank. The objective of the MNP is to establish a network of basic services and facilities of social consumption within a specified timeframe. The basic needs of the people identified in this programme are elementary education, adult education, rural health, rural roads, rural electrification, rural housing, environmental improvement of urban slums, and nutrition.

Health as a Determinant of Quality of Life

Bertrand Russell, in his autobiography, made a philosophical reference to the four most preferred values in human life. He considered freedom from ill-health, and from poverty,

along with a sound relationship with the members of the family as well as recognition and satisfaction in the chosen field of work as the core constituents or the essential reference points. Although freedom from ill-health or absence of diseases has been emphasized by Bertrand Russell in a negative context as a disvalue, health must be viewed as a positive attribute. In the traditional Indian system of medicine, there are two terms used for health: 'Swasthya' and 'Arogya'. While the latter signifies 'diseaselessness', and corresponds to the definition suggested by Bertrand Russell in his expression 'freedom from ill-health', the preferred concept in the Indian medicine is that of Swasthya, which is not a mere absence of diseases, but a positive attribute. Indeed, it connotes the state of well-being of the body and mind, literally meaning 'abiding of oneself.' The definition of health, as propounded by the World Health Organization, is much closer to the concept of Swasthya used in Indian medicine. Health is defined as not merely the absence of disease but a state of positive physical, mental, and social well-being. Ayurveda, which is the science and art of integral and meaningful life, is as much concerned with the maintenance and promotion of health as with the cure of diseases that may have risen as a result of disturbed equilibrium between man and his environment.

Extending these concepts of health, as have existed in India since the dawn of civilization, it may be appropriate to lay an hierarchical foundation for developing a definition of quality of life. At its core, the concept would include Swasthya (positive health), along with adequate availability of food, drinking water, health care, and shelter, so as to provide a harmonious living within a healthy environment. In a way, this would also correspond with the minimum needs as defined earlier. However, at a higher level of hierarchy, additional parameters such as a sense of social well-being involving harmonious relationship within the family, community and society would be included. At the highest level of this conceptual pyramid would lie the aesthetic values including the art and culture reflecting the ethos and ethics of human development in all its dimensions at any point of time. As the later experiences fully merge with the sublime, and at times divine, the inherent quality of spiritual well-being would become an ingredient of the richness of life.

Minimum Needs as Core Content

It may be worthwhile to focus at the core of the hierarchical concepts, and critically examine the contents including health, food, drinking water and shelter. Since the dawn of Independence, rapid strides have been made in the improvement of quality and out-reach of health care services to the people. There have also been some spectacular successes such as eradication of small pox, control of plague, and a significant decline in morbidity and mortality on account of malaria, cholera and several other communicable diseases. The infant mortality rate has shown an impressive decline (Table 1).

Life expectancy has risen from a mere thirty-two years in 1947 to fifty-eight years in 1990. A vast network of health infrastructure has been created under the Minimum Needs Programme, as described earlier. This includes a three-tier system of Sub-Centres (SC), Primary Health Centres (PHC), and Community Health Centres (CHC) in the rural areas. The Sub-Centre is the basic unit for providing health and family welfare services, and caters to the needs of about 5,000 people except in difficult terrains such as hilly and tribal areas where each SC is established for a population of 3,000 persons. As on 1 April 1992, there are 130,219 SCs in the country. The PHC constitutes the intermedial referral centre in the chain of primary health care system and has been set-up for a population of 30,000 in the plains, and 20,000 in the hilly and tribal areas. As on 1 April 1992, there are 22,441 PHCs in the country. The CHC provides specialist services including that of a

Pradesh	142	142	134	125	121	122	117	120	121	117	111
Maharashtra	75	79	70	79	76	68	63	66	68	59	58
Orissa	143	135	132	126	131	132	123	126	122	122	123
Punjab	89	81	75	80	66	71	67	62	622	67	55
Rajasthan	105	108	97	109	122	108	104	102	103	96	83
Tamil Nadu	93	91	83	87	78	81	80	76	74	68	67
Uttar Pradesh	159	150	147	155	155	142	132	127	124	118	98
West Bengal	NA	91	86	84	82	74	71	71	69	77	63

Indian System of Medicine

In order to make a significant impact on the health scene of the country, we must harness all manpower and material resources that may be available to us. It is to this end that not only the involvement but also the commitment of practitioners of all systems of medicine must be ensured. Along with 430,000 practitioners of the modern medicine, there are also 555,000 practitioners of Indian systems of medicine and homoeopathy, providing health care to the communities. Most of these half-a-million physicians are practising in the villages and *talukas*; it is estimated that at least one such practitioner is possibly available at every alternate village or its neighbourhood. They have a high degree of community accessibility and acceptability, as they are considered close to the socio-cultural milieu of the communities that they serve, and are therefore a major influence on the people. They are intimately aware of the traditional beliefs and health practices of the people to whom they provide care in response to their every-day health needs. Several studies in India have shown that they enjoy a higher order of ranking as a 'first-choice' of service users when compared to the state-organized health service infrastructure.

An Expert Committee on Health Manpower Planning, Production and Management (Bajaj Committee, 1987), in its report suggested that the practitioners of the Indian systems of medicine can be gainfully and effectively employed in the implementation of national health programmes like the National Malaria Eradication Programme, National Leprosy Eradication Programme, and Family Welfare and MCH Programmes. However, to ensure an optimum functional competence of these practitioners, it will be essential to strengthen their basic training by incorporating appropriate educational components. In addition, refresher courses for those who are already in practice, can upgrade their knowledge and skills. Thus within the health care system, these practitioners can strengthen components of health education, motivation of the eligible couples for accepting spacing of terminal methods for family welfare, and for educating and motivating the community for environmental sanitation, immunization, etc.

Besides ensuring an active involvement of the practitioners of the Indian systems of medicine, there is also the need for intensifying basic and clinical research to establish therapeutic efficacy or otherwise of a large number of indigenous drugs that are being extensively used in the country over a period of several centuries. The application of modern scientific tools and methods of enquiry to the traditional systems of medicine is

likely to generate rich dividends and enhance our collective capability in the field of health care.

It is estimated that about 1100 medicinal plants find mention in the Indian system of medicine. Of these, about 500 plants are most commonly used in the preparation of drugs both in the Indian system of medicine and homeopathy. The main source of availability of these plants are the forests. Measures are therefore needed to promote the cultivation of these medicinal plants. The agricultural universities and other research organizations must continue to play a major role in developing the most recent technology for the cultivation of these plants. Realizing the importance of these vast resources yet to be exploited fully for health care in India and in other countries, the World Health Assembly in May 1988 resolved to urge the member countries to (a) examine the situation with regard to their indigenous medicinal plants, and (b) take effective measures to ensure their conservation and encourage their sustainable utilization.

With the resurgence of such interest in recent years, one may visualize a renaissance of the traditional systems of medicine, especially Ayurveda. In view of the major thrust for the prevention and care of communicable diseases, the two important milestones of modern medicine during the twentieth century were vaccines and antimicrobial drugs. However, the epidemiological evolution is leading us to life style diseases, i.e., diabetes mellitus, coronary artery disease, hypertension, cerebrovascular accidents, etc., where there are no vaccines or magic bullets such as antibiotics. This will necessarily lead to renaissance of Ayurveda with emphasis on healthy life style, balanced nutrition, physical activity (Hatha Yoga and Pranayam), and techniques of mental relaxation (Dhyan Yoga and meditation). Even minimal investments of scientific and technological inputs to intensify research efforts for exploring the role and place of Yoga for disease prevention and health promotion, may establish the validity of this vast ancient heritage.

The late Prime Minister of India, Smt. Indira Gandhi, in her convocation address delivered at the Lady Hardinge Medical College in 1976 said:

Indian medicine, indeed Indian philosophy as a whole, has always recognized the vital and inalienable connection between the mind and the body, and hence the importance of mental attitude on physical well-being and that of body sickness on the mind. The concept of Maya or illusion is the same on a vast scale, embracing all experience. Our medical scientists should investigate the penumbra region of the relationship between mind and body. Yoga, as evolved in our country, had acquired many insights into the impact of the will and the mind of bodily chemical functions. I find that Western universities have taken to research in this field in a big way. We, the home of Yoga cannot afford to neglect this work.

Technological Inputs

It is only in recent years that the attention of bio-medical as well as non-medical scientists has been drawn to the needs for research and development in the areas of appropriate technology which should provide the complementarity, not only with the health care infrastructure, but also the compatibility with the knowledge and skills of the health manpower functioning in the health sector.

The generation of innovative technology is the base and basis for research and development. For example, while being fully aware of rapid advances in the application of electronics in recent years, a major concern that needs to be exhibited is the accessibility of such technology to the people in remote areas, and the affordability by the people and the national health care system to incorporate such technology in the health

care system. Equally important is the consideration of skills that the health care providers must have in order to effectively use such a technology.

Ultra-thin flexible optical fibres, fibre optic sensors, lasers, coupled with fibre optic and computer hardware, application of powerful computational tools to diagnostic images, development of MRI (Magnetic Resonance Imaging) and PET (Positron Emission Tomography) technology, and exploration of super conducting quantum interferences devices or SQUIDS, have produced a quantum jump in the range of available diagnostic and investigative technology. There have also been accompanying advances in the disease management systems. Automatic drug delivery systems have been developed; some of these can be implanted in the body. Delivery of drugs like insulin in the management of diabetes, with the inherent computerized capability of adjusting the dose in relation to circulating levels of glucose in the body, and development of extra corporal shortwave lithotripsy, constitute some of the new tools that are being made available today. The availability of monoclonal antibodies has enhanced our diagnostic and therapeutic capabilities.

Whether such a technological revolution in medicine, with emphasis on high cost technology, has any direct and significant relevance to the delivery of effective health care to millions of people in the rural areas, is the question that must be considered and answered in the context of available resources, and within the reference frame of our national health policy. For example, when electronic foetal monitoring was introduced in the U.S.A., a drop in the foetal deaths was observed. However, during the same period, foetal death rates were also falling in hospitals where no electronic monitoring had been introduced. The rate for Caesarean section was double in the area of the electronically monitored group. Clearly, no positive value of electronic monitoring was shown in a well designed study¹ but the obstetricians recommended its use in all deliveries. The estimated direct cost to the society in the U.S was \$200 million a year (at the price level of 1976).

Herein lies the key to the concept of appropriate technology: it must be accessible, affordable, and acceptable, with confirmed scientific validity, and proven potential for improving the quality of health care services. In terms of research and development of appropriate technology, which can be used in the PHCs, CHCs and in the district hospitals, major efforts should be generated, not only in medical institutions and medical research laboratories, but also in all scientific and industrial research institutions including the institutes of technology and engineering colleges. Thus development of mass health care related technology and instrumentation must be accepted as a challenge.

In essence, therefore, planning in each segment of the basic needs such as health, drinking water, food, and shelter, must include a programme of research and development to improvise low cost technologies relevant and responsive to the needs of each sector. While doing so, a technology watch must be maintained and technology window must always be kept open so that appropriate technologies developed outside the country can be transferred and adapted to our own needs.

Having emphasized the need for improvements in several sectors of the infrastructure which relate to the basic ingredients inherent in the discussion of the quality of life, it must also be reiterated that all investments in this area are unlikely to be rewarded until and unless the efforts for population stabilization are intensified, and their ultimate success ensured.

One of the most crucial problems facing the nation today is the high growth rate of population. Since 1872, when population census first started in India, there have been thirteen decennial censuses, the last being in 1991. Between 1901 and 1991, the population of India has increased from 238 million to 844 million, the partition of the country into India and Pakistan notwithstanding.

Table 2 shows the demographic trends in India during the present century; the year 1921 emerges as a clear watershed in the demographic history. Thus, while during the period 1911-21, the population of the country was stable with both fertility and mortality rates at a high level, during subsequent decades, there has been a steady growth in population, entirely attributable to a gradual reduction in mortality. With major investments in health in the post-independence era and a marked reduction in mortality and a significant increase in the life expectancy, there has been a rapid increase in population growth till 1981. Indeed, the highest ever recorded decennial growth rate in the population of twenty-five per cent was observed during 1971-81. It is, however, gratifying to note that it has shown a slight decline to 23.5% during 1981-91, as observed in the last census. More significantly, the growth rate was slower in the latter half of the decade, and was estimated to be 2.03% in 1989. Among the states, the lowest population increase was registered in Kerala (13.98%) and Tamil Nadu (14.94%). In contrast, the states of Uttar Pradesh, Madhya Pradesh, Bihar, and Rajasthan constituted pockets of explosive growth of population. While on the one hand, these states are characterized by high birth rate (32-37 per thousand) these are also the states where infant mortality rate is high. Furthermore, there is a strong negative correlation between the availability of potable drinking water, and the IMR. Thus investments in sectors other than health bring out synergistic effects. The World Health Organization includes provision of safe drinking water amongst the eight elements of primary health care.

Table 2: Demographic trends in India, 1901-1991

Census Year	Total popula- tion (in million)	Annual average exponential growth rate (%)	Sex ratio (female per 1000 males)	Density of popula- tion per 1000 sq km.	Birth rate per 1000 popu- lation for the decade	Death rate per 1000 popu- lation for the decade
1901	238.4	—	972	77	—	—
1911	252.1	0.56	964	82	49.2	42.6
1921	251.3	-0.03	955	81	48.1	47.2
1931	279.0	1.04	1.04	90	46.4	36.2
1941	318.7	1.33	945	103	45.9	37.2

1951	361.7	1.25	946	117	39.9	27.4
1961	439.2	1.96	941	142	41.7	22.8
1971	548.2	2.20	930	173	41.2	19.0
1981	685.2	2.25	933	216	37.2	15.0
1991	844.3	2.11	929	267	29.9*	9.6*

*SRS estimates (1990 - Provisional)

The Expert Committee on Population Projection, which was set up by the Planning Commission, has provided three sets of projections corresponding to three levels of couple protection likely to be reached by the year 2001 A.D. Although the medium projections were accepted for use in the formulation of the Seventh Five Year Plan, the 1991 census has shown that the actual population of 844 million corresponds to the high set of projection of 841.68 million. The corresponding medium projections for the year 2001 are 986.10 million, and high projection of the same year is 1021.89 million. If one assumes a growth rate of two per cent from 1991-2000 (having reached 2.03% in 1989), the projected population for the year 2000 shall be 1009 million.

It is, therefore, quite obvious that such a rapid population growth would pose serious challenges in terms of production and availability of food, as well as problems related to inadequate drinking water, poor sanitation, and serious shortage of housing. These constitute base level indicators of quality of life. At another level, there would be pressure on land, increase in the number of those either unemployed or partially employed, and a possible increase in those below the poverty line and those who are illiterate.

Food

Some of these issues are already causing concern. Though the per capita net availability of food grains has increased from 334 grams in 1951 to 490 grams in 1991, the per capita availability of pulses, which constitute the main source of proteins for the majority of population has actually declined significantly from sixty-one grams to thirty-three grams during the corresponding period. Furthermore, while wheat and rice are deficient in lysine, pulses and legumes are a rich source of this amino acid. Pulses therefore contribute both in terms of quantity and quality of protein to an otherwise cereal-based diet, as is the case in poor households.

A closer look at the availability of food for a population of 1.25 billion people, which may be reached in 2015 A.D., does indicate that to maintain the availability at approximately 500 gm per capita per day, would require a net production of about 300 million tonnes of cereals. The past record in the field of agriculture does provide some degree of assurance that such a target may be possible to achieve. From a net production of cereals of 142.3 million tonnes in 1978-79, there was an exponential rate of growth of 2.8% per year, resulting in the production of 176.2 million tonnes in 1990-91. Further extrapolation of the same rate of growth certainly raises the possibility of production of 300 million tonnes after twenty years.

What is important is to realize that the average yield per hectare of wheat in India is 2125

kg, as compared to 5118 kg per hectare in the EEC, and 3194 kg per hectare in the Peoples' Republic of China. Similarly, while the yield of rice in India is 2624 kg per hectare, the corresponding figure for Indonesia is 4301 kg and for Peoples' Republic of China it is 5712 kg per hectare. While it may be possible to increase the total area under food grain cultivation, it is obvious that the requisite increase in the net food grain production can only be through such technological inputs as improved seeds, more and better fertilizers, and better irrigation.

The per capita availability of food, as projected above, does not ensure that every inhabitant of the country will be a beneficiary of equitable distribution and shall be able to maintain a satisfactory nutritional status. A large number of people shall continue to be below the poverty line which takes into account the level of expenditure that would be necessary to ensure a minimum calorie intake and indispensable purchases of non-food items. In spite of all the developmental efforts, a population of 1.25 billion people may have 250-275 million poor (below the poverty line) and, about three-fourth of these would be in the rural areas: this segment of the population would be most vulnerable to nutritional disorders, including protein-energy malnutrition.

Housing

Notwithstanding the backlog that already exists in the provision of adequate housing, the additional demand of housing for new households during the present decade (1991-2000) has been estimated to be of the order of 23-25 million units each in the urban and rural areas. It is estimated that an investment of Rs. 97,530 crores in 1991-92 would be necessary to construct 21.77 million units.

Although major references have only been made to drinking water, food and nutrition, housing and sanitation, it is obvious that similar severe constraints would also be reflected in the generation of employment as well as in mounting programmes for the universalization of education. These issues have been dealt with in greater detail elsewhere in this volume.

Information, Education, Communication (IEC):

Interlinkages with Informatics and Telematics

The essence and essentials of the health care focus sharply on community participation. Without the active participation of the people in the planning and management of their own health care, it may not be possible to raise in any significant manner the status and standard of life. As such, the community itself becomes a major resource in developing effective and efficient health service. It is therefore axiomatic that due cognizance must be taken of the fact that individuals, families and community constitute the most important health manpower resource. In order to play a meaningful role in health-related activities, individuals and communities must be well-informed. Information, therefore, is an essential prerequisite, and its dissemination through different modes of communication using modern technologies must be considered as an essential input.

Although in theory the reach of print and electronic media is quite large, but its effective coverage still remains less than optimal. Therefore, the communication strategies must take into account the new potential of informatics and telematics, while keeping in mind the development of alternate strategies for those segments of the population who are illiterate or semi literate, and who may have no access to radio/TV sets at the household

or even at the village level. Nevertheless, it must be stated that decision making and health care management depend on reliable, relevant and timely information. Development of efficient health management information systems at the district level can be facilitated by appropriate informatics policies and applications which must be compatible with the prevailing conditions and the resources available. It is expected that over the next few years rapid growth in the power of computers and a sharp decline in their prices would accelerate the development of informatics technology and informatics system. Considering the time it takes to train personnel to design and operate the health systems, it is essential to orient the teaching of health informatics to future applications, equipment and methods through integrated research and education. Finally, these technologies would also play an effective role in the design and implementation of continuing education programmes in health sciences, aimed at upgrading the knowledge and skills of the health care providers belonging to all categories of professionals and para-professionals.

Contraceptive Research: Biomedical and Behavioural

In order to seek realistic solutions to reproductive health problems with major focus on population control, a strong national research capacity is mandatory. Over the last two decades, self-reliance in the reproductive research has culminated in the development of 'Centchroman', a weekly pill for female contraception developed at the Central Drug Research Institute (CDRI), Lucknow. It has now been marketed and the data generated so far indicate a low incidence of side effects with a high degree of therapeutic effectiveness. The Indian scientists are also making considerable progress in the use of immuno-logical approaches for fertility regulation. While a vaccine for the regulation of female fertility has reached the stage of Phase-II clinical trials, the vaccine for male fertility regulation is now being subjected to Phase-I studies. Whether these would be the prototypes of the final vaccines, which may emerge over the next decade, or whether the present formulations may by themselves become the final products, shall only be known through further research.

The network of contraceptive testing units, located in several medical colleges in the country, has been established. Some of these have now been upgraded with enlarged scope and functions of research in human reproduction. Thus, the technology development continues to be recognized as a critical element for improving the quality and effective out-reach of the family planning programme. The country has built up the requisite research capability in biomedical sciences including bio-technology, and can be rightly proud of having the leading research scientists, recognized both nationally and internationally. However, it must be remembered that the development of new contraceptives is both time-consuming and costly. It is estimated that it may take five to seven years before the vaccine for female fertility regulation becomes available in India (or for that matter in the world), while the vaccine for the male fertility regulation may become available only during the early years of the next century. Therefore, although scientific research must be encouraged and efforts intensified, it may also be realistically accepted that any impact of these developments on population growth is likely to be at, or following, the turn of the century.

In contrast, research efforts in the field of social and behavioural sciences, as related to reproductive health and family planning, need considerable intensification. Most of the studies done in the field of social sciences have concentrated on knowledge, attitude and practice of family planning as prevailing in different segments of the community. Not much attention seems to have been given to the operational aspects. Much therefore needs to be done in the area of problem based research for evolving cost-effective

intervention(s) and solving the problems of service delivery at the farthest point of its reach. The questions such as the existing gap between the availability and accessibility of family planning methods, and the factors which determine their choices in terms of cost, distance, time effectiveness and safety need to be answered scientifically and rationally. More importantly, the findings of these studies must be used in programme development through confidence-building amongst the programme managers.

Health Planning and Population Stabilization:

Agenda for the Nineties and Beyond

The Eighth Five Year Plan, launched on 1 April 1992 recognizes population challenge as one of the six priority objectives for a concerted and cohesive intervention. Along with universalization of elementary education, provision of safe drinking water and primary health care facilities including immunization, investments in social sector assume the key role for human development. It is therefore notable that not only has the containment of population growth been brought to the forefront in our planning process, but also that for the first time the whole framework of social determinants, with proven interactive interdependence, has been put together on the national agenda for action. In tandem are other priority objectives including generation of adequate employment and achievement of self-sufficiency in food through growth and diversification of agriculture. This constitutes a holistic developmental effort with obvious ramifications in the social sector, including health, nutrition and family welfare.

Epilogue

Scientists must share the precepts of Francis Bacon in acknowledging the fact that the destiny of science was not only to enlarge man's knowledge but also to 'improve the life of men on earth'. At the same time, it must be blended with the wisdom of Bertrand Russell who struck a note of caution by stating 'for it is not enough to recognize that all our knowledge is, in a greater or lesser degree, uncertain and vague; it is necessary, at the same time to learn to act upon the best hypothesis without dogmatically believing it'. Mind must be liberated from the old dogma, so as to be in a position to seek truth remembering the dictum of the economist Keynes, 'the difficulty lies, not in the new ideas, but in escaping the old ones, which ramify into every coiner of our minds'.

Throughout the history of mankind, there has been a continuous struggle to improve the quality of life. As Lesher and Howick (1966) state:

'Eight hundred life spans can bridge more than 50,000 years. But of these 800 people, 650 spent their lives in caves or worse; only the last 70 had any truly effective means of communication with one another, only the last 6 ever saw a printed word or had any real means of measuring heat or cold, only the last 4 could measure time with any precision; only the last 2 used an electric motor; and the vast majority of the items that make up our material world were developed within the life span of the eight-hundredth person. Science has continued to march ahead since this was written about a quarter century ago. This is as it should be because "scientific activity is the only one which is obviously and undoubtedly cumulative and progressive".¹

Indeed, the immense power of the role of science and technology in not only preserving but shaping the destiny of humankind is reflected in the words of the late Prime Minister of India, Pandit Jawaharlal Nehru: 'It is science alone that can solve the problems of hunger and poverty, insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people. . . . Who indeed could afford to ignore science today? At every turn we have to seek its aid. . . . The future belongs to science and

to those who make their friends with science'.

*First published in *Science and Quality of Life*, Qasim, S.Z. (ed.), New Delhi: The Offsetters, 1993, pp. 15-32.

¹Rao, S.K.R., *Encyclopedia of Indian Medicine*, Vol. II, Rao, S.K.R. (ed), Popular Prakashan, Bombay, 1987, 103-104.

¹Sloan, F.A., Steinwald, B., *Jour. Law. Econ.* 1980, 23, 81.

¹ Sarton, G.A.L., *The History of Science and the History of Civilisation*, Dover, New York, 1930, 73.

Relevance and Excellence in Biomedical Research*

Preamble

There is a growing concern regarding a perceived decline in the quality of research in biomedical sciences; a similar concern may be shared by scientists belonging to diverse disciplines. To a certain extent, it is a healthy sign when there is an attempt at looking inwards for self-criticism, the objective presumably being to identify lacunae and deficiencies, if any, and to take remedial measures before it is too late. If used excessively, such a tool can build up morbid fears due to self-condemnation. As for most things in science, the essential prerequisite is rational critique of the prevailing situation in biomedical research. Indeed, the word rational itself has strong scientific connotations, as it is derived from the Greek word 'ratio'. It is generally understood to indicate 'the mean between the extremes'. The rational approach therefore in the context of present theme focused on excellence and accountability in science must also meticulously avoid the extremes of self-glorification on the one hand and self-condemnation on the other. By implication, we must also observe the necessary caution of not accepting *prima facie* the unsubstantiated claim of an all round decline in the quality of research, nor should we succumb to the temptation of endorsing the anecdotal, mostly self-glorifying, narration of high quality scientific achievements in the country in the recent past.

Parametric Reference Framework

Unlike pure sciences, medical science has always been considered to be a blend of art, science and philosophy. Indeed, the science of Ayurveda carries with it the connotations of both human endeavour as well as divine enlightenment. Nevertheless, within this semantic constraint, it is still possible to grasp the basic definition of science in order to recognize the content and quality of scientific research within the sphere of biomedicine. It seems that it was around the beginning of the seventeenth century that the word *science* appeared for the first time in the usage of English language. At that time it was considered synonymous with *knowledge*. Subsequently it acquired the connotation of *accurate* and *systematized* knowledge. Still later, valid experiment as the source of scientific knowledge assumed critical importance. This was the age of Copernican revolution. In a way, there is a discernible commonness between Copernicus's observations regarding the planetary motions in the macro cosmos, and William Harvey's demonstration of the circulation of blood within the human organism. Both focused on motion, a *circular motion*, and more importantly both demonstrated the need of rigorous control of experimental observations so as to draw meaningful conclusions in relation to spatial and temporal dimensions of such movements, whether of planets or of plasma. William Harvey's lecture at the Royal College of Physicians, London on 17 April 1616 not only revolutionized the history and methods of scientific research in medicine, but also rejuvenated the mental attitude of men towards seeking scientific truth at a time when their minds had been bonded for several centuries in slavish submission to what Aristotle had taught and generations of medical teachers had followed. The view propounded by Harvey was so revolutionary, as was that of Copernicus regarding astronomy, that its publication was delayed for twelve years and even then the inferences were only partly accepted and that, too, with considerable scepticism. Thus, both biomedical science as well as science in general require generation of new and accurate knowledge, irrespective of the process through which such knowledge is derived. Indeed,

it is as much of science if it is derived by deductive logic as in Euclid or if developed through the use of precise observation and rigorous experimental condition as demonstrated by Harvey and Bacon. There is a remarkable synthesis reflected in the expression of J.B.S. Haldane who, following intensive training in western philosophy and natural sciences, also had first-hand exposure to logic and science in India. As is well known, during his later years, he became an Indian citizen. According to Haldane, the definition of science must include the following dimensions:

First, it is the free activity of man's divine faculties of reason and imagination. Secondly, it is the answer of the few to the demands of the many for wealth, comfort and victory. Third, it is man's gradual conquest, first of space and time, then of matter as such, then of his own body and those of other living beings, and finally the subjugation of the dark and evil elements in his own soul.

It is worth noting the key references by Haldane to 'man's divine faculties', and his gradual conquest of 'his own body and those of other living beings', thus establishing the conceptual proximity to 'human and divine' in Ayurveda.

Warren Weaver's descriptive narration provides the requisite complementarity to J.B.S. Haldane's views:

Science is not technology, it is not gadgetry, it is not some mysterious cult, it is not a great mechanical monster. Science is an adventure of the human spirit. It is essentially an artistic enterprise, stimulated largely by curiosity, served largely by disciplined imagination, and based largely on faith in the reasonableness, order and beauty of the universe of which man is part.

It is obvious, therefore, that not only in biomedical sciences but also in science in general, there must be a blend of diverse but inter-related elements such as a genuine spirit of enquiry, an unsuppressed urge for the adventure of human spirit, the acute powers of observation, and the rigorous discipline of mind. Nevertheless, there are two additional critical dimensions of biomedical scientific research. First its *relevance* to the contemporary needs of the society. Secondly, its conformation to the highest principles of *biomedical ethics* especially when such research involves human experimentation as in clinical trials of drugs and devices.

Biomedical Research: Contemporary Issues

The national investments in biomedical research have been multiplied manifold during the last decade. The Indian Council of Medical Research (ICMR) is the nodal agency for recognizing and prioritizing the research needs of the country. In addition, other sources of funding include the departments of Science and Technology, Biotechnology, etc. It is essential that there must be transparency as well as accountability not only to the Government of India which provides the total funds for biomedical research, but also to the medical fraternity as well as to the public. The funding from the government to support medical research through the ICMR (Fig.) went up from Rs. forty crore during the Sixth Five Year Plan to Rs. 150 crore during the Seventh Five Year Plan, reaching the present figure of Rs. 168.20 crore during the Eighth Plan period (1992-97). The justification for the increase in final allocation of almost 375% between the Sixth and the Seventh Plan periods was due to the projected need for the establishment of centres of biomedical research expected to deal with area and community-specific problems. For example, it was considered essential to develop centres for high altitude research and for health-related issues of tribal populations. A review of the progress made thus far to assess the sum total of achievements both in terms of growth and development of such centres but more importantly, the research output from these centres including its quality

and relevance in terms of originally proposed objectives, seems most timely.

Furthermore, a breakdown of the funding of Rs. 150 crore during the Seventh Five Year Plan indicates that Rs. fifty crore were from the financial outlays of the Department of Family

ICMR: FINANCIAL ALLOCATIONS

Welfare while Rs. 100 crore were from that of the Department of Health. Thus there was a major emphasis on research in complex issues relating the population dynamics, sexual behaviour, reproductive health of women, health systems research aimed at development of models that may ensure improvement in the quality and outreach of services, in addition to laboratory and clinical research aimed at either improving the safety and efficacy of the currently available methods of fertility regulation, or developing new approaches for this purpose. Critical yardstick, therefore, must be the relevant inputs from the ICMR to the National Family Welfare Programme.

Do the results achieved thus far measure up to the national expectations? What is the process of in-house continuing monitoring and evaluation? How many new products or devices developed through indigenous research effort generated by the ICMR have been introduced in the national programme?

Social Audit: Need and Rationale

The ICMR supports research in family welfare either through its own institutions such as Institute for Research in Reproduction, Bombay or through a network of special centres established in a number of medical colleges in the country. It also provides financial support for research projects submitted by individual investigators, and ensures a careful scrutiny with regard to the experimental design, investigational and statistical methodology, besides ensuring the availability of institutional ethical clearance if the study involves human experimentation.

It is expected that as a result of such huge financial inputs, if there are resultant advances in technological development, the rights of the public sector shall be fully protected. If such an approach is considered axiomatic, then it becomes obligatory to ensure that the scientists leading such research and development in national institutions where state-of-the-art techniques such as in-vitro fertilization are developed and perfected through the funding and support by the government, do not forsake their continued commitment in the guise of voluntary retirement, subsequently establishing similar services in the private sector only to derive personal financial benefit. This may meet with the requirements of administrative norms but does it come up to the requirements in terms of ethical propriety and the commitment of the scientist(s) towards the furtherance of scientific research and development in the country? How do we ensure social equity in the distribution of benefits of such state-funded research amongst the deprived and underserved population groups?

This highlights the need for absolute commitment and devotion on the part of those who are entrusted with the responsibility either to direct or to manage biomedical research. How far should the managers of biomedical research get involved in the deliberations and decisions of international organizations which may have competing interests? How do we

avoid the possible conflict of interests in such a vital area as population research? Should high-level functionaries be permitted to accept financial remuneration from international organizations on a contractual basis while they are working full time within the country? Should it be considered ethical and justifiable to permit a dual administrative control of such highly placed research managers to the extent that such an official is permitted to be 'administratively responsible' to an organization outside the country?

The issue of accountability therefore acquires new dimensions when the very basis of critical decision making in terms of exercise of options in the selection of drugs or devices for national health programmes in the country is even remotely seen to be directly or indirectly influenced by a conflict of interests. Let these statements not be misunderstood in the sense that any national interest has actually been sacrificed due to considerations other than purely scientific. My specific purpose is to generate the necessary awareness so as to avoid any situation in future where even remotely such an issue can be raised. Public and consumer groups have a basic right to information, and transparency regarding the process of decision making must be accepted as an ethical norm.

Excellence in Biomedical Research: Landmarks

Irrespective of the source of funding and the nodal agency involved, we must be proud of the fact that Indian research investigators have developed the first-ever non-steroidal contraceptive for female fertility regulation, starting with the laboratory synthesis of the compound, taking it through the various phases of research and development including all aspects of acute, sub-acute and animal toxicology, and finally phased clinical trials, culminating in the marketing permission from the drug regulatory agency in the country. Centchroman is such a compound, developed by the Central Drugs Research Institute, Lucknow entirely through indigenous efforts.

This is the first and the only non-steroidal contraceptive which has been granted marketing permission. Uniqueness of this compound is in its additional action as a post-coital agent. Thus it can be taken both as a morning-after pill or as is presently recommended, as a once-a-work pill instead of a continuous administration through twenty-one days in a menstrual cycle of twenty-eight days, as is the case with the presently available steroidal contraceptives. This need-oriented research has provided a product which has the advantage of less frequent administration, with additional safety and greater economy.

Post-marketing surveillance indicate that about 40,000 subjects have been covered for over 200,000 months of use with a Pearl Index ranging from 0.08-0.31. This indicates an even higher efficacy than what was earlier demonstrated during the clinical trials. Finally, the Annual Report (1992-3) of the CDRI, Lucknow highlights that Centchroman has been released to a pharmaceutical company in Dhaka, Bangladesh for marketing of this novel contraceptive in that country. Furthermore, the CDRI has also entered into a confidentiality agreement with a South Korean firm for sharing of technical information on this compound. The flow of royalties to India on account of Centchroman is likely to increase manifold in the near future.

Ethics of Biomedical Research and Public Accountability

In his *Republic*, Plato asked the question: 'Can virtue be taught?' The same applies to ethics in biomedical research. Can ethics be learnt? Equally importantly, can compromises be unlearnt? A recent report of the Royal College of Physicians, London

provides a critical analysis and highlights 'badly planned, poorly designed research that causes inconvenience to the subjects and may carry risks without producing useful or valid results is unethical'. A more formal code of ethics for the guidance of medical research investigators is enshrined in the Declaration of Helsinki, adopted in 1964. A revised version, Helsinki II was produced in 1975. The Council for International Organizations of Medical Sciences (CIOMS) along with the World Health Organization have provided periodic reviews on this subject. A further set of guidelines has been made available by CIOMS in 1982,¹ with subsequent updating in 1983.² All these efforts in essence recognize that an enthusiastic and not necessarily unethical investigator may not practice the requisite self-regulation.

An important issue is highlighted in the Helsinki Declaration wherein it is clearly stated that 'clinical research should be conducted only by scientifically qualified persons and under the supervision of a qualified medical man'. The critical element of this statement recognizes the need of the overall supervision to be exercised by a qualified medical man whenever research involves human subjects. Thus, it would be clearly unethical if a non-medically qualified scientist guides or supervises clinical research. Finally, there seems to be a general international agreement that a scientist responsible for the research and development of a compound in the laboratory should not become a part of the team of clinical investigators who are responsible for the studies to establish the safety and efficacy of the compound. This is to avoid any situation of 'conflict of interest'. Unfortunately, even these essential guidelines are not followed for reasons not made entirely clear, but at the same time, not difficult to surmise.

In addition to these general safeguards, there are strict guidelines for different types of animal toxicology studies that must precede the first human administration of any new drug or compound. These have been recently restated for drugs and devices intended to be used for fertility regulation (WHO, 1989).³ By definition, any change in the formulation of a new use of the previously known drug would lead to its categorization as a new drug. Finally, under the rules, no new drug can be marketed in India without limited clinical trials in the country. This is so because of possibly different pharmacogenetic mechanism affecting the biotransformation of the administered compound, and therefore its bioavailability and pharmacodynamics (WHO, 1989). Studies of metabolic effects of contraceptive steroids in different population subsets can be most informative (Bajaj et al., 1989).¹ There is therefore an urgent need of further refining these international guidelines with a view to enhancing their applicability to regional and national requirements.

Measures to Strengthen Biomedical Research

Strengthening of biomedical research must not only aim at improving the quality and content of such research, but more importantly, must also ensure its social relevance and a strict compliance of the highest standards of biomedical ethics. Incentives and recognition must be provided only to those scientists who show a personal commitment to the national priority objectives in health and family welfare, and serve as role models embodying highest principles of professional integrity and biomedical ethics.

Although several measures have been suggested in the past, a relatively under-emphasized aspect relates to the training of young scientists in the essentials of research methodology. In contrast to medical education which has been critically reviewed from time to time by several expert committees constituted by the Government of India, biomedical research has seldom been subjected to the same degree of critical and careful examination at any point in time. Even the inter-connection with medical

education seems to be rather vague and imprecise. Is the present medical curriculum adequate to prepare a medical graduate for dual functions of medical practice and biomedical research? Is there a need for additional training in research methodology? Or alternatively, should there be a different sort of training for those who wish to pursue a career in biomedical research? Should there be a structured exposure to research methodology during the period of internship? Can a young graduate be initiated into health systems research at the field level during this period?

In addition to these questions which deal with the inter-linkages between medical education and research, there are other basic issues that need to be resolved. For example, how many medical research workers do we need in the country? Which are the types of institutions where they can receive appropriate training for this purpose? Should there be a rigid compartmentalization between basic research, clinical research and operational research? Does research in medical education need an entirely different type of training than what is generally required for biomedical research? It is suggested that sooner we resolve these issues, the better would it be for the quality and content of medical research in the country.

A word of caution may however be in order. It is likely that the distinction between basic and clinical sciences shall gradually disappear as we move further into the twenty-first century. It is only then that we will realize the truth of the basic proposition stated by Aristotle:

The natural scientist has to investigate also the basic causes of health and disease, which cannot occur in non-vital things. That is the reason why most of the natural scientists finally turn towards medical research, while the more advanced and far-sighted physicians will utilize the principles of natural sciences.

Epilogue

An overview of excellence and relevance of biomedical research has to be somewhat subjective and must reflect upon more than three decades of personal involvement in the pursuit of knowledge and in collaborating with several scientists, both young and old, belonging to basic as well as clinical sciences. As Goethe said, 'the eyes do not see what the mind does not know'. Simply stated, 'we are prone to see what lies behind our eyes rather than what appears in front'.

Excellence and relevance of biomedical research can be enhanced several orders of magnitude if we avoid the most frequently observed corrupting factors, so well enunciated by Roger Bacon:

Since the days of Revelation, in fact, the same four corrupting errors have been made over and over again: submission to faulty and unworthy authority; submission to what it was customary to believe; submission to the prejudice of the mob; and, worst of all, concealment of ignorance by a false show of unheld knowledge, for no better reason than pride.

¹Council for International Organizations of Medical Sciences. *Proposed international guidelines for biomedical research involving human subjects*. Geneva, CIOMS, 1982.

²Council for International Organizations of Medical Sciences. *Safety requirements*

for the first use of new drugs and diagnostic agents in man. Geneva, CIOMS, 1983.

³World Health Organization Guidelines. In: *Safety requirements for contraceptive steroids*, F. Michal (ed.), Cambridge University Press, 1989, pp. 432-54.

¹Bajaj, J.S., Rajalakshmi, M., Madan, R., Metabolic effects of contraceptive steroids. In: *Safety requirements for contraceptive steroids*, Michal, F. (ed.), Cambridge University Press, pp. 360-84.

The Spectre and Spectrum of Science and Technology in India

Antiquity and Continuity*

Phenomenology

In the philosophy of Immanuel Kant, an object or occurrence presented to our observation either in the external world or in the human mind, in contrast to that object or occurrence as it is in itself, forms the basis of phenomenon. It is in this context that I wish to define the broad parameters of my presentation. I have chosen the word spectre fully realizing the intrinsic duality that the word conveys. While on the one hand it may indicate an apparition or an appearance, it may, on the other hand, also reflect a visible spirit, generally with a negative connotation of a ghost that keeps on haunting over a period of time. In effect, the spectre projects an image of unreality; equally important, it may indicate a ghost that cannot be exorcised. These implied meanings are also a reflection on the attitude of some of the present day scientists who view, through intellectual blinkers, the Vedic concepts of science.

Spectrum is an extension of the same concept but in a more positive manner such as its usage in the term 'ideological spectrum', which includes a sense of continuum. As a pure scientific term, spectrum provides a record of the distribution of the phases of a radiated wave cycle or of the intensity of radiation when some physical property such as frequency, mass or energy, is allowed to vary. In this word, you may also discern a link with Sir C.V. Raman's contributions to contemporary science. A romanticist may however conjure a hue of the colours of a rainbow. Is it pure science or is it also romance when a beam of light undergoes dispersion on passage through a prism, and constitutes a spectrum? The question perhaps lies in the realm of the thin wedge between physics and metaphysics. So also has science over the millennia.

Within the meanings implicit and explicit in the words spectre and spectrum, several shades and grades of attitudes which the scientists and intellectuals may have towards the growth and development of science and technology will possibly discern not only in the pre-historic and proto-historic periods, but also within the present day context.

However, this backdrop to my presentation brings out the dichotomy of approach that I perhaps share with several others. At the end of the presentation you may be justified in calling it a schizophrenic scientific profile. If indeed that would be the judgment, I shall be most delighted because I am certain to be in a distinguished company.

I

BIO-MEDICAL SCIENCES

Rather than transcending across a wide canvas of science and technology, which may be beyond my competence, let me focus on bio-medical sciences for the simple reason that this is an area with which I can closely empathize with. Finally, I shall seek the security of the cocoon of my own speciality, i.e. diabetology, using it as a case study or a prototype to bring out some final conclusions which however may have general

applicability. This may appear to be the most unconventional approach to them subject. If indeed so, I seek your indulgence.

Having embarked on such a perilous course, let me also use a similar unorthodox strategy. Rather than compartmentalizing the knowledge of science through the possible origin into mathematics, astronomy, physics, chemistry and biology, I intend to employ a problem-based approach, thus demolishing the barriers which effectively block our view of the functionality of science at different points of time in the history of mankind.

Let me illustrate this approach. One can learn about radio through diadetic lectures, courses of instruction, or text books dealing with such diverse areas as frequency and form of radio waves, conductors, bands, valves and a basic circuitry. With all this knowledge at command, when confronted with a radio set which does not function, a radio engineer may not be able to diagnose the fault, let alone repair it to make it functional. A better approach, therefore, is problem-based learning wherein a non-functional radio set poses a problem to a learner who then dismantles it, tests each part by acquisition of knowledge dealing with individual parts, understands the interplay of factors such as relay, transmission and reception, and eventually localizes the fault, remedies it, and succeeds in making the radio set functional once again. The modern educational psychology is veering around to the fact that problem-based learning provides the necessary intellectual stimulus, relates it to the solution of the problems, thereby reinforcing learning through performance.

I am of the view that the problems of health and disease, life and death, pleasure and pain, preservation of self and the species, etc., posed serious intellectual challenge to man who first walked on this planet. All this confronted his intellectual abilities. He tried to seek answers through his attempts to comprehend the structure and function of human body either directly or through an understanding of the plants and animals which constituted his immediate environment. This seems to be a logical reason why out of 7,108 documents listed in Sanskrit from the eighth to the nineteenth century, 4,256, i.e., about sixty per cent cover biological sciences. More importantly, of the latter, 96.5 per cent pertain to medicine, and only 3.5 per cent to other areas of biology. This must be so because self survival took precedence over everything else. The present day scientific literature shows a complete reversal of the trend with publications in the field of medicine occupying the lowest rung of the scientific ladder both in terms of quantity as well quality.

The view that I am propounding, perhaps for the first time, relates to the prioritization of life's problems and seeking relevant solutions through acquisition and application of knowledge. This is in direct contrast to the prevailing view propounded by pure scientists who consider an intelligent rational man at the dawn of history asking questions pertaining to the nature of the non-living material such as water, soil, minerals, and even air, thus laying the foundations for the development of science of chemistry.¹ Subsequently, the questions may have related to the physical phenomena that occur at periodic intervals; these include heat, sound and light as exemplified by thunder and lightning. The attempts to seek their answers contributed to the development of physics. Similarly, fascinated by the periodicity and regularity of the rising of the sun and the moon, interest in astronomy was aroused. Lastly, and only lastly, the questions may have related to the living objects, contributing to the development of biology. This makes good didactic sense but defies the rationale of prioritizing the most basic need, namely survival of self and of the species. As health and diseases are important for self-survival, so is the process of reproduction for the survival of the species. It is only with such a perspective that we can understand a basic interest in sexual reproduction and availability of

comprehensive treatises dealing with sexual behaviour. My view also finds support, although in a strikingly different context, in the monograph on the subject *The Selfish Gene*.¹

Historical Perspectives

As I have argued against the compartmentalization of science on the basis of natural phenomena subjected to, and governed by, laws of nature which subsequently led to the development of physics, chemistry, and astronomy as separate branches, let me also argue, albeit less forcefully, against using watersheds of periods of history for the purpose of tracing the growth and development of bio-medical sciences rather than epidemiology and demography which relate to the study of social and medical aspects of health and disease. Conventionally, the pre-Vedic period (10,000 BC to 1,500 BC) which combines the pre-historic and proto-historic periods, is described as the age of ignorance or darkness where disease processes were ascribed to demons and evil spirits and remedial action consisted of offerings to Gods, incantations, magic, and exorcism. The dawn of reason during the Vedic period (1,500 BC to 500 BC) provided rational approaches to the understanding of internal causes of disease, relating these to the humoral theory of *tridosha* including *vatta*, *kapha*, and *pitta*. This period also witnessed the early development of rudimentary knowledge of human anatomy and physiology. The most progressive development during this period was the recognition of certain plants which had medicinal value, and therefore could be used for the treatment of disease processes.

Athurvaveda of the Vedic period directly led to the development of Ayurveda in the post-Vedic period (500 BC to AD 600). I shall deal with this period in detail subsequently. The early mediaeval (AD 600 to AD 1,300) and the late mediaeval periods (1,300 AD to 1,600 AD) broadly encompassed Alchemy and Tantras with successful attempts at the compilation and systematization of knowledge accumulated thus far. There were no major milestones on the road to progress of bio-medical sciences. Indeed, a degree of stagnation possibly set in the early mediaeval period.

Medicine in the Mediaeval Period

Although there is some evidence supporting the influence of Indo-Greek interaction on the evolution and development of medical philosophy and practice, yet a firm and final proof needs to be established. The evidence linking the concept of pneumatic physiology as presented in Hippocratic Treatise *On Winds* (4th-5th century BC) with the discourse on *prana* as detailed in the nature and action of breath in the human body (*Charak Samhita*) the similarity may be more apparent than real. The application of the concept of *prana* resulted in yogic practice of *pranayama* which in its theory and practice may relate to breathing exercises as a part of the therapeutic armamentarium of physiotherapists.

It was during the mediaeval period that exchange of information about medicine and surgery was encouraged. Practitioners of Indian medicine were invited to Baghdad and the major compendia such as *Sushruta Samhita* were translated into Arabic under the title *Kitab-Shawasoom Al-Hind*. The migration of Muslims into India introduced Greco-Arabian medicine in the country. Subsequently, as the Mughals started ruling over India, an exchange of learning took place between the practitioners of Greco-Arabian medicine who were brought to India by the Mughal emperors, and the local medical practitioners who were equally keen to learn about other systems of medicine. There are references by Ziauddin Barani¹ to several renowned Hakims who received recognition at the court of Feroz Shah Tughlaq. These Hakims came from different parts of Arabia including Iraq, Syria, and Yemen.

There are two events of great import which constitute landmarks in the growth and development of medical practice and health care in India. First, the Muslim rulers placed a major emphasis on the establishment of hospitals wherein physicians of both Ayurvedic and Unani systems of medicine were employed; during the rule of Mohammed-Bin-Tughlaq, there were about seventy hospitals in Delhi and 1200 physicians were receiving salaries from the Royal Court.¹ A type of social welfare system was operating wherein not only medicines but also food and drinks were supplied to the indigent patients who came to these hospitals to seek treatment for their ailments. In order to ensure permanency of such an arrangement, the endowment of several villages with fertile land and extensive cultivation was made to these hospitals which also continued to receive Royal grant to support the salaries of physicians working as State employees. There is historic evidence to indicate similar institutionalization of health care in Kashmir under the rule of Sultan Zain-ul-Abidin (AD 1422-72), as well as in Deccan under Alaaddin, the Second. The second milestone of the mediaeval period relates to the development, although in a rudimentary manner, of an integrated system of medicine which in retrospect may also be called National System of Medicine. During the reign of Sikandar Shah Lodhi (AD 1499-1528), a book on medicine titled *Madan-ul-Shifa Sikandar Shahi* was compiled. This compilation is a synthesis of knowledge derived from several sources dealing with Ayurveda; the first chapter deals with the therapeutic principles underlying Ayurvedic system, the second describes the structure of the human body and the third chapter deals with the diagnosis and management of a number of diseases. This practice of drawing freely on two different systems of medicine was extensively followed for almost 100 years and several authenticated works of this period are available for review. The well-known historian, Muhammad Qasim Firishta compiled a book towards the end of the 16th century (AD -1590) the reason for so doing as stated by the author are extremely relevant to some of our present day concepts. Firishta¹ in a third person account states:

‘After the perusal of the books on the subject commonly used in Iran, Turkey and Arabia, his mind turned towards the study of the works of the Indian physicians. He found their theories as well as their practice of medical science extremely well founded. He, therefore, thought it necessary to compile a book dealing with their medical principles and their application and with their system of treatment of diseases which at the outset appeared to be strange. For, there were many Muslim friends living in this country who had no thorough knowledge of the ever-changing climate of this country nor were they well aware of the system of treatment followed by Indian physicians.’

In this book therefore he mentioned the properties of drugs and of the victuals and their names which were difficult to pronounce. Thereby he also wanted to leave behind something by which he might be remembered:

It is in short a work which may remind of me

because the life does not continue for ever.

There is a remarkable display of the awareness of environmental influences on the management of diseases and the necessity of prescribing the dosage of drugs depending upon the ethnicity of the patient. This, to my mind, is the first reference to pharmacogenetics which implies that the metabolism and bio-transformation of any drug in the human body may vary depending upon the genetic regulation of enzymes involved in the bio-degradation of administered drug.

With the advent of Sultanate period, there was a further impetus, both in the synthesis of different medical streams, as well as in the strengthening of secular and welfare basis of

medical and health care. Babur's personal physician was Yusuf-bin-Muhammad-bin-Yusuf who made a special study of those aspects of Indian system of medicine which dealt with hygiene and public health, therapeutic rationale of Ayurveda, and methods of diagnosis and treatment. One of his books reflects his secular approach; the book is entitled *Fawaid-ul-Akhyar* which literally means 'benefits of the best'. He placed major emphasis on health promotion as is reflected in his poem 'Qasida fi Hifz-ul-Sehat' which literally translated, means 'an ode to health promotion'.¹ Akbar, with a secular outlook and as a patron of scholarship, honoured physicians; there is evidence to indicate that twenty-nine physicians, both Hindus and Muslims, were the beneficiaries of Royal munificence and received financial and other rewards.²

Thus, Greco-Arabian medicine was modified and adapted to local needs under the influence of traditional Indian medicine; in addition, it incorporated a number of drugs especially of plant origin, in its own materia medica. It is equally important to recognize a reciprocity of such an arrangement as reflected in *Bhava Prakasha*, wherein several medicines of Unani system were incorporated in the Indian system. Some of these were accepted home remedies, e.g., *ajwaine*, *afyun* (opium), *rhubarb*, etc. Thus, the cross-fertilisation of Ayurveda with Unani system, which was brought into India by Moghuls, and patronised by the Royal households, demonstrated the possibility of developing an integrated system of medicine.

Surgery through the Ages

The pride and place of Indian medicine was given to the development of surgery and its sub-specialities by achieving a high level of efficiency. The Sanskrit word for surgery is *salya* which literally means a spear or a weapon with an arrow head made of iron. However its usage in the Vedic and post-Vedic period was related to any extraneous object lodged in the body and causing pain. It is obvious that practitioners of such a discipline must have provided relief and solace to soldiers on the battlefield. It is in this context that the earliest reference to surgery in India is to be found in *Rig Veda* wherein Asvins appear on the battlefield and provide appropriate prosthesis (artificial limbs made of iron) to Vishpala who lost his legs on the battlefield. The Buddhist text, *Mahavagga*, describes successful performance of cranial surgery by Jivaka who was personal physician to the Buddha.

Sushruta Samhita^{1, 2} gives surgery (*salya-tantra*) a most prominent place amongst the then prevalent branches of medicine and classifies surgical operations into excision (*chhedna*), incision (*bhedana*), puncturing (*vyadhana*), probing (*eshana*) and scarification (*lekhana*). Procedures such as cautery with *agni* and specialised caustic cauterisation (*kshara*) are described in detail. Sushruta extolls the virtues of surgery by stating that this branch of medicine can cure cases which are otherwise found incurable by drugs. The preparation of the patient for surgery, techniques of operations and the postoperative care of the patient are described at considerable length in *Sushruta Samhita*.

Practical instruction through demonstrations including dissection of a dead body was considered essential in the training of a surgeon. Besides familiarizing students with the structural details of the human body, emphasis was also placed in ensuring the manual dexterity of the students in terms of their ability to perform basic surgical procedures. Suturing was learnt on pieces of cloth, skin or hide. For attaining proficiency in tying ligatures and applying bandages, appropriate models and dummies were used. Thus during the period of training, emphasis was placed on skills to ensure appropriate handling of instruments such as knives, scissors, lancets, trocars, hooks, tubes, pincers and forceps. A detailed classification of surgical instruments with illustrations is provided

in *Sushruta Samhita*.

Commensurate with such advanced surgical techniques, there is no corresponding description of the methods of relieving pain during surgery. There is no description of what may be construed as local or general anaesthesia. However, there are references to the use of strong wine prior to the operation in the hope that the patient will be intoxicated to become insensible to the pain inflicted by any instrument. Later, it seems that inhalation of fume of burning hemp or similar substance(s) came into vogue. There are references to inhalation of a drug called *sammohini* prior to cranial surgery, and post-operative use of another drug called *sanjivini* also administered by inhalation, to revive the patient.

Sushruta Samhita also describes in detail, with illustrative diagrams, a large number of surgical instruments which were made of steel. Using such instruments, difficult operations were undertaken. These included amputation, laparotomy, repair of hernias, removal of haemorrhoids and treatment of fractures. However, the two operative procedures which subsequently brought widespread fame to Indian surgery include crouching for the treatment of cataract and rhinoplasty. Indeed, the speciality of plastic surgery was so well developed with procedures for making skin flaps, repair and construction of noses, repair of cleft lip and possibly palate, and repair of mutilated or traumatized ear or earlobe, being widely practiced with considerable success.

Some of the surgical instruments described by Sushruta have in fact been used by modern surgeons although in extremely modified forms. There is evidence that the operation of crouching for cataract found a widespread use in the later period and was practiced by surgeons in ancient Greece and Egypt. Similarly, technique of rhinoplasty was learnt through visits to India, later spreading the knowledge through Arabia and Persia to Egypt and even to parts of Europe.

Qualities of a Physician: Medical Ethics

Charaka Samhita^{1,2} defines the desirable attributes in the potential candidate who wishes to enroll himself for learning Ayurveda, or the science of life:

‘The medical student must exhibit a calm and generous disposition, besides being virtuous and of a noble mind. He must be tolerant of others and exhibit patience and perseverance in his academic pursuits. Although of sharp intellect, he must be both rational and modest. He should possess a pleasant appearance and good looks, with a well-proportioned body which should be free from physical defects or any obvious diseases. Above all, he must be compassionate. He must exhibit deep interest in the art and science of healing. He must use his intelligence to discover facts about the disease and to understand the clinical significance of symptoms: clinical and applied research are obviously implied.* Such knowledge he must use not only for his own intellectual enrichment, but also for acquiring requisite skills in practical management; a concept of mission-oriented research.* He must be humble and loyal to his teachers and instructors. He should be free from any addictions, greed, arrogance and intolerance’.

As a part of initiation ceremony for being admitted to the group of students for learning the art of medicine, the new entrant received the exhortation to direct his efforts towards achieving success in all his professional undertakings (*karma-siddhi*), beside earning well (*artha-siddhi*), attaining recognition and celebrity status (*yasolabha*), and also heavenly abode after death (*pretya svargam*).

There is a lengthy and detailed discourse on the code of conduct expected of the medical

student aspiring to be a physician; it may be worthwhile to highlight some of the most relevant and critical guidelines worthy of a health care provider.

Perhaps we may state these as 'ten commandments' underlying the ancient code of medical ethics:

1. Thou shall never harbour feelings of ill-will towards your patient, irrespective of the provocation, even if it may involve risk to your life.

2. Thou shall never entertain thoughts of sexual misconduct, and thoughts of appropriating property that does not belong to you.

3. Thou shall not consume liquor, or commit a sin, nor (shall you) keep company with the wicked.

4. Thou shall not undertake the treatment of a woman when her husband or any other relative of hers is not present.

5. Thou shall not accept any gift presented by a woman patient without first ensuring that such a gift has been approved by her husband or guardian.

6. Thou shall not enter the house of your patient, until and unless you are so invited.

7. Thou shall not attend to anything other than the patient, or anything that does not directly relate to the wellbeing of the patient, following your entry into the house of the patient for counselling.

8. Thou shall not reveal to others what goes on in the household of the patient.

9. Thou shall not disclose a grave prognosis indicating a short life span of the patient, either to the patient or to the near relatives, as parting with such information may result in a shock.

10. Thou shall not show off your knowledge, even when you are learned and proficient and possess erudition and scholarship.

Irrespective of the system of medical science that we practice, there is no doubt that the general principles of medical ethics which have been so well enunciated as a part of our heritage and tradition, need to be emphasized and reiterated. It is only a harmonious blend of antiquity and continuity that can serve as an inspiration to our present and future generation of students, and hopefully to the teachers also.

Western System of Medicine

Foundations of the western system of medicine were laid in this country by the Portuguese with the establishment of a Royal Hospital in Goa in 1510. In 1703 education and instruction of local nationals was started in order to train them in the vocation of dressers and medical assistants. With the expanding health needs of the staff of the East India Company in some parts of the country, Indian Medical Service was started in 1740

and the physicians and surgeons from Great Britain who joined this service, were entrusted with the responsibility to train the local assistants, dressers, etc., who would constitute the subordinate medical services.¹

The nucleus of the first medical school for teaching western system of medicine was laid in the form of a Madrassa in Calcutta in 1822; this was followed by similar institutions in Bombay and Madras. A committee was constituted by Sir William Bentinck in 1833 to suggest the framework for the development of medical education in India. The principles enunciated by this committee were accepted, and incorporated in the curricula of the first three medical colleges established in Calcutta, Madras and Bombay.

It is ironical that 150 years later, with about 150 medical colleges in the country, we continue to accept the model of western system of medicine as perhaps the only one relevant to our needs. The western system has become synonymous with the modern system of medicine, the chronological order of development of homoeopathic system notwithstanding, with the result that homoeopathy is now considered as a part of traditional or Indian system of medicine in the country.

Basic Sciences as Applied to Medicine

There is considerable evidence to show that the Vedic Indians accumulated adequate knowledge of pharmacognosy, dealing with the morphology, physiology and therapeutic uses of a large number of plants. The *Agnipurana*, the *Arthasastra* and the *Brahatsamhita* have sections generally devoted to plant science, dealing with seeds, sowing, planting, germination, grafting and cutting. In addition, there was information regarding the characteristics and selection of proper soil, its manuring and the climatic conditions which favour the growth of plants. This knowledge provided a complementarity to the medical compendia of Charak, Sushruta, and Vagbhata which laid emphasis on the use of herbals for the treatment and cure of diseases.

Charak recognized a comprehensive knowledge of plants and their therapeutic uses as an essential part for the training of a physician. He observes that an expert physician is one who knows the herbs botanically, pharmacologically and in every other respect; in contrast a pharmacologist may know the use and action of herbs though he may not know their morphological characteristics. The term *bhesajavidya* is used in a work ascribed to Dhanvantari wherein the role and place of a separate science devoted to the study of plants and plant life with special reference to their medicinal properties is highlighted.

What is of considerable interest to the modern scientist is the fact that Vedic Indians made adequate reference to several characteristics of plant life such as growth, movement, sleep, waking, and disease including transmission of certain characters. It was thus recognized that the plants pass through stages of infancy, youth and age. They have periods of growth. They have cycles of sleep and waking, and they respond to touch, light and sound. An extreme example of sensitivity to touch is demonstrated by the plant *Mimosa pudica*, referred to as *lajjavati lata*. In essence, the plants were recognized as living organisms.

More than 2000 years later, Jagdish Chandra Bose studied the transmission of excitement in plants and animal tissues. Several of the tenets of Vedic philosophy of treating plants as living organisms found a resounding echo in his scientific observations. This is reflected in the concluding paragraph of the lecture-cum-experimental demonstration delivered by J.C. Bose on 10 May, 1901 at the Royal Institution in London:

I have shown you this evening autographic records of the history of stress and strain in the living and non-living. How similar are the writings! So similar indeed that you cannot tell one apart from the other. Among such phenomena, how can we draw a line of demarcation and say, here the physical ends, and there the physiological begins? Such absolute barriers do not exist.

It was when I came upon the mute witness of these self-made records, and perceived in them one phase of a pervading unity that bears within it all things ... it was then that I understood for the first time, a little of that message proclaimed by my ancestors on the banks of the Ganges thirty centuries ago: 'They who see but One, in all the changing manifoldness of this universe, unto them belongs Eternal Truth—unto none else, unto none else!'

The commonality of observations, set more than 2000 years apart, include the following:

- (i) Plants feel pain and hurt, and both pain and relief can be recorded;
- (ii) Plant cells expand and contract like the heart in man and animal;
- (iii) Plants have the power of responding to touch, light and sound;and

(iv) A plant sways abnormally if treated with alcohol, and assumes normalcy following the removal of such a toxic cause.

The classic monograph by J.C. Bose, *The Response in the Living and the Non-living* won recognition from the Royal Society, London. He was elected a Fellow of the Royal Society in 1920. Of course, Bose was a physicist-par-excellence in addition to being a distinguished biologist.

Although chemistry, as recognized today as a branch of modern science is about 300 years old, certain chemical practices characterized the technical skills of the Vedic and post-Vedic periods. There is enough evidence to indicate the existence of adequate knowledge as well as technique concerning the baking of clay and production of pottery, both of which required a process of hardening by a controlled use of heat through fire. I had the privilege of observing the pottery of Harappan culture during my recent visit to Taxilla, Pakistan. The use of metals including gold is mentioned in *Rig Veda*. It was believed that gold possessed supernatural powers and confers long life. The process of fermentation was well known and the rejuvenating powers of *somas* are described elaborately in the *Rig Veda*. Besides these essential facts, there are references to actual weights and volumes obtained by balances and measuring vessels, along with the use of several chemical processes such as concentration, precipitation, evaporation, distillation, sublimation and combustion.

This brief account of some of the basic sciences such as chemistry and botany also supports my thesis that major applications of the basic sciences were directed towards medicine and therapeutics, knowledge thus gained being used for treating diseases in sick persons, and for imparting health, vigour, vitality, and longevity, when prescribed for healthy individuals.

Traditional Medicine: Contemporary Resonance

It is therefore obvious that rich heritage over the millennia needs to be internalized into the modern thought process dealing with principles and practices of medicine as they exist today. The issue was brought into a sharp focus by the University Education

Commission which was constituted a year after India attained independence. The relevant observations and recommendations of the Commission¹ have been referred to in the Radhakrishnan lecture (pp. 5-6). In essence, the objective was to familiarize students of modern medicine with the history of Indian medicine. As is the wont of many reports and recommendations of several commissions, even after fifty years following the publication of this report hardly any follow-up action has been taken to implement such an important recommendation, with the result that a wide hiatus continues to grow between the practitioners of modern system of medicine and those of the Indian system. Let alone its wider acceptance by all medical institutions, even the All-India Institute of Medical Sciences charged with the responsibility of developing patterns of undergraduate and postgraduate medical education in the country, has neither developed the curricular framework for imparting knowledge about history of medicine, nor has the faculty been motivated to develop requisite expertise for the education and instruction of students in this important branch of medicine.

Indian Medicine: Futuristic Perception

Such knowledge is of extreme relevance for nurturing the minds of young students as I foresee a renaissance of Indian system of medicine and Yoga. Just as the communicable diseases dominated the scene in the twentieth century, and the modern system of medicine provided the two magic bullets of vaccination and antibiotics, epidemiological evolution is leading us to an era of non-communicable diseases related to altered life-style and social pathology. As the muscle is being replaced by machine, we are witnessing a major increase in the prevalence of diseases such as diabetes mellitus, hypertension, coronary artery disease, cerebrovascular diseases, etc.

Unfortunately, there are no magic bullets as yet invented by modern medicine for these diseases. Therefore, the essential approach to the prevention and management of these diseases lies in a balanced nutrition with a major emphasis on vegetarian diet and less refined, high fibre, complex carbohydrates, regular physical exercise and activity, and the practice of mental relaxation.¹

These therapeutic principles and modalities are fairly well enshrined in our traditional systems. Dhyana Yoga for meditation and Hatha Yoga for physical activity are much more acceptable to our culture and ethos than the bio-feedback alpha rhythms generated through amplifiers, and the imported treadmills for physical exercise. The preferential cost-effectiveness of traditional approaches is obvious.

Diabetes Mellitus in Ayurvedic Medicine: A case study

In the course of earlier discussion I had referred to the possible use of such a case study for drawing out essential conclusions which may have general applicability especially in relation to lifestyle diseases which include amongst others, diabetes mellitus.

The key feature of diabetes mellitus is an excessive concentration of glucose in the blood, which may be due to an absolute lack of insulin, or to an impairment of its action. Insulin is a hormone produced from pancreas and is essential for glucose utilization which provide a source of energy in the body. When the concentration of glucose rises in the blood beyond a certain limit, it spills over into the urine. The sweet taste of urine was known to the ancient Ayurvedic physicians Charak and Sushruta who accordingly designated the disease as *madhumeh* which literally means 'honey urine'. In *Charak Samhita*, the following description of the disease is provided:

A person is said to be suffering from incurable *madhumeh* (diabetes mellitus), whose urine is aromatic and sweet in taste, white in colour and which is not unctuous' (Ch. Nid 4/44).

It is remarkable that not only diabetes mellitus was recognized as a distinct entity, but it was also well differentiated from other diseases where large and copious amounts of urine are passed (polyurias) as well as some other causes of passage of sweet urine (glycosurias). Thus *madhumeh* was differentiated from *udakmeh* (description tallies with that of diabetes insipidus) and *ikshumeh* (glycosuria but without accompanying sweetness of other body secretions such as sweat).

The contribution of the ancient physicians is recognized by the western scholars as indicated by the following paragraph from *Joslin Diabetes Manual* published in the USA:¹

The first actual description of diabetes dates back some 1500 years before Christ. In the centuries near the beginning of Christianity, the appearance of diabetes in succeeding generations was described. The famous works of Sushruta (400 B.C.), of India, and his disciple, Charak (6 A.D.), noted many of the symptoms and even the types of diabetes.... Although the Indian name for diabetes, '*madhumeha*' or 'honey-urine', was used in the sixth century A.D., the Latin word 'mellitus' (honey) was applied much later.

The above description is essentially correct except that the historical chronology of Sushruta and Charak is not in line with the thinking of the Indian scholars.

A fairly accurate analysis of the causes of the common type of diabetes (non-insulin-dependent diabetes mellitus) is provided by Sushruta who noted its occurrence 'in very indolent persons who indulge in siesta, are averse to exercise and are in the habit of consuming cool, fatty, sweet food, and drinks which promote overweight'. It seems that the ancient physicians knew the two types of diabetes as have been recently classified by the World Health Organization.² Indeed Sushruta has also provided the description of the second type (insulin-dependent type) by mentioning its occurrence 'in those with lean constitution' and its presentation with symptoms 'such as loss of appetite and increased thirst, with the flesh melting away and producing extreme emaciation and weakness'.

Finally diet, exercise and certain drugs were recommended in the treatment of diabetes mellitus. Particular emphasis was placed on diet in the context of the type of disease as discussed above. If the diabetic was emaciated and underweight, emphasis was placed on prescribing nourishing diet in adequate amounts. In contrast, in the obese (overweight) diabetic, fasting was recommended. There were also pertinent recommendations regarding the qualitative aspect of diet; cereals, especially rice, products of sugarcane such as jaggery and molasses, alcoholic drinks such as beer, sweet fruits, and large amounts of oils, butter, and flesh of domestic animals were to be avoided.

The role of physical activity and exercise is highlighted especially in those who were overweight. While making a choice of physical activities, due consideration was given to the socio-economic status of the patient. Sushruta recommended sports, wrestling, riding and long walks for the affluent while digging wells was recommended for the poor who were nonetheless overweight. As is the modern day practice, the thin diabetic (insulin-dependent type) was forbidden heavy exercise.

In essence, it was concluded that a diabetic 'who takes food which is balanced and only

for the need of the body and observes the rules of health, enjoys happy life'. It is also mentioned that *sine quo non* for recovery from the disease was the change in the taste of the urine with loss of sweetness.

It can be rightly surmised from the above description of diabetes as well as its classification and recommendations regarding diet and physical exercise that the Ayurvedic physicians were far ahead of the others in their diagnostic and management skills. They also seem to be fully conversant with the possible causes of diabetes, such as eating large amounts of foods rich in carbohydrates and fats, and lack of physical activity.

*Conclusion*As nutritional imbalances and lack of physical activity constitute the main causes for the lifestyle diseases of the twenty-first century, it would be right to draw upon the knowledge of the traditional systems of medicine which may have the requisite tools for prevention and management.

Nevertheless, it is important to explore the scientific basis of such tools, using modern methods of research. In a similar way I include drug abuse, traffic accidents and AID as the diseases of social pathology. All are due to high risk behaviour. The remedial actions are, therefore, through a behavioural approach, leading not only to mental health but also to the possibility of attainment of social and spiritual well-being.

Thus, it is not only important to bring out the best of the Indian experience as available today in the form of text books, but it is equally important to establish a sense of continuity of the very best of Indian medicine that has been available over the centuries and combine it with the practice of modern medicine. It is therefore suggested that *History of Medicine*, with particular reference to Indian systems, should form a part of curriculum of undergraduate course in M.B.B.S. not only in India, but also in other countries. The Eighth Five Year Plan, which is now under implementation since 1 April 1992, recognizes the contribution of Indian Systems of Medicine, and aims to provide requisite support and strength to this.¹ Encouragement for research and development makes ample sense in the 'post-GATT' scenario and the anticipated increase in the price structure of newer pharmaceutical agents developed elsewhere.

*The lecture was presented at the International Symposium on Indian Studies (ISIS) at Kovalam, Kerala (Nov. 28-Dec. 2, 1994). Published in an abridged form in *The Perennial Tree*, K. Satchidananda Murty and Amit Dasgupta (eds.). New Delhi: Indian Council for Cultural Relations and New Age International (P) Ltd., 1994, pp. 337-57.

¹Bhargava, P.M., Chakrabarti, C, A new approach towards the study and analysis of the history of development of biology in India, Occasional Paper 7. New Delhi: Project of History of Indian Science, Philosophy and Culture, 1991.

¹*The Selfish Gene*, Dawkins, Richard (ed.), Oxford University Press, 1989.

¹Barani, Z., *Tarikh-e-Firuz Shahi* (Persian), Calcutta, pp. 362-63.

¹ Afif, S., *Tarikh-e-Firuz Shahi* (Persian), pp. 353-59.

¹Siddiqi, M.Z. *Studies in Arabic and Persian Medical Literature*. Calcutta: 1959.

¹Elgood, C, *A Medical History of Persian and Eastern Caliphate*. Cambridge: 1951,378-79,

² Abul Fazl, *Ayn-e-Akbari* (Eng. translation), Delhi: pp. 612-13.

^{1,2}*Samhita*. In: Jivananda Vidyasagara (ed), Calcutta, 1889. *Sushruta Samhita*. Nirnaya-Sagara, Bombay, 1915 and 1931.

^{1,2}*Charaka-samhita* with commentary of Chakrapani-datta, Nirnaya Sagar. Bombay: 1941.

Charaka-samhita, Gulab Kunverba Ayurvedic Society, Jamnagar: 1949.

*interpretive references by the author; these are not a part of original text.

¹Crawford, D.G., *A History of Indian Medical Service*. Thacker Spint & Co. Calcutta: 1914.

¹*Report of the University Education Commission*. Ministry of Education, Government of India.

¹Bajaj, J.S., Social and cultural perspective in medical education. In: Bajaj, J.S. (ed), *The Indian Journal of Medical Education*. Vol. 31, No. 1, New Delhi: The Indian Association for the Advancement of Medical Education, 1992; 6-11.

¹Krall, L.P., *Joslin Diabetes Manual*. 11th edn. Philadelphia: Lea & Febiger: 1978,6-7.

²The author was the Vice-Chairman of the WHO Expert Committee on Diabetes Mellitus which recommended the new classification in 1979. (*World Health Organization Expert Committee on Diabetes Mellitus*. Geneva: World Health Organization, 1979).

¹ *Eighth Five Year Plan (1992-97), Vol II*. New Delhi: Government of India, Planning Commission, 1992; 322-43.

II

SCIENCE AND TECHNOLOGY

Was the mind of Pre-Vedic or Vedic Indian scientific? Was he rational? To answer this, we must define the yardstick with which we want to measure this attribute. Dealing with this basic question on a universal plane, Bertrand Russell responds:

With this perspective, the Vedic Indian was perhaps rational, or was being probably initiated into rationality, and was thus laying the foundations of what is generally recognized today as the scientific temper. If it is accepted that the Harappan civilization preceded the Aryans, then considerable evidence can be cited to support scientific approach to town planning, house and city drainage, development of tools and devices for agricultural production and transportation, and possibly an organized system of governance. Undoubtedly, there were also widespread cobwebs of superstition and supernatural, but a path of observation, analysis and inference was already being developed at that time. These basic traits of science were recognized as means for acquiring knowledge. *Pramana*, or valid knowledge, has been referred to in *Rig Veda*.

The Nyaya school is realistic and pragmatic and demands that cognitive experience must be definite, must correspond with objective details, and must be capable of resulting in successful activity. Utility, i.e. *pragatti-samarthya* is an important test of true knowledge. Thus it is implied that knowledge to be valid must find its successful application. The means of acquiring valid knowledge is technically called *pramana*. There are ten possible instruments of valid knowledge: perception (*pratyaksha*), inference (*anumana*), comparison (*upamana*), verbal testimony (*sabda*), presumption (*arthapatti*), non-perception (*anupalabधि*), implication or equivalence (*sambhava*), legendary or traditional account (*aitihya*), gesture (*cheshta*) and elimination (*parishesha*). The acceptance of all or some of these *pramanas* by different schools of thought in India depends on their particular philosophical orientations.

The Nyaya school accepts four *pramanas*, viz. perception, inference, analogical reasoning, and verbal testimony:

(i) Perception is knowledge brought about by the contact of self-organs with their objects. The Nyaya system recognizes six sense-organs, five of them external (visual, auditory, tactile, gustatory and olfactory), and one internal (mind). Accordingly, perceptual knowledge can be of six varieties; five external (sensory), and one internal (mental). The mind, called an 'internal organ', is not constituted (like the sense organs) by material elements (earth, water, fire and air); nor is it limited (again like the sense-organs) to the cognition of specific types (like visual, auditory, etc.). Its function is general, central, and integrative.

(ii) Inference (*anuman*) is comprehension of an object following some other knowledge, usually obtained by perception. This involves the process of reasoning (*yukti*) on the basis of a 'middle term' (*linga*, also called *hetu*, i.e., ascription of reason, or *sadhana*). It involves relating a subject under consideration (*paksha*, minor term) with something that is sought to be established (*sadhya*, major term), through the relation of invariable concomitance (*vyapti*).

(iii) Comparison or analogical reasoning involves the attainment of knowledge of a thing

on the basis of its similarity with another thing already known. This type of evidence has been considered as that of an inferior quality.

(iv) Verbal testimony involves the employment of verbal knowledge as a means of correctly knowing an object. The idea of reliability proceeds on the assumption that the person who has direct and correct knowledge about the thing in question has also the desire and competence to communicate this knowledge to another. The three conditions necessary to make him a reliable authority are: knowledge of truth, communication that is truthful, and the desire to guide others (*tarkika-raksha*).

A detailed and critical analysis as presented here may be accepted as a reasonable basis of the scientific temper that may have been prevalent at that period of Indian history, although as I have stated before, it may have been shrouded in the traditional veils of superstition and mysticism. Further, it is quite obvious that such exacting standards for the acquisition of true knowledge were probably non-existent in the life and times of a large number of human beings who inhabited this country during that period. Islands of scientific excellence therefore may have been partially submerged in the general sea of ignorance and darkness where tradition and beliefs may have irrationally swayed the minds of the people.

Science and Technology in the Post-Independence Period

Jawaharlal Nehru, on whose shoulders rested the mantle of guiding the destiny of Independent India, had a characteristic vision which blended the past lessons of history with the futuristic perceptions of science. He recognized the value of science not only in the socio-economic development of the country, but also as an important tool in the sharpening and chastening of the human mind. The chain of first-rate scientific laboratories all over the country bear a mute testimony to the immense faith that Nehru placed not only in science, but also in the ingenuity of the Indian scientists. In the Scientific Policy Resolution adopted by the Government of India in 1958,¹ it was unequivocally stated that the key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors: technology, raw materials and capital. It was recognized that 'modern science has not only radically altered man's material environment, but, what is of still deeper significance, it has also provided new tools of thought and has extended man's mental horizon'.

Consistent with the evolution of thought process over the millennia, the emphasis of science shifted from disease and death to joyful life and all that enhances the quality of living. This was emphasized in the Resolution that I have referred to wherein it was stated: 'Only through the scientific approach and method and the use of scientific knowledge that reasonable material and cultural amenities and services can be provided for every member of the community, and it is out of a recognition of this possibility that the idea of a welfare state has grown'. In recognizing this new role of science, equal emphasis was also placed on the scientific education of human resources who constituted an integral component of manpower infrastructure. The Resolution therefore stated: 'The use of human material for industrialization demands its education in science and training in technical skills'.

While emphasizing the new role of science as a social, political, and economic instrument, the Nehruvian concept of history and tradition also found an expression in the Resolution: 'It is an inherent obligation of a great country like India, with its traditions of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably mankind's greatest enterprise today'.

However, it may not be possible for us to objectively judge how far the successive governments in India have succeeded in realizing the full potential of science as defined in the Resolution, although I shall refer to this aspect when I focus on the Technology Policy Statement. What I can say with certainty is that the assurance held to the scientists of this country has neither been fulfilled nor is there any perceptible effort to do so even now. This assurance was in the last paragraph of the Resolution: 'The Government of India have decided to pursue and accomplish these aims by offering good conditions of service to scientists and according them an honoured position, by associating scientists with the formulation of policies, and by taking such other measures as may be deemed necessary from time to time'. The relevant questions that come to mind include the following:

(i) Is it a failure on the part of the Government of India that the scientists of today feel marginalized and compromised? Or is it the failure of those scientists who managed to secure for themselves honoured positions and who were associated with the formulation of national policies, thus leading to the present predicament of the younger and more dedicated scientists.

(ii) Is it the bureaucracy that compromised the scientist or is it the scientist-turned bureaucrat who compromised the science?

I am not expressing any of my own views, not that I do not hold any on the subject, but because as a member of the Government of India, a free expression of some of these views may be misconstrued. All that I may do is to echo Albert Camus: 'Do not wait for the last judgment. It takes place everyday'.

In 1983, a quarter of a century after Scientific Policy Resolution, the Technology Policy Statement of the Government of India was drafted and published.¹ It made a laudatory reference to the process of planning and to the Resolution mentioned above. The statement legitimately claimed: 'As a result of three decades of planning, and the Scientific Policy Resolution of 1958, we now have a strong agricultural and industrial base and a scientific manpower impressive in quality, number and range of skills. Given clear-cut objectives and the necessary support, our science has shown its capacity to solve problems'. Emphasizing the role and place of technology, the statement unequivocally emphasizes:

'The use and development of technology must relate to the peoples' aspirations. Technology must suit local needs and to make an impact on the lives of ordinary citizens, must give constant thought to even small improvements which could make better and more cost-effective use of existing materials and methods of work. Our development must be based on our own culture and personality'.

The statement also laid clear directions for the procurement and development of technology:

'Our directives must clearly define systems for the choice of technology, taking into account economic, social and cultural factors along with technical considerations; indigenous development and support to technology, and utilization of such technology; acquisition of technology through import and its subsequent absorption, adaptation and upgradation; ensuring competitiveness at international levels in all necessary areas; and establishing links between the various elements concerned with generation of technology, its transformation into economically utilizable form, the sector responsible for production (which is the user of such technology), financial institutions concerned with the resources needed for these activities, and the promotional and regulating arms of the Government'.

There was an oblique reference to Defence Research and Development: 'We seek technological advancement not for prestige or aggrandizement but to solve our multifarious problems and to be able to safeguard our independence and our unity'. As in the Scientific Policy Resolution, so in the Technology Policy Statement, our deep roots in tradition and history were also emphasized: 'Our modernization, far from diminishing the enormous diversity of our regional traditions should help to enrich them and to make the ancient wisdom of our nation more meaningful to our people'. Attainment of technological competence and self-reliance were recognized as priority objectives, and broad goals were enunciated. Concomitant with technological developments, emphasis was also placed on ensuring harmony with the environment, preserving the ecological balance and improving the quality of the habitat. To be particularly singled out were the ministries concerned with large investments and production activities in areas such as food, health and energy, and an assurance was provided for appropriate technical support to these efforts through suitably structured science and technology groups. Within the area of health, provision of safe drinking water in rural areas, improvement of nutrition, rapid reduction in the incidence of blindness, eradication of the major communicable diseases (such as leprosy and tuberculosis), and population stabilization were identified as specific areas for intensive investment. In conclusion, the Statement posed a serious, although not insurmountable challenge to the scientists by stating: 'Indian scientists and technology improvement unlock the creative potential of our people and help in building the India of our dreams'.

Once again, I do not wish to pronounce any judgment either on the responsiveness of the scientists to the challenge posed, or the political will and commitment of the successive governments to accelerate the process of implementation, to monitor and evaluate the progress at periodic intervals, and to keep technology watch over the international scene so that relevant technologies even under development can be identified and procured, both to prevent time and cost overruns as also to avoid obsolescence in terms of our technological development.

Surely, a lot has been accomplished in several fields. Subsistence agriculture has been transformed into a profitable agricultural system, thanks to the Green Revolution in the seventies. Animal husbandry has progressed with the improvement in the genetic pool of livestock resulting in higher yields in milk, meat, egg and fish production. Nuclear energy has kept pace with international developments, generating new capabilities covering the entire nuclear cycle from exploration, mining, extraction, purification and conversion of nuclear material. We have designed and constructed power reactors and control systems and India today is one of the few countries which has worked on breeding, processing and fabricating U-233 fuel. The impact of all these developments in diverse fields such as use of radioisotopes in agriculture and health has resulted in quantum improvement in our capabilities in these fields. Epoch-making events have been witnessed during the last two to three years, thanks to the pioneering developments in the Indian Space Programme and the highly acclaimed accomplishments in the Defence Research Development Organization (DRDO) under Dr. A.P.J. Abdul Kalam. A direct impact of some of these achievements which impinges on the life of a majority of citizens in this country, is through long distance communication, nationwide television, radio networking, meteorological services, etc. The exploration of oceans, i.e. oceanography has an equally enviable record of . development with state-of-art advanced oceanographic research vessels having been built and commissioned within the country during the last decade. The first expedition to Antarctica led by Dr. S.Z. Qasim in December 1981 was a landmark, now frozen in the polar ice forever. Bio-technology is a full-fledged department now and is contributing its own share to the developments in agriculture and health. This is an impressive record. However, by no means should we be complacent in

our approach to the development of science and technology in India, nor should we be reticent in making requisite investments in this area of human endeavour.

¹ Russell, B., Can Men Be Rational? In: Russell, B. (ed.), *Sceptical Essays*. London, New York: Routledge, 1928, 36-42.

¹*Scientific Policy Resolution*. New Delhi: Government of India, Department of Science & Technology, 1958.

¹*Technology Policy Statement*. New Delhi: Government of India. Department of Science & Technology, 1983.

III

EPILOGUE

There is strength and weakness in those who stand for status quo: the strength that comes of tradition, and the weakness that comes of lack of fresh thought.

—Bertrand Russell

If social scientists discern a few strands of William James in this paper, they may do so with some justification: like James, I have my basic training in physiology and medicine; like James, I inherited a religious and mystical bias from my parents and grand-parents; and like James I was initiated into democratic values, and the concepts of human dignity and human rights during the struggle of independence and therefore I share with James the ‘New England Conscience’ of the mid-nineteenth century. But the comparison ends here; I have no contributions to philosophy or claims to pragmatism for which he is so well recognized.

Just as a scientist is handicapped due to lack of philosophical thought, so is a philosopher restricted in his conceptual comprehension resulting in his inability to appreciate the depth of scientific pronouncements, even if these deal with a subject such as medicine, which is traditionally considered both a science and an art. Those who look for factual inaccuracies in the Vedic and post-Vedic medicine shall certainly find them; indeed there are many who have done so. How to evaluate a fact as true or false *over a period of time*? John Dewey, one of the most eminent American philosophers, resolves this dilemma by suggesting that scientific theories do change from time to time. What is more important is to find out: does a particular hypothesis work? A theory is a tool; it can be judged as good or bad on the basis of its efficiency for a specific task at a specified point in time. While it is a good tool, it is ‘true’. The concept of truth, therefore, is based on the utility value. If this is the yardstick of judging the past and ongoing contributions of traditional medicine, then the conclusions can only be positive.

While focussing on the utility value of Ayurveda, let us not forget the contemplative thought of those who practiced it. I do not wish to blend the argument with religious flavour, nor is it my intention to fortify it with religious fervour. But I may ask you to contemplate on the following poem by Leopardi, the French philosopher:¹

THE INFINITE

Dear to me always was this lonely hill
And this hedge that excludes so large a part
Of the ultimate horizon from my view.
But as I sit and gaze, my thought conceives
Interminable vastnesses of space
Beyond it, and unearthly silences,

And profoundest calm; whereat my heart almost
Become dismayed. And as I hear the wind
Blustering through these branches, I find myself
Comparing with this sound that infinite silence;
And then I call to mind eternity,
And the ages that are dead, and this that now
Is living, and the noise of it. And so
In this immensity my thought sinks drowned:
And sweet it seems to shipwreck in this sea.

Only a few may discern the resonance and vibrance of *Vedas* and *Guru Granth* in this poem. Nevertheless, several scientists imbued with intellectual temper and training will agree: 'sweet it seems to shipwreck in this sea'. And pray, why not?

¹Trevelyan, R.C., *Translations from Leopardi*. Cambridge University Press, 1941.

6

Multiprofessional Education as an Essential Component of Effective Health Services*

Preamble

Multiprofessional education, structured in recognition of the priority health needs of individuals and communities, and aimed at fostering and developing a series of learning experiences for health care providers that will enhance their competence to respond with sensitivity to the expressed but unmet needs of the population, has received major consideration in recent years. Instructional modules for each category of health personnel provide for a rational synthesis of a core curriculum on the basis of complementarity of educational objectives, leading to an inter-dependent interaction between those pursuing different vocational courses, in the setting of the community and in direct contact with real-life situations seeking remedial interventions.

Health: An Indicator and Determinant of Quality of Life

In the historical perspective, health and health care have generally evolved through a phased process. The first phase placed overwhelming emphasis on disease, thereby making the patient as the focus of attention and clinical treatment as the main instrument of improving the health of the people. With the further development of health sciences, the morbid concept of disease was replaced by a more positive concept of health, with the emphasis shifting from patient to person; from cure to care; and from prevention and control of disease to promotion of health. Finally, in most parts of the world today, there is a growing realization that health is not only a major indicator but also a significant

determinant of the quality of life of the people (Bajaj, 1993). The people must interact with health care functionaries not only in the planning process, but also in the participatory management. Viewed in this perspective, multi-professional education may in future enlarge its scope to include community leaders as possible partners in the health team.

It is generally accepted that primary care services which constitute the base and basis of national health care systems in most of the countries, reflect and evolve from the economic conditions and social values of the country and its communities. Therefore, the structure and content of primary care tends to follow a pattern consistent with social norms and community aspirations, and utilizing health outcomes as an entry point for community and socio-economic development. The broad objectives of multiprofessional education must evolve within this conceptual framework, both in terms of context and content

Health Care: A Team Concept

The provision of primary health care must be the responsibility of a well-identified primary health care team; the success of the primary care movement to a very large extent would depend on the effective and efficient functioning of the team as a whole. Such a team approach ensures that the responsibility to perform identified task(s) is assigned at a level of vocational training which combines the twin advantages of lowest possible costs and maximal permissible quality assurance, with demonstrable evidence of community acceptability.

The health team is traditionally headed by primary health care physician, although the leadership role may change depending upon the individual expertise in a task-related performance. The team is generally supported by a variety of auxiliary personnel, including paraprofessionals and village level primary health care workers. The important functionaries in the primary health care team in the developing countries include a doctor, a nurse, a nurse-midwife, an extension educator, a laboratory technician, a radiographer, a lady health visitor, etc. In more developed countries, additional team members may include a social worker, a public health nurse, a school health nurse, a dentist, dental auxiliaries, etc. With this identified core of health care providers, additional members of the team at any time must be identified on the basis of health-related tasks (Fig 1). Thus, for safe drinking water and water resource management, civil engineers including sanitarians need to be included in the team. In essence, the composition of the team would largely depend on the national health policies and programmes, and the available resource-inputs in the health sector. Several countries in the South-East Asia region have involved practitioners of traditional system of medicine within this framework. While the core members of the team belong to health vocations, the additional (optional) members are inducted due to their involvement in health-related tasks. The role of community volunteers and leaders have been previously referred to and needs to be constantly reviewed.

FIG. 1

There was a time when the responsibility of organising health care services was considered to be a medical responsibility. Gradually, it has given way to the thought that health is not a medical or a biological responsibility, but a social and developmental entity. It would therefore be an obvious prerequisite for students enrolled for basic education programmes in medicine, dentistry, nursing and midwifery, nutrition and dietetics, and medico-social work amongst others, that they must not confine themselves to a single compartmentalized vocational curriculum. On the contrary, specially designed instructional modules must foster a spirit of professional socialization which would be conducive to blending biological, social, managerial, and humanitarian attributes, and would facilitate sharing of learning experiences among students pursuing courses in diverse fields such as civil engineering, sociology, ecology, education mass communications, informatics, and telematics, amongst others.

The Concept and Contour of Multiprofessional Education

It has already been stressed that the ultimate objective of health services has to be the improvement of quality of life of the people through the services and performance focused on health-related team tasks. Some of the significant factors that impinge on the health of the people in the developing countries are:

- (i) Quality and outreach of health services,
- (ii) The state and status of safe drinking water, environment sanitation and the sewage disposal;
- (iii) Nutritional status, especially of vulnerable groups, i.e., mother and child;
- (iv) The extent and level of social and community development programmes and of community participation, and
- (v) The existing national mechanisms for problem definition, prioritization, resource allocation, meaningful programming and effective implementation of these programmes, ensuring the optimal utilization of scarce resources available in most developing countries.

These, and other area-specific requirements, provide the reference point(s) for development of competencies and services, and intersectoral coordination (Fig. 2).

(FIG. 2)

Learning Settings

Multiprofessional education to be meaningful in developing countries, and possibly in the industrialized societies also, must relate to the pertinent health problems of the community and thus should be mostly or entirely community-based so that the health problems of the community are clearly and categorically analyzed in clinical, social and epidemiological contexts and the education and instruction of multi-vocational health workers who constitute the health team is carried out in the settings where health and disease are constantly happening, and threatening the lives of a large number of people in most developing countries.

This is in contrast to the generally prevailing milieu wherein the major setting for

education and training of multiple health professionals evolves around a pre-defined and pre-designated institutional framework, mostly a hospital with a major orientation towards tertiary care. Such an approach also serves as the basis for future projections for requirements of identified categories of designated individualized vocations (e.g., doctors, nurses). The obvious disadvantages include: (i) lack of consideration of the interactive role of team members; (ii) the possibility of delegation of functions; and (iii) the flexibility of job substitution.

There is thus an urgent need to either replace this frame, or at least to enlarge it into the context of the community, with a commitment to allocate a relatively much larger portion of the training period within an appropriate community setting. It is absolutely essential that all institutions engaged in training and education of a variety of health professionals in developing countries must have a field training area where community-based training is imparted to the workers throughout the total duration of the course, and instruction modules remodelled to permit mutual sharing of learning experiences, and on-the-job team interaction.

Learning Strategies

Multiprofessional education, in any setting, must include a set of learning objectives both in relation to individual—as well as team—tasks, and must also relate to the psycho-social skills and behavioural attributes that individual health workers are expected to exercise and acquire during the period of instruction (WHO Report, 1988). While team interaction constitutes the conceptual core, adequate weightage must also be given to individuality as well as creativity in terms of problem recognition and decision making.

The expected outcome as a result of education and training must find a clear expression in the definition of competencies both for the health team collectively, and for each member individually. An essential prerequisite is the successful definition of vocational profiles, based on an in-depth task analysis, taking into consideration the quality and outreach of health services, and their efficiency and effectiveness. The delineation of team profile, while taking into account the individual vocational profiles, must not be a matter of summation alone. A major approach is to develop requisite competencies through problem-solving, task-related approach wherein the learners not only determine the individual assigned tasks, but also see possible solutions for individual and community health problems through interactive interdependence.

A competency-based education employing a task-related and problem-solving approach, and in the learning setting of the community, seems to be an effective combination for multi-professional education (Fig. 3). The teacher as a resource person may act as a facilitator for recognition of a problem or set of problems that affect the community especially the underprivileged and under-served 'high risk' population segments. The obvious advantage of such a learning strategy relates to experiential recognition of a wide range of problems that are prevalent in a community, developing a set of possible options for intervention, and demonstrating resolution of one or more of such problems through realistic, cost-effective solutions.

(FIG. 3)

Phases of Multiprofessional Education

There are at least three phases which need consideration for multiprofessional education and training programmes:

(i) Pre-certification Phase (Basic Education)

It would be desirable to critically analyze the existing curriculum of multiple professionals working in the health sector so as to identify specific training modules which can be integrated in a meaningful manner both at the institutional, and preferably in the community setting. Within this framework, each member of the team must be able to clearly identify individual tasks as well as establish clear linkages and interaction with other professionals, who share equal responsibility for achieving the ultimate outcome in term of desirable and discernible impact on pre-defined health indices.

As health sector and health professionals alone will not be able to achieve the Health for All, it is essential for all health professionals to identify a set and range of activities amenable to team approach and involving workers such as nutritionists, sanitarians, extension educators, community development functionaries, women and child development workers, school teachers, etc., with due recognition of the importance of their contribution in the overall context of a successful health care delivery system which will enrich the lives of the people. It is obviously of considerable advantage if the students enrolled for different academic courses, and sharing the concept that health is an entry point for community development, are provided reasonable opportunities during their instruction and training to interact together to generate community awareness and ensure community participation in health-related tasks (Fig. 4).

The Expert Committee on Health Manpower Planning, Production and Management (Bajaj Committee, 1987), under the chairmanship of the author, made a number of recommendations, the most noteworthy one being the development of vocational training courses for ten categories of health functionaries (e.g. male and female multipurpose workers, laboratory technicians, ophthalmic assistants, physiotherapists, etc.) who are considered essential for providing primary health care services in India, at the +2 level within the framework of 10+2 pattern of general education. The states of Andhra Pradesh, Tamil Nadu, and Maharashtra have already made significant progress in this direction which lends itself to the development of meaningful programmes for multiprofessional education and training.

CME: CONTINUING MULTIPROFESSIONAL

EDUCATION

(FIG. 4)

Case Study I: *Rehbar-i-Sehat Programme*,

Jammu & Kashmir:

Rationale: As medical care and modern public health programmes reach out in effective and permanent units to the remote rural areas, the problems of the health personnel who work in these rural units emerge, and appear to be far more complicated than those encountered in urban hospitals and institutions. The health worker in a rural area becomes

aware, perhaps for the first time, of the existence of another 'medical care' culture based on ideas about the causes and treatment of disease evolved over long years of experience by the people in terms of their environment, their pattern of living and their beliefs about human, environmental, and super-natural relationships. The key to successful health planning lies in constructing such training programmes and learning experiences for the primary health workers that take appropriate cognizance of traditional beliefs and cultural ethos.

Organization: It is precisely to achieve such objectives that the *Rehbar-i-Sehat* programme was started with the support of the then Chief Minister, late Jenab Sheikh Mohammed Abdullah in Jammu and Kashmir in 1975 (Bajaj, 1986). It was, and continues to remain, a most innovative approach involving village school teachers as primary health care workers, following a period of adequate training for a total period of 500 hours, divided into several instructional modules, with a range of learning activities including health-related team tasks, shared with other village level functionaries including medical interns and para-professionals. Such a model of multiprofessional education, over the years, has been continuously refined. Each primary school teacher, trained as first contact health worker serves a population of 700 to 1,000 people; each primary health centre is linked with fifty health care workers. Such teachers not only provide the first-contact care in the remote rural areas, but also constitute an effective instrument for imparting health education. Obviously, principles and practice of educational philosophy and educational technology are fairly similar, irrespective of whether the content focus on general education or health education. Nearly 4000 school teachers have already been instructed and trained, and constitute the first level of community health care.

Having established the validity of instructional methods and materials, and the efficiency and effectiveness of such first-contact health care providers, additional health-tasks were assigned. As their main responsibility is preventive and promotive health care, an awareness of the high risk factors pertaining to emerging life-style diseases such as diabetes, early diagnosis of the disease, prevention of some of the complications, reinforcement of patients' education and follow-up programme. Indeed, as a cluster of high risk factors is shared by several degenerative diseases, such multifaceted approach for diabetes care has served as a prototype, with the likelihood of a beneficial outcome in more than one direction.

A multiprofessional training workshop course for allied health professionals for primary health care in diabetes mellitus, was conducted in Srinagar, Kashmir. The course was sponsored by the Ministry of Health and Family Welfare, Jammu and Kashmir, All-India, Institute of Diabetes, Bombay and the Diabetic Association of India, Jammu and Kashmir.*

The objective of the Workshop Course was to incorporate and integrate diabetes care in the primary health programmes, and to update the component of diabetes health care within the *Rehbar-i-Sehat* programme. The categories of allied health professionals who attended the course, included *Rehbar-i-Sehat* workers, nurses, dieticians, auxiliary nurse mid-wives (ANMs), and medical social workers. In addition, health planners and medical officers attended the course so as to imbibe the philosophy of the integration of diabetes care into primary health care programmes, and the multi-professional approach to education and learning (Bajaj, 1984).

The Workshop Course was planned with an adequate number of formal presentations from the Faculty. Each of the plenary lectures was followed by an open discussion among

the participants. The participants were divided into four groups and were allotted appropriate group tasks in relation to the course contents. The group work was then jointly reviewed by the participants and the Faculty. In addition to formal plenary lectures, laboratory demonstrations, clinical demonstrations and field trips, were arranged with well-defined instructional objectives, patient and family education was conducted in real life situation, using the collective expertise of all members of the health team.

A multiple response type of objective test, focused both at primary health care as well as to diabetes care, including epidemiology, clinical management, social attitudes, rehabilitational facilities in the community, and systems of referral and linkage to secondary and tertiary levels of care, was conducted initially and all participants were asked to respond to the questions. In view of the heterogeneity of the group population, the pre-test exercise was useful in determining the average group level at the beginning of the Workshop Course, and the individual strengths and weaknesses.

At the conclusion of the Workshop Course, a post-test on similar lines and pitched at an appropriate level was conducted. The comparative evaluation of the grades scored at the pre-test and post-test, indicated a substantial gain in knowledge, and more importantly, in the ability to respond to simulated problem solving emergency situations.

The evaluation of the Workshop Course was made through a pre-designed questionnaire. The Satisfaction Index for each response was calculated. It was gratifying to note that the mean Satisfaction Index was 88.7 with S.E. of 3.2. The mode was 91.3. The minimum Satisfaction Index was 73.2, and the maximum 97.4. There were only three questions with an Index of below eighty per cent. Several of such educational courses have since been conducted, and learning materials in seven Indian languages have been published.

It is therefore, suggested that the experience gained over the past several years in developing an alternate model of a non-physician approach to primary health care, utilizing the existing talent of primary school teachers at the village level, and the strategy of community-based multiprofessional education, should be carefully studied as a possible model for the training of primary health care functionaries of equivalent categories and with similar or identical background of knowledge and attitudes.

(ii) Orientation training for existing professionals

In most countries, vast health infrastructure has been created which at the present moment is being manned by a large number of health professionals who unfortunately did not have the opportunity of multiprofessional education and training programme during the period of basic education and certification. As such, it is essential that some type of condensed capsulated post-basic orientation courses are designed for these professionals which would give them an opportunity of understanding (i) the problems of the community and their prioritization; (ii) definition of specific individual and team tasks, and (iii) the mutual complementarity of other health professionals. Such an education and training programme should lead to the development of a holistic attitude within all professionals.

Case Study II: *India Population Project (IPP6 and IPP7Z)*

The training projects initiated and organized by the Government of India in the four states of Uttar Pradesh, Madhya Pradesh, Bihar, and Rajasthan strongly emphasize learning in context of community-based education. Approximately forty per cent of the total

population of the country is located in these four states, which also have the highest crude birth rate and population growth rate.

The US Aid supported an IEC (information, education, communication) and training project in these four states during the period 1986-1993. The training was provided in the community setting, and employed problem-based learning as a major approach, using a variety of competency-based instruction modules.

A number of area development programmes have been launched in the country in the health sector. In most of these programmes funded by the World Bank, US Aid, UNFPA, DANIDA, etc., human resource development has been given a high priority along with development of health services infrastructure, with the ultimate objective of achieving a quantifiable improvement in the outreach and quality of service to the people. District training teams, district training units, and district training centres are being established in the country to pursue the training of health professionals in an integrated manner centered around the problems of the community.

(iii) Continuing Multiprofessional Education

The concept of CME, which till now generally refers to continuing medical education, needs to be given a new meaning and direction, with the acronym CME projecting continuing multiprofessional education (Fig. 4). It can be sequential, following the basic and post-basic phases. Alternatively, it can be a stand-alone programme. In any case, continuing multi-professional education at regular and periodic intervals needs to be built into the total health manpower management system.

Performance Assessment: Validity of Criteria

The evaluation process aims to measure the extent to which a learner individually and as a member of the health team, has achieved the pre-defined educational objectives. The instruments used for such measurement must ensure the essential prerequisites of validity, reliability and objectivity (Bajaj, 1991). Although significant progress has been made to refine the instruments of measurement employed for the evaluation of an individual learner, considerable amount of work needs to be carried out still to ensure a corresponding level of validity, reliability, and objectivity while developing instruments that would measure, in an objective and quantifiable manner, predefined team-work skills and competencies. These instruments should be made available to students for formative evaluation at an early stage to be followed later by the tutors for final certifying purposes. To demonstrate validity, the assessment of team performance must be in the field practice area in real-life situation.

As the health-related tasks would demand graded responsibility corresponding to different levels of instruction and training requirements, there must be an inbuilt flexibility to use such techniques and tools of measurement that would generally be corresponding in complexity and variety to task-related needs and demands. Finally, there is a general lack of trained educators who can develop such instruments and use them for performance assessment in multiprofessional education. Action for faculty development for this purpose must be initiated in the countries motivated to launch multiprofessional education.

Ultimately, a satisfactory level of performance must relate to a measurable impact on the predefined indices of community health. International experience needs to be generated

on the basis of well-designed micro-level studies; pooled together, this may form the basis of general recommendations at a macro-level.

Case Study III: *Rehbar-i-Sehat Programme*;

Health Impact and Outcome

As the final evaluation of multiprofessional education must relate to a performance audit, measurable in terms of health impact and outcome, a study was carried out to evaluate the *Rehbar-i-Sehat* programme (case study I) with respect of: (i) functional organization of health team; (ii) task-related performance of health team collectively and diabetes health care providers individually; (iii) health care outcome measured as fetal and neonatal loss in pregnancy with-diabetes in the project area, and compared with a control area; and (iv) cost-effectiveness (Bajaj, 1991). A significant reduction in fetal and neonatal loss was demonstrable in the project area; such an outcome has received international attention and commendation (Hu Ching-Li, 1989).

Health Research and Multiprofessional Education

Decision-linked research is an efficient means of obtaining and analysing the data generated as a part of multiprofessional education. Several areas of study include: (i) health systems research; (ii) planning and development of human resources for health; (iii) development, adoptability and adaptability of appropriate technology for health; (iv) educational technology; and (v) social and behavioural research (Table). The possible applications generally aimed at efficient and effective use of material and human resources are indicated. These may be directly built into different aspects of health service inter-linkages with multi-professional education.

The range and variety of data generated can be of value to several categories of health manpower—from medical pedagogue to general practitioner, from health planner to provider of health care, and from highly skilled professional to grass-root primary care worker.

A strong endorsement of health-team concept in the national health system especially as a part of primary care approach, extended up to and including district level, needs to be reinforced by the learning strategy of multiprofessional education. Instructors and perceptors need to be motivated, and instruction modules employing task-related, problem-solving approach developed, to enthuse the students towards sharing of learning experiences in the community setting. Innovative approaches aimed at bringing together students from other disciplines not belonging to health vocations, but involved in social and community development must be developed on the basis of area-specific needs. Valid instruments of performance assessment need to be developed and faculty perceptors trained for their proficient use. Health research of a diverse range may be built into the programmes interlinking health services. Obstacles and road blocks need to be crossed with vision and courage.

Table: Health Research and Multiprofessional Education

Focus

Application

* Health system research

—Efficiency and effectiveness of

health management systems

*Social, economic and

—Health and behavioural

behavioural research

correlates

—Ethics of health care

Inter-sectoral coordination Social and

community development

* Appropriate technology
for health

—Generating new knowledge and
technologies for unresolved

health problems

* Educational technology

—Improving the quality and

content of education in health

* Institutional networking:

—Building national research

cost and benefits

capabilities and achieving

country's self-reliance

*The author was the Director of the Workshop Course.

REFERENCES

Bajaj, J.S. (1984), Diabetes Health Care Management: Critique and Caveats, In Bajaj, J.S. & Madan, R. (eds), *Diabetes Mellitus in Developing Countries*, *Interprint*, New Delhi, pp. 15-25.

———,(1986), Health and Education: an interface for human resource development, *Indian Journal of Medical Education*, 25, 19-44.

-----, (1991), Evaluation in Education, *Indian Journal of Medical Education*, 30, 1-3.

-----, (1993), Health as an indicator and a determinant of quality of life', In Qasim, S.Z. (ed.), *Science and Quality of Life*. The Offsetters, New Delhi, pp. 15-32. Expert Committee on Health Manpower Planning. Production and Management

(1987), Ministry of Health and Family Welfare, Government of India, New Delhi. Hu Ching-Li (1989), Mobilization Against Diabetes, In Larkins, R.G., Zimmet, P.Z., Chisholm, D.J. (eds.), *Diabetes* 1988, Excerpta Medica, Amsterdam, pp. 873-76. Madan, R., Bajaj , J.S. (1991), Models of Diabetes Care in India and South East Asia, In Rifkin, H., Colwell, J.A., Taylor, S.I., (eds), *Diabetes*, 1991 pp. 774-78. Report of a WHO Study Group on Multiprofessional Education of Health

Personnel: The Team Approach (1988), Learning together to work together for Health, *Technical Report Series 769*, World Health Organization, Geneva.

Quality and Equity in Medical Education*

With ever increasing constraints on financial resources for higher education, there is a growing discontent in the universities regarding the possible impact on the quality of education. There is a strong emerging view favouring privatization of higher education. Whatever be the final outcome of the debate, there is an apprehension that it may encourage inequity besides compromising the quality of higher education, and by extrapolation, of medical education.

In this context, there are four landmark events during the last three years which require recapitulation and serious deliberation. The Eighth Five Year Plan which is under implementation since April 1992 unequivocally recognizes the distortions that have crept into the health manpower system in the country. In Volume II of the Plan document which was approved by the National Development Council under the Chairmanship of the Prime Minister of India and in the presence of all Central Ministers, Chief Ministers of all States, and Members of the Planning Commission, it is emphasized that:

While the States have been more than anxious to start new medical colleges, their efforts to develop institutions for training of para-medical staff have been entirely sub-optimal. This has resulted in a considerable mismatch between the requirement and availability of health personnel of different categories.

Reiterating the urgent need for an in-depth review, it has been categorically stated:

It is, therefore, of crucial importance that the entire basis and approach towards manpower development in terms of national needs and priorities are reviewed and training programmes restructured accordingly. Besides there is an urgent need to reassess appropriate health manpower mix to deliver health services at primary, secondary and tertiary level and for the purpose of training and research.

Regarding medical education, the Eighth Plan concedes that:

The existing facilities for training of medical graduates have outstepped the needs. No new medical college or an increase in the admission capacity of the existing colleges will, therefore, be supported during the Eighth Plan. Instead, resources will be used to strengthen the hospitals, laboratories and libraries of the existing medical colleges so that the standards of training are maintained.

Although the Chief Ministers of all states supported the Plan document and its contents were approved with unanimity, local and regional compulsions (to put it mildly) triggered a chain of events contrary to the letter and spirit of the approved document. The Andhra Pradesh Educational Institutions (Regulation of Admission and Prohibition of Capitation Fee) Act, 1983 was amended by inserting Section 3A which came into force on 15 April 1992. This Section almost completely negated the intent of the original Act which was meant to stop the undesirable practice of collecting capitation fee at the time of admitting students and was enacted 'to effectively curb this evil practice in order to avoid frustration among the meritorious and indigent students and to maintain excellence'. Contrary to the original intent of the objective, Section 3A made it lawful for the management of any unaided private engineering college, medical college, dental college

... to admit students to the extent of one-half of the total number of seats from amongst those who qualify on the basis of a common entrance test or in a qualifying examination, 'irrespective of the ranking assigned to them in such test or examination'. Obviously, the only consideration being the capacity to pay the capitation fee, the admission being secured by the highest bidder.

A month later, on 25 May 1992, the Government of Andhra Pradesh issued a notification inviting applications for seeking permission of the Government to establish medical, dental and engineering colleges, and a Committee was appointed to formulate guidelines. The report of the Committee was submitted on 21 July 1992 recommending the establishment of as many as twelve medical colleges with an intake of 100 students each, and eight dental colleges with an intake of forty students each from the Academic Year 1992 itself. Within six days of the submission of the Report, the then Chief Minister accorded the approval on 27 July 1992, and the Government order was issued on the same day granting permission. Thus it took only a period of three months from the initial amendment of the Act by inserting Section 3A, thus removing the restriction on the collection of capitation fee, to the final order permitting the establishment of a total of twenty medical and dental colleges.

The decision of the State Government generated considerable public concern and the Students' organizations decided to collectively agitate against this decision. *The Indian Express* in a news item dated 28 July 1992 stated:

Among the Educational Societies permitted to start both a Medical and a Dental College in the private sector are those belonging to the family of the Chief Minister, Mr. N. Janardhana Reddy at Nellore, the Society floated by the Congress (I) MP from Ongole and liquor baron, Mr. Mugunta Subbarami Reddy.

Private medical colleges will be started by the societies associated with the Finance Minister, Mr. S. Santosh Reddy at Nizamabad and the Minister for Public Works, Mr. J.C. Diwakara Reddy at Anantpur J. This year about 600 seats would be available for candidates, who have qualified at the Common Entrance Test (but without the requisite rank) if they can pay donation up to Rupees five lakh for a seat in MBBS.

A writ petition was also admitted in the Andhra High Court and was referred to a Division Bench which ruled against the decision of the State Government, and subsequently the matter reached in Appeal to the Supreme Court.

In the neighbouring State of Karnataka which already had nineteen medical colleges, of which only four were Government colleges and fifteen were private unaided medical colleges, steps had earlier been initiated to consider the establishment of additional private medical colleges. As reported in the *Deccan Herald* of 28 November 1991 the Health Minister of Karnataka stated that a Cabinet Sub-Committee would consider opening of additional private medical colleges in the State after deciding eighteen applications which were pending consideration of the Government, and were seeking such approval. Almost concurrently, Justice Kuldip Singh and Justice R.M. Sahai, constituting a Division Bench of the Supreme Court, delivered the epoch making judgment on 30 July 1992 in the case of *Mohini Jain Vs. State of Karnataka and Others*. A detailed consideration of the background of this case and the essence of the landmark judgment is in order.

The Karnataka Legislature enacted, in the year 1984, the Karnataka Educational Institutions (Prohibition of Capitation Fee) Act. While recognizing 'that the practice of

collecting capitation fee for admitting students into educational institutions is widespread in the State; and that this undesirable practice besides contributing to large scale commercialization of education has not been conducive to the maintenance of educational standards', the Act aimed 'to prohibit the collection of capitation fee for admission to educational institutions in the State of Karnataka'.

Clause (b) of Section 2 of the Act defines the expression 'Capitation fee' in the following words:

'Capitation fee' means any amount, by whatever name called, paid or collected directly or indirectly in excess of the fee prescribed under Section 5, but does not include the deposit specified under the provision to Section 3.

Section 3 prohibits collection of capitation fees by any educational institution or anyone connected with its management, notwithstanding any other law for the time being in force.

Section 5, which is the other provision referred to in the aforesaid definition, in essence empowers the Government to regulate the amount of fees to be paid as specified hereunder:

It shall be competent for the Government, by notification, to regulate the tuition fee or any other fee or deposit or other amount that may be received or collected by any educational institution or class of such institutions in respect of any or all class or classes of students.

In exercise of the power conferred by Section 5 of the Act, the Government of Karnataka issued a notification on 5 June 1989. According to this notification, from academic year 1989-90, the fees payable in private medical college was Rs. 2,000/- p.a. in case of students admitted against 'Government Seats' (the same as in the Government Medical Colleges), Rs. 25,000/- in the case of other Karnataka students and Rs. 60,000/- in the case of non-Karnataka students.

Miss Mohini Jain, a non-Karnataka student alleged that besides being asked to pay Rs. 60,000/- towards the first year's tuition fee, she was also asked to pay (this was denied by the Management) an additional sum of Rs. 4,50,000 as capitation fee. Being unable to do so, she was refused admission. She then filed a writ petition in the Supreme Court.

The Bench which heard and disposed of the writ petition framed four questions as arising for its consideration viz, (i) Is there a 'right to education' guaranteed to the people of India under the Constitution? If so, does the concept of 'capitation fee' infract the same? (ii) Whether the charging of capitation fee in consideration of admission to educational institution is arbitrary, unfair, unjust and as such violative of the equality clause contained in Article 14 of the Constitution? (iii) Whether the impugned notification permits the Private Medical Colleges to charge capitation fee in the guise of regulating fees under the Act? and (iv) Whether the notification is violative of the provisions of the Act which in specific terms prohibit the charging of capitation fee by any educational institution in the State of Karnataka?

On the first question, the Bench held that 'charging capitation fee in consideration of admission to educational institutions is a patent denial of a citizen's right to education under the Constitution'.

On the second question, the Bench held that ‘the State action in permitting capitation fee to be charged by state-recognized educational institutions is wholly arbitrary and as such violative of Article 14 of the Constitution of India...The capitation fee brings to the fore a clear class bias.’

On the third question, the Bench held that having regard to the scheme of the Act, charging of Rs. 60,000 for admission is ‘nothing but a capitation fee’. The Bench also held the view that Rs. 60,000 per annum permitted to be charged from Indian students from outside Karnataka in Para 1(d) of the notification is not tuition fee but in fact a capitation fee and as such cannot be sustained and is liable to be struck down.’ The notification impugned was accordingly held to be outside the scope of the Act and bad.

It was a combination of factors including the Supreme Court judgment in Mohini Jain case as well as the political fate of the Chief Minister of Andhra Pradesh following the decision of his Government as referred to above, which probably resulted in the final action of the Chief Minister of Karnataka who announced the withdrawal of the Government order of 1992 sanctioning fresh capitation fee colleges.

At this time, there was increasing public awareness and concern as reflected in the reports in newspapers and questions raised in Parliament. Taking cognizance, the Central Government intervened by promulgating the Indian Medical Council (Amendment) Ordinance 1992 which resulted in the insertion of Section 10A to the Indian Medical Council Act, 1956. The Section under reference is such a landmark that it warrants complete recapitulation:

Notwithstanding anything contained in this Act or any other law for the time being in force,

(a) no person shall establish a medical college, or

(b) no medical college shall

(i) Open a new or higher course of study or training (including a post-graduate course of study or training) which would enable a student of such course or training to qualify himself for the award of any recognized medical qualification; or

(ii) Increase its admission capacity in any course of study or training (including a post-graduate course of study or training), except with the previous permission of the Central Government obtained in accordance with the provisions of this Section.

In the enabling provisions, it was stated that any proposal for opening new medical college etc. shall be referred by the Central Government to the Medical Council of India who while passing an order shall have due regard to the following factors, namely;

(a) whether the proposed medical college or the existing medical college seeking to open a new or higher course of study or training, would be in a position to offer the minimum standards of medical education as prescribed by the Council under Section 19A or, as the case may be, under Section 20 in the case of post-graduate medical education;

(b) whether the person seeking to establish a medical college or the existing medical college seeking to open a new or higher course of study or training or to increase its admission capacity has adequate financial resources;

(c) whether necessary facilities in respect of staff, equipment, accommodation, training and other facilities to ensure proper functioning of the medical college or conducting the new course of study or training or accommodating the increased admission capacity have been provided or would be provided within the time-limit specified in the scheme.

(d) whether adequate hospital facilities, having regard to the number of students likely to attend such medical college or course of study or training or as a result of the increased admission capacity, have been provided or would be provided within the time-limit specified in the scheme;

(e) whether any arrangement has been made or programme drawn to impart proper training to students likely to attend such medical college or course of study or training by persons having the recognized medical qualifications;

(f) the requirement of manpower in the field of practice of medicine; and

(g) any other factor as may be prescribed.

It may be noted that the Ordinance for the first time empowers the Government of India to regulate medical education both in quantitative and qualitative terms by linking the decision-making to the requirements of manpower in the field of practice of medicine, i.e. quantitative, and the provision of appropriate and adequate facilities in respect of staff, equipment, training, hospital beds, accommodations, etc., so as to ensure compliance with the mandatory requirements prescribed for maintaining minimum standards (qualitative) of medical education.

Furthermore, the seriousness with which the Government of India viewed this matter was reflected in the fact that the Ordinance did not only come into force on the 27 August 1992 i.e. the day it was promulgated by the President of India, but was enforced with a retrospective effect so as to bring in its purview even those medical colleges (and through separate Ordinance, dental colleges) for which sanction may have been given (as was indeed the case in Andhra Pradesh) by one or more State Governments in June and July 1992. Thus Section IOC of the Ordinance states as follows:

If, after the 1st day of June, 1992 and on and before the commencement of the Indian Medical Council (Amendment) Ordinance, 1992 any person has established a medical college or any medical college has opened a new higher course of study or training or increased the admission capacity, such a person or medical college, as the case may be, shall seek, within a period of one year from the commencement of the Indian Medical Council (Amendment) Ordinance, 1992, the permission of the Central Government in accordance with the provisions of Section 10A of the principal Act.

The Ordinance clearly spells out the fact that no medical qualification granted to any student by any medical college not established within the provisions of the Act, shall be considered as a recognized medical qualification. There was thus a legal bar enforced regarding practice of medicine by in effect derecognizing the medical qualification granted by such an institution.

While the Ordinance, which subsequently in April 1993 became an Act of Parliament, provided effective means for regulating the quantitative and qualitative aspects of medical manpower, the question of capitation fee which was being charged by private

medical colleges already in existence prior to 1 June 1992, was deliberated upon by the Supreme Court in the judgments delivered in *Mohini Jain Vs State of Karnataka* and *Unni Krishnan Vs State of Andhra Pradesh* and Ors. The judgment dealing with the question of admission of a student to medical college determined through the payment of unrestricted and unspecified amount of capitation fee irrespective of the merit of the student determined by a ranking order, crystallizes the issue most succinctly by putting the Amendment introduced through Section 3A referred to earlier, in its correct perspective:

In short it means that it is open to a private medical/engineering college to admit students of its choice to the extent of fifty per cent - so long as they have qualified in the common entrance test - without regard to the ranking and/or merit. The dispensing with the Section 5 for the above purpose is a clear indication that it is open to the institution to collect such capitation fee as it can from such students. Of course, the 'tuition fee' shall be the same as is prescribed by the Government under Section 7.

It was further stated that Section 3A, read as a whole, reads to the following consequences:

(a) It is open to the private educational institutions to charge as much amount as they can for admission. It will be a matter of bargain between the institution and the student seeking admission.

(b) The admission can be made without reference to inter-se merit of paying candidates. The institution will be entitled to pick and choose the candidates among the applicants on such considerations as it may deem fit.

(c) Section 5, which prohibits collection of capitation fee by an educational institution, is expressly made inapplicable to such admission. This is not without a purpose. The purpose is to permit the institutions to charge as much as they can in addition to the collection of the prescribed tuition fee. Having crystallized the issue most candidly, the judgment provides an equally precise pronouncement:

The State Legislature had, therefore, no power to say that a private educational institution will be entitled to admit students of its choice, irrespective of merit or that it is entitled to charge as much as it can, which means a free hand for exploitation and more particularly, commercialization of education, which is impermissible in law. No such immunity from the constitutional obligation can be claimed or conferred by the State Legislature. On this ground alone, the Section is liable to fail.

By this pronouncement, the Supreme Court of India upheld the judgment of the Full Bench of the Andhra Pradesh High Court which had earlier struck down Section 3A as being violative of Article 14 of the Constitution.

The two judgments of the Supreme Court as pronounced by the Division Bench of Justice Kuldeep Singh and Justice R.M. Sahai and the majority judgment of the Full Bench presided over by Chief Justice Lalit Mohan Sharma and including Justice Ratnavel Pandian, Justice B.P. Jeevan Reddy, Justice J. Mohan, and Justice S.P. Barucha, are epoch-making pronouncements defining the role and place of private sector in medical education. Although both the judgments deliberate upon the questions of education as a fundamental right of the citizens of this country, for the limited purpose of the present discussion, it may not be necessary to go into that question.

To summarize, (i) health manpower policy as stated in the Eighth Plan document shall be one of the determinants for the future expansion or otherwise of medical education in the country, and shall be taken into consideration along with the quality of the process of medical education to be ensured through a critical review of necessary facilities and infrastructure, before permission is granted to open a new medical college, (ii) a certain degree of uniformity regarding standards of entry of students for undergraduate medical education shall be mandatory as determined by *inter se* merit irrespective of the category, and shall not be distorted by the ability of the parents to pay for such education; and (iii) the fee structure for medical education shall be determined through a well-defined process which must be fair, objective, and transparent.

In the context of these far-reaching policy decisions, legislative action and judicial pronouncements, it may not be easy to envision the future shape of medical education with clarity and precision, although undoubtedly it is bound to be more robust and vibrant. One thing is, however, certain: any system is as good as the people who operate the system. The Planning Commission, the Parliament and the Supreme Court have reinforced the basic tenets of equity and quality in medical education. It is now for the medical educationists to respond with sensitivity and responsibility to the challenge posed—and the opportunity provided.

Bio-Social Dimensions of Ageing*

There is a growing challenge of ageing population throughout the world, and an equally imperative necessity to develop rational intervention strategies to respond effectively to perceived and projected needs of the elderly. While so doing, it is as important to consider scientific basis of the existing and emerging issues, as to relate these to the traditional and cultural context of Indian society.

Although human life span in Biblical context is three score years and ten, longevity according to Shastras seems to be a function of the time cycle or *yugas*. In the *Satyuga*, life span extended over two to three hundred years. It progressively declined in *Dwapar* and *Treta yugas*, till it reached 100 years or less in the present age of *Kaliyuga*. The Vedas put the human life span between 100-120 years. Hindu astrologers use *vimsottari dasa* which covers a span of 120 years. The concept of age in *Charak* and *Sushruta Samhitas* provides an interesting study of the evolution of human thought process. *Charak Samhita* (Vimana, 8, 122) defines age as the bodily condition which is a function of time-units. Human life is broadly divided into three age-groups: (i) childhood where the physical (and possibly hormonal and biochemical) constituents are as yet immature, tender and incapable of bearing excessive physical or emotional strain; (ii) middle age when the constituents of the body have matured and all the faculties are functionally efficient; and (iii) old age. It is interesting to note that middle age has been further sub-divided into three phases: adolescence (16-18 years); early youth (18-25 years); middle youth (25-55 years); and late youth (till 70 years). Thus old age begins after completing three score and ten years and continues till about 100 years, considered as the normal human life span. Finally, old age has been described as a period of life when the individual gradually loses his bodily strength, sensory efficiency and mental vigour; his body constituents begin to disintegrate and the *vayu dosha* predominates in this phase. In fact, late old age (till 100 years), when the abilities of organs of action (i.e. comprehension, speech, locomotion, excretion, and procreation) are diminished has been clearly demarcated and separated from the final ripe old age (till 120 years), when the awareness of the surroundings gets progressively dim. The description of the final end of an individual is provided in *Sushruta Samhita* (Sutra, 35, 29) which compares the end of life's journey to 'collapse of an old house in a storm'.

It seems abundantly clear that our ancient wisdom differentiated the process of ageing from that of senescence; it also finds a resounding echo in our recent definitions and concepts of ageing such as those provided by Finch (1990). The term 'ageing' is commonly described to include post-maturational processes over life time. Thus ageing can refer to a time-related process while senescence includes those processes which are deteriorative and impart increased vulnerability to disease and disability.

Ageing: A Bio-social Interface

Sir Peter Medawar, a foremost biologist of our times, succinctly stated in 1952: 'Ageing is a problem of conspicuous sociological importance'. While at the time when the statement was made it was considered somewhat exaggerated, in today's context it may well be called an understatement. As shall be discussed subsequently, the demographic shifts and epidemiological evolution are posing enormous social and societal challenges which not only relate to the narrow confines of increasing needs of medical and health

services but also to the wider context of the requisite structural changes in the social *milieu* of our society.

Evolutionary Perspective

Table 1 provides the evolutionary perspective of human longevity, in contrast to the traditional Indian perspective over the millennia that was described earlier. Two pieces of significant information emerge from such a study. First, that the average (or median) life span represented by the age at which fifty per cent of a given population survives, has progressively increased to reach the present level of approximately 70-80 years in the industrialized societies and sixty to seventy years in some of the rapidly developing societies. Secondly, in contrast, the maximum life span has remained approximately constant at about ninety to hundred years.

Table 1. Evolutionary Perspectives on Human Longevity

Period	Age (years)
Africa 50000 yrs.	13.5
Europe, 15000 yrs	27
Rome, 1100BC	37
US, 1970	70

Although there is some recent evidence suggesting that a small increase in the human maximum life span is occurring, but the data need to be further substantiated. Maximum life span also appears to be species-specific, suggesting a programmed genomic component as a determinant of the rate of ageing process that is characteristic for a given species. For example, when a literal or proverbial reference is made to ‘men and mice’, there may also be a biological dimension to it as maximum life span of humans is 30-fold higher than that of mice.

Ageing Population: Concerns and Constraints

Major determinants for the development of sound and rational policies and programmes for the elderly include: (i) population growth; (ii) demographic shifts; (iii) epidemiological evolution; (iv) changing nutritional profile; and (v) altered life styles.

Population Growth

Present world population in different geographical regions, and of the two most populous countries, along with the projected growth trends over the next century are shown in Table 2. Salient features that emerge from a critical study indicate that (i) the world population at the end of the twenty-first century will be about twice as much as it is at the present time, (ii) the population growth will be much more in the developing than in the developed world, and that (iii) China and India, which presently constitute one-half of the developing world, shall continue to be the most populous countries in AD 2100, although they would then constitute about forty per cent of the total population of the developing

countries.

Demographic Shifts

The developing countries are undergoing, and shall continue the trend through the first half of the twenty-first century, a demographic shift resulting in changes in age-structure thereby transforming the population profile, which will increasingly resemble that of the industrialized societies. Thus, the proportion of population aged sixty-five and above shall increase from four per cent in 1990 to nine per cent by 2030, resulting in a major change in the absolute number of the elderly from 184 million to 678 million.

The progressive growth of older population in India is shown in Table 3. During the four decades (1961-2001), the number of people in age group 65-9 will multiply four-fold, and in age group 70-4 three-fold, with a total of 75 million persons over the age of 60 by the year AD 2000, constituting 7.4 per cent of the total population.

There is a considerable demographic diversity in India. Within the general contours of a marked increase in life expectancy along with a change in the population structure and an increase in the number of elderly, there are major differences within different states of India. For example, the female life expectancy in Kerala is 73.8 years while the corresponding figure in Uttar Pradesh is 49.6 years. Such differences are also reflected in other demographic indicators; infant mortality rate is ninety-nine in Uttar Pradesh, while it has been brought down to seventeen in Kerala. It is therefore obvious that health planning and health care services must relate to area-specific needs, and must take into cognizance the competing demands for resources. While general principles of health care for the elderly would have a commonality of approach, precise planning, and strategies would differ in different parts of the country.

Table 2. World Population: Present and Future

	Population*		Annual Growth	Projected		
	(in millions)		Rate**	Population Levels***		
Geographical						
Perimeter			1990-			
	1990	2000	2000	2025	2050	2100
World	5,292.2	6,260.8	1.7	7,765.5	8,911.9	9,705.6
More Developed	1,150.1	1,206.4	0.5	1,318.4	1,338.0	1,347.0
Less Developed	4,070.6	4,978.3	2.0	6,447.2	7,573.9	8,359.0
Africa	639.3	862.7	3.0	1,226.9	1,547.5	1,807.8
Latin America						
and Caribbean	445.2	535.2	1.8	685.9	798.9	860.6
Asia and						

Middle East	2,990.7	3,585.7	1.8	4,539.1	5,235.4	5,698.4
Eastern Europe	124.0	129.2	0.4	139.7	146.9	152.7
India	853.1	1,041.5	2.0	1,287.4	1,495.0	1,648.8
China	1,139.1	1,299.2	1.3	1,582.0	1,741.1	1,826.3

* Source: Population Council, New York, September 1991,

** Based on UN median projections. World Population Prospects 1990, New York, 1991.

*** Source: World Bank Data Files (McNamara).

Table 3. Growth of Older Population, Actual and Projected

Age group	in thousands							
	1961		1971		1981		2001	
	No.	%	No.	%	No.	%	No.	%
55-59	9831	2.2	12829	2.3	16442	2.5	33813	3.5
60-64	11241	2.6	14372	2.6	18154	2.7	28185	2.9
65-69	4850	1.1	7000	1.3	9499	1.4	20697	2.2
70-74	4416	1.0	5977	1.1	8200	1.2	13144	1.4
75-79	1723	0.4	2369	0.4	3166	0.4	7542	0.8
80-84	1572	0.4	2174	0.4	2715	0.4	3918	0.4
85+	916	0.2	1215	0.2	1439	0.2	2210	0.2
Total	438933		548159		665385		959215	

There is also a progressive increase in the median age at death in the developing countries, e.g., India, as has happened in the developed world during the first half of this century: median age at death* in England and Wales increased from 32.5 years in 1891 to approximately 75.5 years in 1990. A similar phenomenon is being observed in all six regions of the developing world wherein the median age at death has shifted from below twenty in 1950, to sixty in China and to nearly forty in India, in 1990. The projected median age at death by the year 2030 is seventy for India, and seventy-eight for China: these figures would be similar to those in the U.K. in 1990. Thus, both the absolute increase in numbers and an increase in median age at death, shall continue to result in a disproportionately large increase in the proportion of the elderly. The ongoing demographic transition (Table 4) therefore, consistently points only in one direction: population and health profiles in the developing world during the first-half of the twenty-first century and possibly later also, shall demonstrate a profound epidemiologic impact with significant reduction in the health problems of the young, and a proportionate increase in the health problems of the elderly.

Table 4. Change in the age structure of population

Census year	Male			Female		
	0-14	15-59	60+	0-14	15-59	60+
1881	39.2	56.2	4.6	37.6	56.5	5.9
1891	39.4	56.0	4.6	38.2	55.9	5.9
1.901	38.7	56.7	4.6	37.4	57.0	5.6
1911	38.2	57.0	4.8	37.4	56.9	5.1
1921	38.9	56.0	5.1	38.5	55.8	5.7
1931	38.6	56.5	4.9	38.4	56.2	5.4
1941	39.3	55.3	5.4	39.0	55.1	5.9
1951	38.2	56.5	5.3	38.6	55.7	5.7
1961	40.9	53.6	5.5	41.2	53.0	5.8
1971	41.9	52.2	5.9	41.9	52.1	6.1
1981	39.5	54.1	6.4	39.6	53.8	6.6
1992*	36.3	57.8	5.9	35.8	37.7	6.5

* SRS data; excludes J & K.

The less developed countries such as those in Asia, Sub-Saharan Africa and in Latin America presently have a high prevalence of communicable diseases which add to the already significant morbidity and mortality due to malnutrition-related and pregnancy-attributable causes, a situation not dissimilar to the one that prevailed on a world-wide basis at the end of the last century. Sub-Saharan Africa at present has the highest total disease burden per 1000 population; seventy-one per cent of this burden is accounted for by communicable diseases. In contrast, it is medium in Latin America where communicable diseases account for forty-two per cent of this burden. There is a striking change in this pattern in industrialized countries, generally grouped as established market economies, wherein communicable diseases account for only ten per cent of the total disease burden. In contrast, non-communicable diseases including diabetes, heart diseases and cancer show an exact opposite pattern, accounting for nineteen per cent of the total burden in Sub-Saharan Africa, forty-three per cent in Latin America and seventy-five per cent in the established market economies.

Factors contributing to Age-related Degenerative Diseases

Changing Nutritional Profile

Westernized diets with an excess of energy, dense, saturated fat, and refined carbohydrate-rich foods are adding to the burden of diabetes and heart disease. Indeed, the developing countries are presently exposed to a 'double-trouble syndrome' wherein while malnutrition-related diseases still constitute a significant proportion of disease burden in the young, increasing economic liberalization is opening hitherto non-available national markets to westernized fast-food conglomerates which use modern marketing techniques through media networks and are successfully effecting changes in age-old dietary habits, thereby contributing to an already discernible increase in the prevalence of diabetes and heart disease. The human indignity inflicted by imperial colonization in the past is now being subtly replaced by the human disease burden through *cola*-nisation!

Altered Lifestyles

Increasing physical inactivity characterizes a significant change in the lifestyle of people in most parts of the world, more so where there has been a sharp rate of increase in the GNP resulting in economic affluence over a short period of time. This phenomenon has been witnessed in the oil rich countries in the Middle-Eastern crescent, and is associated with a marked increase in the prevalence of diabetes (NIDDM), obesity and cardiovascular disease. Cross-sectional studies provide confirmatory evidence showing a two to four fold increase in the prevalence of diabetes in several ethnic groups including migrant Indians, Polynesians, Micronesians, and Melanesians.

The association between physical activity and the risk of developing diabetes and heart disease continues to show a significant correlation, even when adjusted for multiple variables such as obesity and family history of diabetes and cardiovascular disease. Obesity has also been implicated as a risk factor for diabetes both in cross-sectional as well as in longitudinal studies.

A more significant correlation seems to emerge between the distribution of body fat and prevalence of diabetes and hypertension; central or visceral adiposity constituting a risk factor in multi-ethnic groups such as Asian Indians, Hispanic population in the US, native Americans, Chinese, and Creoles in Mauritius. The exact mechanism(s) through which overall body mass and visceral adiposity (central obesity), either independently or combined together, influence carbohydrate tolerance and blood pressure, need precise

definition; however, physical training may improve glucose intolerance as well as other associated metabolic abnormalities, in addition to bringing down blood pressure.

Neuronal Ageing

Neuronal ageing is emerging as the key to the understanding of underlying neuro-biological processes. The crucial question is the selective and heterogeneous nature of the neuronal changes. For example, why is it that in the ageing brain very few neurons disappear from those areas of hypothalamus that synthesize and release hormones which are trophic to the pituitary, while a large number of neurons disappear from the *substantia nigra* and *locus coeruleus*? Why is the neuronal loss in the hippocampus so regulated that it approximates about five per cent of the total neurons in this area during each decade in the second half of life? As it is, the limbic system is essential to learning, memory and emotion. In preprogramming the quantum of neural loss at a low rate, is nature being merciful to man?

Lifestyles and Longevity: Lessons from Epidemiology

The biology of ageing is a subject of intensive research. Recent data provide enough evidence to indicate that dietary restriction may be an important antidote to ageing, provided such an approach is followed throughout life, and is initiated during early adulthood. It has also been demonstrated that older persons who regularly do aerobic exercise perform better in cognitive tests than age-matched sedentary individuals. With the emerging role of highly reactive free radicals in the ageing process, and as possible causes of membrane damage in general, and mitochondrial DNA in particular, there is a growing recognition of the advantage that vegetarian diets offer in counteracting these processes. Put together, it seems that our ancient Rishis who practiced dietary restrictions, followed vegetarian diet, practiced yoga throughout life, and lived at high altitude in the Himalayas, had imbibed the essentials for longevity and the quality of life. Indeed, both are equally important. The basic role of medicine need not, and indeed must not, be only to add years to life; it should also strive to add life to years.

Socio-economic Perspective

The complexity and multi-dimensional nature of socio-economic perspective warrant a major in-depth study and debate. Two areas however need to be highlighted, although briefly.

Dependency Ratio

The economic capacity and capability of the elderly is sometimes measured by the estimation of dependency ratio. This relates economic well-being to the demographic structure of the population. The child dependency ratio, the elderly dependency ratio, and the total dependency ratio, constitute the core of such consideration. While the child dependency ratio relates to the number of children under the age of fifteen per 100 persons in the age group 15-59, the elderly dependency ratio is defined as the ratio of persons aged sixty and above per 100 persons in the 15-59 age group. A summation of these two ratios provides the total dependency ratio.

The underlying assumption that children under fifteen and persons aged sixty and above are unlikely to contribute to productive economic activity and therefore shall necessarily be dependent on those belonging to 15-59 age group, may not be necessarily true. On one

end of the spectrum we are deeply conscious of the problem of child labour where children under fifteen do work in harsh and primitive conditions at the cost of their health and welfare, thus reflecting the undesirable element of the socio-economic structure; at the other end we must also be aware of the fact that a person may be defined as old on the basis of a certain pre-established chronological point in life, irrespective of his or her continuing capability to contribute positively and effectively to an economically productive life. In industrialized societies, retirement from a full time employment based on the provision of financial or social security in the later years of life may not necessarily relate to the biological process of ageing.

Notwithstanding the proviso mentioned above, recent data compiled by Sharma (1994)* is shown in Table 5. It provides not only the child, elderly and total dependency ratios over a period of fifty years (1951-2001) but also includes information regarding index of ageing which is defined as number of persons aged sixty plus per hundred children aged 0-14 years.

Table 5: Dependency ratios and indices of ageing, India, 1951-2001

Year	Dependency Ratio			Index of Ageing
	Child	Elderly	Total	
1951	68.49	9.80	78.29	14.31
1961	76.97	10.56	87.53	13.72
1971	80.82	11.47	92.29	14.20
1981	73.64	11.92	85.56	16.18
1991	61.43	11.31	72.75	18.42
2001	50.94	12.59	63.53	24.72

Source: Sharma (1994).*

With the change of demographic profile in India and an upward shift in the median age of death, there is a proportionate decrease in the number of children below the age of fifteen as compared to a corresponding increase in the work force aged 15-59. Thus, since 1971 when the child dependency ratio at 80.82 was the highest, there has been a progressive decline to a ratio of 61.43 in 1991, and is projected as 50.94 in 2001. As expected, there has been a progressive increase in the elderly dependency ratio from 9.80 in 1951 to the projected ratio of 12.59 in 2001. Corresponding changes are also seen in the index of ageing.

While the dependency ratios are based on cut-off points related to pre-defined specific age groups, available data also indicates that the number of economically active in the aged population in India compares favourably with the corresponding data from other countries. While in Sweden, UK and USA the figures are 2.5, 2.1 and 2.4 per cent

respectively, the corresponding figure from India is 2.2 per cent.

Besides the economic productivity, it may also be emphasized that the oriental cultures including the Indian and the Chinese have evolved over the millennia a social stratification and traditional structure where the elderly not only continue to have a sense of belonging, recognition and involvement, but also continue to provide advice and guidance to the younger members of the family who show in various ways their love, affection and gratitude to the older generation. The last few decades have seen large rural to urban and urban to urban migrations thus disrupting the social fabric of joint family and creating rural-urban imbalances, to the disadvantage of the elderly. However the family still constitutes the base and basis of the traditional social security system for the aged population.

Social Welfare for the Elderly

For the care of the elderly, the most important welfare measure was the scheme of the old-age pension to those without any means or support. By the end of the Seventh Plan, all the states and union territories had old-age pension schemes, the extent of coverage depending upon the resources of the state. In 1988, 49.16 lakh persons, constituting about nine per cent of the population above sixty years, were receiving old-age pension from the state governments/union territory administrations. The rates of pension varied from Rs.60 to Rs.100 per month. The central government operated a scheme under which grants were given to voluntary organizations for a wide range of institutional and non-institutional services. In the Seventh Plan, Rs.136.73 lakhs were given as grants-in-aid. The scheme received encouraging response and in 1990-91, grants-in-aid of Rs.85.58 lakhs were given to ninety-three organizations. Some of the states, too, assisted voluntary organizations to set up old age homes.

The Eighth Plan emphasizes that the programmes for the elderly will be both developmental and humanitarian. Their experience and energies will be utilized for societal well-being. Community and family-based welfare services will be developed for the elderly with the assistance of voluntary organizations. Public services are being directed to show greater sensitivity to the needs of the elderly. The scheme of old-age pension in the states is being rationalized, and attempts are being made to provide wider coverage and the process of disbursement is being streamlined.

A provision of Rs.10 crores has been provided as financial outlay for schemes for the welfare of the aged during the Eighth Plan.

Gender-specific Issues in the Elderly

The recent projections by the UN indicate that by 2025, the number of sixty plus women shall be 604 million amongst a total world population of 7.7 billion, thus constituting about nine per cent of the total population. More than two-third of these women shall live in rural poverty. Thus these women will be disadvantaged on three counts: (i) gender; (ii) age; and (iii) poverty. This is what I call a 'triple-trouble syndrome'. It seems that from the birth to the grave, die is cast on the basis of gender: female foeticide, female infanticide, sexual exploitation, and crimes such as rape and bride burning.

Although there is a major emphasis in the Eighth Plan on development of women, most of the efforts are circumscribed to younger age groups including the girl child with emphasis on education, employment, and empowerment. These issues have been

prioritized as they have a strong correlation with the fertility rate and population growth. Even the health issues are viewed in the context of reproductive health, again emphasizing that reproductive years constitute the critical and crucial period of the life span of a woman.

In a study, D'Souza has highlighted critical areas requiring further study and possible action. Compared to men, elderly women have a higher rate of widowhood. While seventy-eight per cent of the women in the seventy plus age group had lost their spouse, the corresponding figure for men was twenty-eight per cent. In industrialized societies, a similar phenomenon is also seen but at a smaller scale and for different reasons. In India, it is considered culturally unacceptable for a man to marry a woman who is elder to him in age; generally the man is older by three to five years, and therefore tends to die earlier. On the other hand, in the Western society, women tend to have a longer life span than men, thus contributing to widowhood. Finally, remarriage of an elderly woman in a Western society *is* considered entirely acceptable. In the context of our culture, such a phenomena would be extremely rare, if at all it ever happens.

The average age of widowhood in an Indian study was forty-four years in contrast to the corresponding age of fifty-six years for the American women. In the context of social poverty in the developed countries, it was observed that following widowhood the living standards became lower by eighteen per cent, and ten per cent of the women were pushed to a level below poverty line as defined in those countries. In India, especially among the rural poor, widowhood is an unmitigated disaster leading most of them to mere level of subsistence and causing emotional trauma and physical distress. Finally, the carefully inculcated traditional image of lack of self-reliance and an attitude of helplessness subjects these women to total dependence in old age irrespective of their marital status. In order to survive, they continue to prove their usefulness by sharing household chores, caring for the sick children, and assisting the family in more than one ways. All this leads to lowering of self-esteem and a persistent feeling of being considered a non-entity within the family surroundings where they once enjoyed position of prestige and respect. Concerted efforts are therefore necessary to study the issues related to the socio-economic well-being of the elderly women, along with their health needs especially those related to physical and mental health. It is only when sound data base is made available and a community awareness is generated to prioritize the needs of the elderly women as issues of major importance for women, then and then alone policy makers and health planners would respond to such unmet needs in this underserved segment of society.

Epilogue

Some of the concerns expressed regarding the socio-economic, psychological and emotional, and health care support for the elderly are in effect overarching and need not be considered distinct issues. It is only when a holistic view is taken that the different hues of the golden sunset years can be visualized and efforts made to enhance the quality of life of the elderly.

Shakespeare in *As You Like It* uses the memorable characters of Lord Jaques to describe the seven ages of man, with a masterly description of the golden sunset:

Last scene of all, that ends this strange eventful history, is second childishness and mere oblivion.

Health care of the elderly is now an area which requires intense interlocking of the services offered by the national health care system and the efforts of the voluntary organizations in providing social and behavioural support to the elderly by strengthening the traditional family structure through counselling.

The ultimate end should neither be looked at with a sense of relief from the drudgery and misery of living, nor should it create a sense of awe and fear of death. Religious beliefs and faiths can provide the requisite support till the journey's end.

*McNamara, R.S., A Global population policy to advance human development in the 21st century, with particular reference to India. In the Rajiv Gandhi Memorial Lecture, New Delhi, May 23, 1992.

*Median age at death is the age below which half of all deaths in a year occur.

*Sharma, S.P., Ageing in India: Some facts brought about by census data. In Ramachandran, C.R. and Shah, B. (eds.) *Public Health and implications of Ageing in India*. Indian Council of Medical Research, New Delhi.

Nutrition, Health and Poverty*

An Interactive Interdependence

Poverty has existed in every society at all times of history. Mahatma Gandhi believed that basic education must include 'the elementary principles of sanitation, hygiene, nutrition'. Soon after Independence, the National Planning Committee estimated that 'something like seventy-five per cent or even more of the incidence of physical disabilities other than those due to infectious diseases can be prevented by the provision of suitable food, adequate both in quantity and quality'. The main cause for malnutrition in India, as in other countries of the South-East Asia, is poverty. The interactive interdependence of nutrition, health and poverty is therefore obvious, although its awareness amongst health professionals and health planners seems to be generally lacking.

In spite of the advances in science and technology and the progress of human civilization, poverty continues to remain a universal phenomenon. Nevertheless, its magnitude differs in different countries, as do its causes and manifestations. The impact and outcome of economic development must be measured in terms of a quantifiable reduction in the numbers of those below the poverty line. Estimates of the prevalence of poverty vary widely in different countries and in different regions, depending upon the conceptual framework of the definition of poverty, methods of its measurement, and data base used for its ascertainment.

Defining Poverty

Although there is a general agreement regarding the importance of quantifying poverty, there is a considerable divergence of opinion among experts regarding the methodology to be employed for its measurement. Nevertheless, in order to assess the outcome and impact of the poverty alleviation programmes, use of a predefined yardstick is an essential prerequisite.

The delineation of a poverty line in India was first attempted by a Working Group in 1962. Amongst its members were eminent economists and social scientists including V.K.R.V, Rao, Pitambar Pant, Ashok Mehta, P.S. Lokanathan, D.R, Gadgil. While making its recommendations, the Working Group gave major consideration to the Report of the Nutrition Advisory Committee of the Indian Council of Medical Research (ICMR), prepared in 1958. The Working Group concluded that the national minimum for each rural household of five persons (four adult consumption units) should not be less than Rs.100 per month at 1960-1 price level. For urban areas the corresponding figure was Rs.125 per month per household. Thus, it was Rs.20 per capita for rural and Rs.25 per capita for the urban areas. This national minimum excluded expenditure on health and education, both of which were expected to be provided by the State as committed in the Constitution.

Dandekar and Rath (1971) recognized an average calorie norm of 2250 per capita per day for both rural and urban areas, as a criterion to define the poverty line. Using the National Sample Survey (NSS) data on consumer expenditure, they concluded that at 1960-61 prices, annual per capita expenditure of Rs.170.80 (or Rs.14.20 per capita per month) in rural areas would provide the requisite level of food consumption to meet the

defined calorie requirements. The corresponding figures for the urban areas were Rs.271.70 and Rs.22.60 respectively, at 1960-1 prices. In their effort to reconcile their recommendations as far as possible with those of the Working Group, it was suggested that an upward revision be made for the rural minimum so as to raise it to Rs.180 per annum or Rs.15 per month, and that the urban minimum be rounded off to Rs.270 per annum or Rs.22.50 per month, both at 1960-1 prices. It may however be noted that the poverty norm or national minimum proposed by the Working Group in 1962 reflected a broad judgment of minimum needs and was not exclusively related to nutritional requirements, although these were taken into account based on the ICMR recommendations. In contrast, Dandekar and Rath used the calorie norm as the base and basis for their recommendation.

A Task Force constituted by the Planning Commission in 1979 defined the poverty line as the per capita expenditure level at which the average per capita per day energy intake was 2435 calories in rural areas and 2095 calories for urban areas. This definition fully took into account the age, sex, and activity as important determinants of caloric allowance as recommended by the ICMR Nutrition Advisory Committee. To facilitate common usage, these calorie norms were rounded off to 2400 calories per capita per day for rural areas and 2100 calories per capita per day for urban areas.

In order to work out the consumption expenditure corresponding to these caloric norms, NSS data (1972-4) relating to household consumption both in quantitative and value terms were used, and the caloric content of consumption baskets corresponding to various per capita expenditure classes was worked out. Based on the observed consumer behaviour in 1973-4, it was estimated that on an average, consumer expenditure of Rs.49.09 per capita per month provided a per caput intake of 2400 calories per day in rural areas while the corresponding consumer expenditure in urban areas was Rs.56.64 per capita per month for a calorie intake of 2100 per day.

The concept of poverty line that has been used since 1979 for the planning process in the Planning Commission is therefore partly normative and partly behavioural. Although it is anchored to a pre-defined norm of calorie requirements, it neither seeks to measure nor does it attempt to relate to the nutritional status of the population, which in most specific terms would be the measurement of prevalence of under-nutrition or malnutrition in the population. Finally the calorie norms used for the delineation of the poverty line relate to an average for the reference group and not to the minimum required for biological existence, nor do these take into account the inherent capacity of the biological system for metabolic adaptation.

Poverty and Hunger

Do we need economists and social scientists to continue the academic debate on the limitations of the existing methodology to measure poverty? Could there be an alternative approach imparting an inherent depth and intrinsic meaning to this exercise? To a poor man, what is important is not the quantitative or the qualitative aspects of food nor is he concerned with the requisite consumption expenditure to meet with his predefined caloric requirements. To him, the only criterion is whether he has the means to satisfy the pangs of hunger not only for himself but also for his family. It has therefore been suggested that hunger as perceived by people could provide an alternate approach to assess the magnitude of poverty in the country. It was with this purpose in mind that the 38th round household consumption expenditure survey of NSS, 1983, for the first time, included a set of questions addressed to the head of the household with, the objective of eliciting information regarding the provision of two square meals a day for all members of the

household throughout the year. The responses were tabulated in three categories:

- (i) Number of persons who were getting two square meals a day, all the year round;
- (ii) Number of persons who were not getting two square meals a day for some months of the year; and
- (iii) Number of persons who were not getting two square meals a day even for some months of the year.

When a summation of those who were categorized under (ii) i.e. seasonally hungry, and those in category (iii) i.e. chronically hungry, was made, the sum total provided information regarding distribution of persons who go without food at least on some occasions during the course of the year. The ratio of such persons to total population is termed as 'the hunger ratio'.

The analysis of information available indicates that the prevalence of hunger is less than the prevalence of poverty as calculated on the basis discussed earlier, both in the rural and in urban areas. This is as it should be because not all those who are poor are hungry, although all those who are hungry necessarily must be poor. What is of significance is the information that 18.54 per cent of all those living in rural areas do not get two square meals a day throughout the year. This highlights the significance of the approach: one in every five persons living in the rural areas is denied the basic need of two square meals a day during the whole year. The problem of hunger is more serious in the rural areas than in the urban areas where the corresponding figure is 6.33 per cent. Finally, a state-wise analysis does indicate that hunger is more concentrated in certain regions of the country than is poverty. For example, the proportion of chronic hunger varied from a high of 39.6 per cent in rural West Bengal, 37.2 per cent in rural Bihar, and 36.8 per cent in rural Orissa to a low of 0.85 per cent in rural Haryana and 1.6 per cent in rural Punjab in 1983.

Although the purists among social scientists and economists looking for precise and valid data may not approve of a single probing question as a determinant of the adequacy or otherwise of food available for consumption, and may rightly express reservations regarding lack of objectivity and precision in such an approach, there may be an equal number of social and behavioural scientists who may recognize the inherent strength of such an approach which relates the basic human drive of hunger to economic deprivation characterized by poverty, which in effect means a state of denial resulting in inability to satisfy such an elementary need as hunger. Be what it may, the utility of this approach essentially lies in sharply focussing attention to the most unfortunate of all problems facing humankind, namely, the problem of hunger.

Poverty and Health: Concepts and Constraints

In spite of the limitations of various approaches, both in terms of concept and content, the estimates of the number and proportion of the poor at any point in time, and variations and trends relating to them across states and over time, have provided a reference framework for not only putting the poverty alleviation programmes on the national agenda of development, but also for measuring the outcome and impact of such programmes. Measurement of such reference points have also provided a qualitative framework for research studies on the magnitude, distribution, causation, consequences and other aspects of poverty.

The ratio of the population below the poverty line to the total population is the poverty ratio, also known as the 'head-count ratio'. The poverty line and the poverty ratio quantified as numbers do not capture the essence and essentials of poverty. A reference has already been made to prevalence of under-nutrition and malnutrition. In a wider perspective, ill-health, low levels of literacy, geographical isolation, handicaps due to social hierarchy including ineffective access to law, inability to participate in civil, social and political power structures, caste and/or gender-based disadvantages, singly or in various combinations, continue to generate, sustain, and breed poverty.

Caloric intake per capita related to consumption expenditure at best provides a basis for the definition of poverty. Along with the quantitative intake of calories, it is equally important to focus on the qualitative aspects of food intake. While protein-energy malnutrition continues to remain a worldwide problem, deficiencies of micro-nutrients not only contribute to disease processes but more importantly constitute essential predisposition for vulnerability to diseases.

Indeed, it is estimated that twenty per cent of the world's population, mostly in the developing countries, are at-risk for micronutrient malnutrition. Iron, iodine, and vitamin A are the three micronutrients whose deficiencies pose the major public health challenge in view of their high prevalence, high morbidity and associated mortality. Of these micronutrient deficiencies, iron deficiency anaemia (IDA) affects the largest segment of population; the number of people at-risk of IDA is double that of those at risk of iodine deficiency disorder, and nearly ten times those at-risk of vitamin deficiency.

This is only an illustrative example to reinforce the message that measurement of poverty based on quantitative intake of calories alone, does not provide a full picture of the health impact and outcomes of poverty, which has a much larger magnitude and much wider dimension.

Finally, it is only when consumption expenditure is combined with items of social consumption such as basic education and health care, safe drinking water supply, environmental sanitation and housing, that a holistic matrix of normative requirements and effective access can be interwoven, thus providing a quantifiable dimension to quality of human capital (Fig.).

Measurement and Alleviation of Poverty during

Eighth Plan

It is worthwhile recapitulating that human development has been a continuing theme in the national developmental process. The First Five Year Plan which reflected the vision of the great leader and thinker Jawaharlal Nehru stated:

The central objective of planning in India ... is to initiate a process of development which will raise living standards and open out to the people new opportunities for a richer and more varied life. . . . Economic planning has to be viewed as an integral part of a wider process aiming not merely at the development of resources in a narrow technical sense but at the development of human faculties and the building up on an institutional framework adequate to the needs and aspirations of the people.

An equally resounding echo of this thought process reverberates in the Foreword to the Eighth Plan by Prime Minister, Shri P.V. Narasimha Rao:

. . . Human development, in all its many facets, is the ultimate goal of the Eighth Plan. It is towards fulfilling this goal that the Eighth Plan accords priority to the generation of adequate employment opportunities to achieve near-full employment by the turn of the century, building up of people's institutions, control of population growth, universalisation of elementary education, eradication of illiteracy, provision of safe drinking water and primary health facilities to all, growth and diversification of agriculture to achieve self-sufficiency in foodgrains and generate surpluses for exports...

In a publication by the Planning Commission entitled *A Technical Note to the Eighth Plan of India (1992-7)* an attempt has been made to outline the methodology of Plan formulation in detail by capturing the diverse inter-relationships and by describing the various techniques and analytical procedures that formed the basis of the Eighth Plan. As the relationship between the goals, macro-economic parameters and physical conditions are amenable to modelling in terms of a set of defined mathematical relationship(s), several sub-models were used for the Eighth Plan formulation. Of these, the consumption sub-model estimates provide consumption demand for different goods and services, taking into account the growth pattern of the economy, the projected growth in population and its demographic composition, and the inequality in consumption distribution. Private consumption is divided into four segments: rural and urban; and amongst each, into poor and non-poor groups of population. The consumption model, in effect, quantifies the extent of improvement, if any, in levels of living as a result of increase in per capita consumption expenditure and reduction in the disparity of consumption expenditure between different income classes of the population.

Using the calorie norm of 2400 calories per capita per day for rural areas and 2100 calories per capita per day for urban areas, the poverty estimates have been made with consumption expenditure at Rs.192.20 per capita in the rural and Rs.221.80 per capita in the urban population, at 1991-2 prices. Table 1 indicates the monthly per capita consumption expenditure at two different time points in the beginning (actual) and at the terminal year (projected) of the Eighth Plan period, amongst rural and urban areas, and within them, amongst poor and non-poor segments of population. Table 2 shows the poverty ratio in rural and urban areas at the beginning (actual) and at the terminal year (projected) of the Eighth Five Year Plan period.

Table 1. Monthly per capita Consumption Expenditure

(in Rs. at 1991-2 prices)

	Rural	Urban	Total
1991-92			
Poor	144.53	163.63	148.2
Non-Poor	386.97	590.56	442.93
Total	330.6	522.35	379.92
1996-97*			
Poor	154.88	174.17	159.2

	(1-39)	(1.26)	(1.44)
Non-Poor	424.1	629.75	482.15
	(1.85)	(1.29)	(1.71)
Total	394.83	592.24	449.39
	(3.61)	(2.54)	(3.42)

Note: Figures in the parenthesis indicate annual average increase in per capita consumption during Plan period.

*Projection.

The changes in consumption expenditure during the Plan period suggest a relatively higher growth in per capita terms in rural areas as compared to urban areas. The Eighth Plan projects a relatively higher growth in per capita consumption by 3.61 per cent per year in rural areas as compared to 2.54 per cent per year in urban areas. This will help in reducing, however marginally, the per capita consumption expenditure differential between rural and urban segments of the population. Per capita consumption for the country as a whole is projected to increase by 3.42 per cent per year in the Eighth Plan. The increase in per capita consumption of non-poor group of population during the Plan period is marginally higher as compared to the poor group as the incidence of poverty reduces from twenty-one per cent in the base year to ten per cent in the terminal year of the Plan.

Table 2. Poverty Ratio

(Per cent)

Sl. No.	Year	Rural	Urban	Total
1.	1991-92	23.25	15.98	21.38
		(147.44)	(35.09)	(182.53)
2.	1996-97*	10.88	8.24	10.15
		(73.55)	(21.27)	(94.82)

Note: Based on the assumption of lognormality in the distribution of per capita consumption expenditure.

Figures in the parenthesis indicate number of persons (million) below poverty line.

* Projections.

As a result of close interaction between biomedical scientists, educationists, agricultural scientists, health planners, economists, and social as well as behavioural scientists (thus not only demonstrating but amplifying the need of a cohesive and coordinated planning process with professionalism as the key, as in the Planning Commission), the recommendations made by the Expert Group on estimation of proportion and number of poor, as published in the 1973 report of the perspective planning division of the Planning Commission include the following formulation, and consequential framework of recommendations for further work:

The estimates of the poverty-ratio derived from the NSS provide a composite picture of the number of people whose per capita consumption expenditure is below the level corresponding to the basket of commodities constituting the desired minimum. It does not, however, provide a complete picture of the State of well-being of the population: for instance it does not tell us anything about the living environment (housing, sanitation, and amenities). . . . We, therefore, need to supplement the estimates of the proportion and number of poor with the assessment of the following aspects in order to capture a fuller picture of the living conditions and wellbeing of the poor.

i) The composition of the poor population in terms of dominant characteristics, i.e. their distribution by region, social group, family characteristics (e.g. size, education, age, sex of household head, dependency ratio) and the way this is changing over time. Much of this can be done by appropriate tabulation of NSS employment and consumption survey data.

ii) Nutritional status of the population: levels of intake of principal nutrients, incidence of malnutrition, anthropometric measurements and activity patterns by age, sex and socio-economic categories. This can be done by the National Institute of Nutrition.

iii) Health status: mortality (overall, infant and child, maternal); morbidity; access to and use of health services (public and private) and costs. The quinquennial surveys of public consumption as well as the mortality indicators based on the Sample Registration System and the morbidity surveys of NSS need to be put on a systematic and continuing basis.

iv) Educational status: school enrolment by region, sex and age group and by economic-social class; reach and quality of public education services and costs. Here again information from the NSS social consumption enquiries and the All-India Education Survey suitably restructured would provide the basic data.

v) Living Environment: distribution by density of settlement; living space per head; type of houses; access to safe drinking water and sanitation; access to amenities (post office, telephones, railway, pucca road, markets, etc).

Finally, it is suggested that in addition to effecting necessary improvements in the range and quality of survey data as proposed *vide supra* under (i) to (v), major research initiatives are required to validate the anthropometric data such as body weight and height for age in children (growth retardation) and body mass index in adults as easily measurable and quantifiable parameters in the country for the purpose of estimating chronic energy deficiency.

The multidimensional nature of the measurements, causes and manifestations of poverty necessitate critical in-depth studies. It needs to be emphasized that although the ability to meet with the necessary consumption expenditure for the intake of pre-defined calorie intake continues to be a parameter employed for measurement of poverty, it is equally important to supplement this methodology by the direct measurement of the presence and degree of malnutrition especially amongst the children, combined with the quality of living environment as reflected by access to safe water, sanitation and housing. Even a combination of all these measures only reflects a state of deprivation: it is equally important to realize that poverty is as much a state of deprivation as a state of vulnerability.

*Median age at death is the age below which half of all deaths in a year occur.

*Sharma, S.P., Ageing in India: Some facts brought about by census data. In Ramachandran, C.R. and Shah, B. (eds.), *Public Health, and Implications of Ageing in India*. Indian Council of Medical Research, New Delhi.

*Based on the Inaugural Address delivered at the National Seminar on Bio-social Dimensions of Poverty, Bombay, March, 1994. The seminar was jointly organized by Indian Institute of Advanced Study, Shimla and National Science Academy, New Delhi.

* Projection.

MACROECONOMIC DETERMINANTS
OF
NUTRITION AND HEALTH

Agro-Economy and Reproductive Ecology'

The interactive interdependence of health, environment and sustainable development was accepted as the fulcrum of action under Agenda 21 at the Earth Summit at Brazil in 1992. It is generally believed that the quantum increase in global population is having an adverse impact on the environment. Nevertheless, it is equally important to realize that the consumption per capita also directly contributes to environmental degradation. The relationship $ED = P \times C \times D$ illustrates this point wherein ED (environmental damage) equals P (population) multiplied by C (consumption per capita) and D (environmental damage per unit of consumption). Although current global and country populations along with projections of population growth are readily available, the rates of growth of consumption per capita need to be projected both in terms of GNP and purchasing power parity. Between developed and developing countries, a ratio of approximately seven to one bears a true relationship to purchasing power parities.

In this perspective, data in Table 1 becomes extremely meaningful.

While several developing countries are trying to improve their quality of life by rapid industrialization without putting adequate safeguards for maintaining the pollution levels in soil, water and air, the existing environmental damage is mostly due to what developed countries (industrialized societies) have already done, and still continue to do, in spite of international commitments.

Table 1

Country	% share of World Population 1996	% share of Gross World Product 1994	% share of World Carbon Emissions 1995	Emissions per capita
United States	5	26	23	5.3
Russia	3	2	7	2.9
Japan	2	17	5	2.4
Germany	1	8	4	2.9
China	21	2	13	0.7
India	17	1	4	0.3
Indonesia	4	0.7	1	0.3
Brazil	3	2	1	0.4
Total	56	59	58	0.9

Source: State of the World, 1997.

Indeed, most of the greenhouse gas emissions which carry the risk of global warming and worldwide climatic change, result from carbon dioxide release into atmosphere as a consequence of activities in the developed world (Table 1). The magnitude of health impact of such environmental damage is large, and needs consideration. The essence and essentials of health programmes must therefore include reduction of health risks from environmental pollution and hazards. The inter-digitation of primary environmental care and primary health care is therefore obvious, as is the substantial synergy that exists between poverty alleviation and environmental protection.

Population growth and industrial as well as agricultural development pose huge environmental challenges.

Socio-Economic Implications of Rapid Population Growth

India's population has expanded from 342 million in 1947 to 846.3 million in 1991. A fast growing population places increasing demands for large variety of goods and services. Any increase in population raises the Malthusian question of food supply. Modern agriculture techniques have resulted in increased crop yields per hectare, thereby resulting in agriculture growth of an average 2.6% per annum, exceeding marginally the population growth 2.1-2.3% during the last two decades. Nevertheless, it needs to be emphasized that in terms of grain equivalent, while the average per capita consumption in India is about 250 kg per year, the corresponding consumption in the European community is 450 kg and in the US, 840 kg. The spectre of malnutrition is ever looming large on the Indian horizon. But this is bound to change, both due to specific targeting of social programmes to those below the poverty line, and also due to a general increase in incomes with projected GNP growth of seven per cent per annum. Therefore, it would be realistic to anticipate forty to fifty per cent increase in per capita food consumption, to a level of 350-375 kg of grain equivalent per capita per year. It would require new high-yield crop varieties, increased use of fertilizers and pesticides, and an increased utilization and expansion of irrigated land. Until and unless agro-technologies are ecofriendly, this will further lead to a major environmental disaster which would affect agriculture and natural ecosystems, thereby directly influencing the quality of life including the reproductive health.

For a developing country like India, with low per capita income, an unchecked growth of population neutralizes development efforts and erodes all endeavours to bring about any discernible improvement in the quality of life. Rapidly growing population would have adverse effects on every sector of the economy. The priority objectives, therefore, in the national planning process must include accelerating the growth rate of the economy with stable prices in order to generate adequate quality employment and to eradicate poverty, as well as ensuring nutritional adequacy and food security for all, particularly vulnerable sections of society. Thus, industrial and agricultural development become essential prerequisites to the attainment of the objectives.

Consideration of the health and environmental impact of industrial growth and agro-economy must engage the attention of bio-medical scientists across the world. The impact in terms of reproductive ecology constitutes a priority consideration.

Reproductive Ecology

It is now known that various germ cell stages in the male have differential sensitivities to environmental mutagens, with predominant effects on post-stem cell stages of spermatogenesis, and produce transmitted germ cell mutations. The ovarian follicles in different stages of development are also susceptible to radiation and chemical damage. Such differential susceptibility of male and female germ cells to environmental pollutants indicates the need to evolve a national policy that will internalize these concerns and identify the pollutants that could have a major impact on reproductive health, with particular emphasis on progeny.

In 1993, my colleagues and I proposed the term 'Reproductive Ecology' in the international fora and literature. We defined reproductive ecology as, 'the study of causes and mechanisms of the effects of environmental risk factors on reproductive health and

the methods of their prevention and management'. The conventional definition of reproductive health has been elaborated to include the ability of men and women to reproduce, regulate their fertility and to practice and enjoy sexual relationships.

In the paper (Bajaj et.al, 1993) published in the *Environmental Health Perspectives*, USA, the concept of reproductive ecology was illustrated with several pertinent examples. The role of environmental pollutants was emphasized with reference to their known effects on human reproduction. These pollutants include lead and methyl mercury; organochlorine compounds used as pesticides, herbicides, fungicides; as well as radiation, electromagnetic field etc. However, in the publication under reference the inter-linkage between agricultural economy and reproductive ecology was not elaborated upon. Recent literature is illustrative of the existing and emerging challenges in this context.

Confronting Environmental Racism

It would be of interest to note the views expressed in an article by Marion Moses published in the book *Confronting Environmental Racism*. Moses focuses attention on pesticides, especially those used in the USA. She states:

Little is known about the extent or magnitude of pesticide-related chronic problems in farm workers because appropriate studies have not been done. Because the period of time between the exposure and the development of a chronic health effect (called clinical latency) can range from ten to twenty years or longer, it is much more difficult and time consuming to document chronic health effects than acute effects.

Another difficulty in documenting chronic health effects is that most farm workers have no idea of the names of the pesticides they are exposed to, let alone the potential risks to their health; and they can be exposed to many different pesticides over a working lifetime. The keeping of records of pesticide use that would document exposures, and be useful for health studies of workers chronically exposed to pesticides is not required by current law.

If this is a true portrayal of the existing situation in a developed country such as the USA, it is not difficult to imagine the multi-dimensional complexities in the developing countries with increasing use of pesticides required to boost agro-economy and food production.

An illustrative example is the increasing use of pesticides in India. Starting with a mere 2,350 tonnes in 1950-1, it increased about fourfold to 8,600 tonnes in 1960-1, with further threefold increase to 24,300 tonnes in 1970-1, and finally peaking at 75,000 tonnes in 1990-1. Taking cognizance of the possible health hazards, efforts were intensified to reduce pesticide use and in the last five years there has been an over ten per cent decrease of pesticide use to about 68,000 tonnes. Nevertheless, the nationwide data of pesticide consumption needs to be disaggregated for an in-depth analysis. When this is done, it is observed that almost one-half of total pesticide usage is confined to only five states, e.g. Gujarat, Punjab, Maharashtra, Andhra Pradesh, and Tamil Nadu. Further, one-third of the total consumption is confined to the two southern states of Andhra Pradesh and Tamil Nadu. The possible reasons may include agro-climatic diversity and the cropping pattern, amongst others. Such data on pesticide use from all developing countries are not readily available nor is there any indication whether regulatory processes have been brought in to control and check the increasing use of pesticides in order to enhance agricultural production for meeting the food requirements of a growing population.

Dibromochloropropane (DBCP) and Human Reproduction

DBCP is an interesting case study. Marion Moses provides the following brief account: DBCP was found to cause adverse reproductive effects in male lab animals in studies conducted in the USA in 1950s by Dow Chemical Company and Shell Chemical Company, its primary manufacturers. However, the companies suppressed the information and pressured government officials to approve the chemical. DBCP's reproductive hazards weren't known publicly until 1977, when the sterility of thirty-five workers at an Occidental Chemical Company plant in California was linked to DBCP. The U.S.EPA banned all but one use of DBCP (on pineapples in the state of Hawaii, which was cancelled in 1985); but U.S. production and export of DBCP continued.

It was therefore a matter of time only that the effects of DBCP manifested in agriculture and plantation workers in a large number of third world countries to which the American manufacturers continued to export DBCP fully conscious of its reproductive toxicology and in full knowledge of the laws in USA which prohibited its use in their own country. The consequences are reflected in the news item published in a newspaper in Philippines in its issue dated 25 September, 1995. The news report indicates that over 7,000 banana plantation workers from Philippines have become sterile due to long years of exposure to DBCP and have joined more than 12,000 male plantation workers from eleven other nations in filing before a Texas Court a class action law suit against US companies which manufactured or distributed DBCP. It is alleged by the plaintiffs that the manufacturing companies willfully misrepresented and suppressed the truth as to the risks and dangers associated with DBCP and continued to do so even after the product was banned in the US, i.e. the country of its origin.

It is not the intention to dwell any further on moral, ethical or legal issues involved in this case. Nevertheless, the scientific information regarding the causes of sterility reported after exposure to DBCP, needs to be discussed.

Potashnik and his associates have provided extensive data indicating that the cause of sterility was azoospermia (complete absence of sperms) and oligospermia (severe reduction in number of sperms to < twenty million per ml) as a result of testicular damage affecting spermatogenesis. In men with oligospermia, reduction of sperm motility and increase in the number of abnormal sperm were observed. Testicular biopsies in men with azoospermia showed severe atrophy of the germinal epithelium and the tubules were lined either mainly or entirely by Sertoli cells. Large groups of Leydig cells were however observed. A follow-up study after a period of eight years showed recovery in some of the subjects. Hormonal profile revealed that the reversibility of DBCP-induced spermatogenic suppression was demonstrable only in those who continued to show normal serum FSH levels. On the contrary, increase in serum FSH which reflected the severity of damage, carried poor prognosis with regard to the recovery of testicular spermatogenic function.

Gonadotoxicity of DBCP is perhaps an extreme example. However the controversy on the overall decline in sperm counts in men in many parts of the world during the past several decades has been exercising the minds of reproductive biologists. In 1929, Macomber and Sanders reported normal sperm density to be 100 million sperm/ml based on sperm counts of 294 individuals without regard to their fertility status. They also reported that men with sperm densities of < sixty million/ml were rarely capable of initiating pregnancy. Later, in 1943 Weisman reported normal sperm densities ranging from 80-120 million/ml. In 1951, McLeod and Gold reported a mean sperm density of 107 million/ml in 1000 fertile men; they demarcated a sperm density of twenty

million/ml below which the chances of infertility increased.

Major concern was however generated through the studies of Skakkebaek and his colleagues in Denmark in 1992. As the result of a meta-analysis of 61 studies worldwide involving 14,947 males, a trend towards decreasing sperm concentration and semen quality over the past four decades was observed. The Danish group reported a decline in average sperm density from 113 million/ml in 1949 to 66 million/ml in 1990. Further, average semen volume decreased from 3.40 ml to 2.75 ml thereby indicating a decline in total sperm count per ejaculate. The data of Skakkebaek and colleagues showed that the overall decrease was not caused by a deterioration of a subset of ranges of sperm concentration but by a general decline in sperm counts.

A similar decline both in concentration and quality of semen was found in samples from a sperm bank in Paris between 1973 and 1992 (Auger et. al, 1995) and also in a Scottish study of semen donors between 1940 and 1969. Meanwhile, the incidence of testicular cancer has been increasing in many countries, and increases have also been recorded in structural abnormalities of the male reproductive organs such as hypospadias and cryptorchidism. It has been hypothesized that the increased frequency of reproductive abnormalities in men is due to the action of xenoestrogens (environmental chemicals that possess estrogenic activity), and is similar to the reproductive changes in wildlife that have been observed in association with environmental pollution. There is cumulative evidence that changes in male reproductive health are linked with the action of xenoestrogens, and that exposure of the male foetus to supraphysiological concentrations of estrogenic compounds could be the key triggering factor.

The estrogenic pollutants presumed responsible for the reproductive changes in animals range from the organochlorine pesticides, which include DDT, aldrin, and dieldrin, to poly-chlorinated biphenyls (PCBs), dioxins and furans, alkylphenol polyethoxylates (APEs), phytoestrogens, and other xenoestrogens such as phthalates.

Phytoestrogens, natural compounds present in plants and ingested daily by both animals and human beings, are plant chemicals like isoflavonoids and lignans. These are readily metabolized and do not bio-accumulate. But, during the time the body is exposed, or by repeated exposure to certain phytoestrogens, significant adverse health effects, particularly with regard to development and fertility may occur. Changes in animal husbandry and dairy management practices by which milk from pregnant but lactating cows is mixed with milk from non-pregnant cows may also expose the human to estrogens. Pregnant dairy cows produce high levels of estrogens.

The only study available in India so far regarding sperm counts over time is from the AIIMS which shows a decline in sperm count in normal Indian men between the years 1984 and 1994. Further, it also shows a decline in percentage of subjects reporting sperm counts above 100 million/ml. The data of 1994 showed a predominant shift to left with more subjects reporting sperm count in the range of twenty to twenty-five million/ml. These limited data also indicate a likely trend of declining sperm counts in the Indian male.

What could be the possible causes? DDT, earlier used extensively as a pesticide in agriculture, and presently used as insecticide in anti-malaria programme has become a health hazard. DDT and its principal metabolite, DDE (dichloro-diphenyl dichloroethane) are lipophilic and are found in serum, adipose tissue and breast milk. The half-life of DDT in human adipose tissue is approximately 7.5 years. Due to its weak estrogenic activity, DDT acts as a xenoestrogen thereby increasing the risk of breast

cancer in women. It may also play a role in the etiology of pancreatic cancer, leukemias, decrease in sperm count, increase in the frequency of preterm birth, congenital malformations, and decrease in the duration of lactation.

It would be of interest that similar observations regarding the effect of DDT and its metabolites on male reproduction in several animal species have been recorded. Lake Apopka, Florida was polluted in 1980 by accidental spilling of DDT, DDD and DDE along with dicofol. The chemical spill was followed by a significant decline in the number of juvenile alligators; the population decline was associated with reproductive disorders. The male alligators had abnormally small phalli, and abnormal germ cells were observed in the testes. Basal and LH-stimulated plasma testosterone concentrations in the alligators were significantly lower, equalling those of females. The data suggested that the gonads of alligators had been permanently modified, altering steroidogenesis and inhibiting normal sexual maturation.

Similar observations have been made in birds. For example, feminization of gulls and terns along the pacific coast has been associated with DDT and DDE pollution. Feminization leads to a skewed male/female ratio. However, there is controversy as to whether such skewed ratio may also be explainable on the basis of differential mortality of the males. Finally, the association between disorders of genital development and sexual differentiation and gonadal malignancy is now well recognized.

Commercial DDT contains several isomers of which *p,p'*-DDT constitutes about 75-80%; the most oestrogenic isomer is however *o,p'*-DDT which constitutes about 10-25%. Although the oestrogenic activity of DDT isomers is very weak as compared to that of oestradiol, the long half-life and bio-accumulative properties of DDT predispose to oestrogenic effects in the human following a prolonged period of exposure. There is recent evidence to indicate that *p-p'* DDE, the main metabolite of DDT in the human body, is a potent antiandrogen. Thus the anti-androgenic (demasculinising) and oestrogenic (feminizing) effects may get synergized, although through distinct receptors.

It is in this context that studies in India, though only a few, need to be considered. Kalra and Chawla in 1985 reviewed the dietary intake of DDT in USA, Canada, UK, and India and found that the mean dietary intake of DDT in India was many fold higher (Fig. 1). The mean dietary intake of DDT by vegetarians and non-vegetarians, as reported in the studies of Singh (1982) were essentially similar. With the continuing use of DDT for malaria control, the inherent health hazards must outweigh cost considerations.

MEAN DIETARY INTAKE OF DDT

Birth Anomalies and Pesticide Usage

An evaluation of the possible relationship between the frequency of birth anomalies and pesticide use between 1989-92 was done in Minnesota among pesticide applicators and referred by Garry et. al in 1996. The birth defect rate for all birth anomalies was significantly higher in children born to private pesticide applicators. The birth anomaly rate differed among regions with varying cropping pattern. The highest anomaly rate was in Western Minnesota which is a major wheat, sugar beet and potato growing region while the lowest rate was in the non-crop regions. In Western Minnesota, a seasonal influence on birth anomaly rate, with most pronounced effects in infants born in spring, was seen. A change in male/female sex ratio was also seen. Preliminary data suggested differences in testosterone and gonadotropin levels. Of the herbicides used and related to birth anomalies, chlorophenoxy herbicides and some of the fungicides are known to cause

endocrine disruption.

The genotoxic effects of pesticides or fumigants used by pesticide applicators has been investigated with a view to assessing chromosomal aberrations. Phosphine exposed workers had five fold increase in deletions compared to controls; chromosome gaps and breaks were also significantly increased in phosphine exposed workers. Agriculture workers exposed to pesticides (high exposure group, > 10 times/season) similar to patients with ataxia telengactasia (a congenital disorder affecting immune system and associated with unstable gait), showed an increased frequency of lymphoid malignancies.

From Lab to Land: Policy Implications

It is in the context of the data presented so far that we should focus on agriculture and farm labour in India, especially the women and children who constitute a large segment of such labour.

Of a total population of 846.3 million (1991 census), the rural population constituted 600 million persons. Of these, nearly 300 million were agricultural workers of all types—cultivators, labourers and others. Thus we are dealing with a population of agricultural workers in India which almost equals the total population of US.

Health hazards of major pesticides used in India are now being increasingly recognized and a ranking order of possible risks established. Efforts need to be intensified to restrict the usage of the most hazardous, with the ultimate objective of phasing out some of these compounds. This would be a critical and crucial prerequisite to ensure the prevention of diseases due to pesticide use in a large segment of population, eventually leading to optimal health resulting in increased productivity.

REFERENCES

Auger, J., Kunstmann, J.M., Czyglik, F. and Jouannet, P., Decline in semen quality among fertile men in Paris during the past 20 years. *New Eng J of Med* 332: 281-285, 1995.

Bajaj, J.S., Misra, A., Rajalakshmi, M., Madan, R., Environmental release of chemicals and reproductive ecology. *Environmental Health Perspectives Suppl.* 101 (Suppt. 2): 125-130,1993.

Carlsen, E., Giwerman, A., Keiding, N., and Skakkebaek, N.E., Evidence for describing quality of semen during past 50 years. *British Med J* 305: 609-613,1992.

Gary, V.F., Griffith, J., Danzl, T.J., Nelson, R.L., Whorton, E.B., Krueger, L.A. and Cervenka, J., Human genotoxicity: Pesticide applicators and phosphine. *Science* 246: 251-155,1989.

Gary, V.F., Schreinemachers, D., Harkins, M.E., and Griffith, J., Pesticide appliers, biocides, and birth defects in rural Minnesota.

Environmental Health Perspectives 104: 394-399. 1996.

Kalra, R.L., and Chawla, R.P., Pesticide contamination of foods in the year 2000 A.D. *Proc Ind Nat Sci Acad B52*: 188-204, 1985.

Macomber, D., and Sanders, M., The spermatozoa count: its value in the diagnosis, prognosis and treatment of sterility. *New Eng J Med* 200:981-984, 1929.

MacLeod, J., and Gold, R.Z., The male factor in fertility and infertility.

II. Spermatozoan counts in 1,000 men of known fertility and in 1000 cases of infertile marriage. *J Urol* 66: 436-448, 1951.

Potashnik, G., Ben-Aderet, N., Israeli, R., Yanai-Inbar, I., and Sober, I.,

Suppressive effect of 1,2-dibromo-3-chloropropane on human spermatogenesis. *Fertil Steril* 30: 444-447, 1978.

Potashnik, G., and Yanai-Ibnar, I. Dibromochloropropane (DBCP): An 8-year reevaluation of testicular function and reproductive performance. *Fertil Steril* 47: 317-323, 1987.

Singh, P.P., Insecticide residues in food in the Punjab-Typical dietary survey, Ph.D. thesis, Punjab Agricultural University, Ludhiana, pp. 123, 1982.

Weisman, A.I., Spermatozoal counts in fertile males. *Urol Cutan Rev* 47: 166-168, 1943.

The Science and Art of Medical Practice*

The progress of medicine at any period of history must be viewed in the context of the social relevance and the societal needs at that point in time. Evolution of medicine may thus provide the key to the understanding of evolution of man. During the twentieth century, there has been an intense debate between the proponents of rigorous requirements for the learning of scientific basis of medicine, and those who argue equally forcefully for upholding the traditionally recognized needs for the learning of necessary skills and appropriate attitudes to translate the principles of science into the sublime art of practice of medicine. While the science of medicine provides the requisite knowledge, learning of skills is an essential prerequisite to build up the necessary competence. In the ultimate analysis, what counts is a blend of knowledge and competence, culminating into performance of the highest professional order.

Sushruta Samhita, a compendium of our ancient heritage emphasizes the need of combining theoretical knowledge and practical skills in a most inimitable style:

He who is learned only in the theory of the science but not skilled in practice gets confused at the approach of a patient, just as a weak-hearted person is confounded when facing a battle. One who is an expert at practical work but is devoid of theoretical knowledge of the science, does not receive the approval of good men, and receives capital punishment from the king. Both such persons are inexpert, and are inept in the discharge of their duties, for they know only half the science. They are like birds with one wing only.

It is therefore obvious that over the centuries the evolution of medicine has been both in its scientific content as well as in its professional accomplishment.

However, the continuing evolution of human mind is now making additional demands on medicine as a profession. Sir Julian Huxley, the noted biologist, in a lecture delivered at the Chicago University in 1959, added a psycho-social dimension to the process of evolution:

Man's evolution is not biological but psychosocial; it operates by the mechanism of cultural tradition, which involves the cumulative self-reproduction and self-variation of mental activities and their products. Accordingly, major steps in the human phase of evolution are achieved by breakthroughs to new dominant patterns of mental organization of knowledge, ideas and belief—ideological instead of physiological or biological organization.

Huxley argues his case further with great conviction when he wrote in his essay on 'Emergence of Darwinism':

In the light of our present knowledge, man's most comprehensive aim is seen not as mere survival, not as numerical increase, not as increased complexity or organization or increased control over his environment, but as greater fulfillment—the fuller realisation of more possibilities by the human species collectively and more of its component members individually.

It seems axiomatic that there must be a convergence of the psycho-social dimension of man's evolution and the socialization of medical education, both striving to contribute effectively towards enrichment of the quality of life. In other words, the basic role of medicine need not and indeed must not, be only to add years to life; it should also strive

to add life to years. At the time when India attained independence, the average human life span was a mere thirty-two years. In 1991, it was 58.1 years in the case of a male, and 59.1 years in the case of a female. Thus, during our own life time, a major accomplishment has been the doubling of the average human life span in India. Nevertheless, if medicine has to respond to the new challenges, it must generate such social environment in the medical schools that would specifically change the students' future behaviour in terms of the anticipated role of the physician as a catalyst of social and psycho-behavioural change. The teaching and learning of medicine must now take into cognizance educational concerns about the ethical values that the medical students acquire as a part of their undergraduate and postgraduate education. The ethical dilemmas not only emerge as a result of psycho-social evolution of man, but also relate to technological advances of modern medicine. While the ideals of the dignity of man and the social interdependence of human community may seem Utopian, there is undoubtedly a need to humanise medicine while preserving its intrinsic scientific core. This can only be achieved by homogenously blending the basic sciences such as anatomy, physiology, bio-physics, bio-technology and molecular biology, with the behavioural sciences including psychology, sociology, and anthropology.

A cross sectional profile of those who enter the portals of medical colleges indicates that the students are highly intelligent, conscientious, hard working, curious to observe, eager to learn, and generally come from middle class strata of society. At the time of entering undergraduate medical courses, a significant number of students are motivated to develop human dimensions of medical learning. However, by the time they pass the final examination, majority of the graduating physicians tend to enter postgraduate courses, guided in their choice by the market economy. Even amongst those who do not find opportunities of higher learning, there are hardly a few who exhibit social mindedness and therefore join avenues such as general practice or family medicine, aimed at strengthening community health services. Thus, rather than enhancing the motivation to serve society which may still be a guiding force at the time of entry to medical schools, the academic environment over a period of five years becomes counterproductive for nurturing such ideas, let alone strengthening and reinforcing healthy social mindedness.

The reasons may be complex. These may relate to power structure in medical schools, the processes of decision making, and above all, the role models provided by the faculty where a highly skilled super-specialist commands and gets all the power and privileges. Should we not strive to create those role models which exhibit in abundance the attitudinal traits that we wish to engrain in the minds of our students? This requires a deep introspection by all of us who hold professorial chairs, and are entrusted with the responsibility to mould and sharpen young minds. How often do we pause and look for that spark of brilliance amongst our students, which if nurtured carefully, is likely to enlighten the path of next generation? We must remember that every student of ours carries a small imprint of our values. The system of medical education can only be humanized through the transformation of medical educators.

Having developed at some length the comparison and contrast between the basic sciences on the one hand, and the social and behavioural sciences on the other, let me conclude by attempting a final synthesis. We have entered an exciting era of human biology wherein the application of the newer tools and techniques of molecular biology have helped us to construct the demographic history of human population. Recent studies of mitochondrial DNA have shown that it accumulates mutation five to ten times as fast as the nuclear DNA, is inherited maternally, and that the rate of change is uniform over time, is the same for all species, and approximates two per cent sequence divergence per million years. More importantly, it seems that all of us had a common ancestor, a single female,

who lived about 2,00,000 years ago. Whether this Eve lived in Africa or Asia is still a matter of scientific debate.

The same scientific tools which ushered a new and highly specialized era of mitochondrial pathophysiology in medicine, are also helping us not only to unravel the mysteries of origin of man, but also the migration pattern of populations by tracing human lineages. Mitochondrial anthropology has generated a scientific revolution which may in itself provide the clue to human evolution. Indeed, the ultimate may be a mitochondrial unity amongst demographic diversity! A unique blending of basic and behavioural sciences.

A medical university such as this must provide the crucible for blending the basic with the behavioural sciences, and the science with the art of medical practice. As the Chairman of the Expert Committee on Health Manpower Planning, Production and Management which was constituted by the Government of India in 1986, I had strongly recommended the establishment of Universities of Health Sciences which would not only synthesize and coordinate the existing professional courses of education for all members of the health care delivery team, but more importantly, would provide the physical environment where all faculties can interact together to provide model learning experiences for the future functionaries responsible for the delivery of health care to the community. We had recommended that additional faculties, shared commonly by all educational institutions, must be developed to promote studies of health economics, health systems research and management, social and behavioural sciences, and educational technology, amongst several others. An important role of medical and health universities, such as yours, should be to develop programmes of continuing education not only for medical graduates, but also for those who qualify for nursing, pharmacy, and other allied health professions. Those who are receiving their degrees today must remember that formal education with prescribed curricular contents and syllabi must not be viewed as self-contained and a part of close-loop system. It is only a first step to continuing learning throughout the professional life span, which is much longer than the period spent on formal education. We must realize that continuing education is not just a response to the individual needs; today, it is a result of both public demand as well as professional pressure. The development of such technologies as distance learning must be adapted to the needs of continuing professional education for all health care providers. I do sincerely hope and wish that the Tamil Nadu Dr. M.G.R. Medical University shall take innovative steps to play a leadership role in this direction. It would be our endeavour to extend every help and assistance in this direction.

May I extend my sincere felicitations to Dr. A. Venugopal for the conferment of the honorary degree of Doctor of Science. May I also congratulate all those who shall be admitted today to their respective degrees, and specially those who shall receive well-merited prizes and medals. May each one of you attain the heights of professional eminence and earn the gratitude of the people and the society that you may serve with devotion and dedication. Let striving for excellence in all that you may do be your goal. Let the obstacles, if any, generate in you a greater intrinsic strength to overcome them. Let each one of you be a pride of the medical fraternity. May you be blessed with a long life to see India gloriously march forward amongst the leading nations of the world in the twenty-first century. Once again, my congratulations and best wishes.

Logic and Learning

Sound foundations for the promotion of western science, philosophy, and literature in this country were laid in 1857 with the establishment of universities at Calcutta, Madras and Bombay. This was in accordance with the dispatch of Sir Charles Wood, the then Secretary of State for India, who also suggested the use of medium of English language for imparting such education.

The scholastic goals of attainment of knowledge and wisdom are deeply enshrined in our traditional value system. However, what is not well recognized is the approach to be followed in the pursuit of knowledge. Gautama in his book *Nyayasutra*, compiled around the 4th century B.C. outlined the role of perception (*pratyaksha*), reasoning (*yukti*), inference (*anumana*), and comparison (*upamana*) as objective and valid ingredients of the theory of knowledge. In essence, process of learning was interlinked with the science of logic, thus providing for a sound basis of rational analysis in any branch of knowledge, ultimately preparing the mind to seek realistic solutions to problems of life and living. It is the spirit of enquiry, the insatiable urge of inquisitiveness, that needs to be cultivated to impart meaning and purpose to pursuit of knowledge. The universities, therefore, must not remain temples of learning only but must also provide the necessary impetus for facilitating intellectual growth and imaginative insight which in turn can enrich social dynamics and political processes. Such an attitudinal change must result from every educational experience, and not necessarily in those who study in the Faculty of science. History of science, in a broad sense, is the history of the progress of human civilization.

If intellectual growth and advancement of knowledge were indeed the yardsticks to measure the achievements of this university, then there could not be any stronger evidence than the fact that the only two Nobel laureates in science from India namely Sir C.V. Raman and Dr. S. Chandrasekhar were both the products of the academic environment of University of Madras. It was on 28 February, 1928 that Dr. C.V. Raman did his Nobel Prize winning experiment on the scattering of light and the Raman effect was announced to the world two weeks later, on 16 March. Truly, it was a glorious period in the history of science and higher education in this country, and was the result of a collective, concerted and conscious endeavour by those who were guiding the destinies of these universities. Sir Asutosh Mookerjee, the first Indian Vice-Chancellor of the University of Calcutta, in his Convocation address delivered in 1907 superbly articulates these concerns:

You cannot estimate intellectual work by numerical standards alone. It is absolutely wrong to apply statistics to the case of institutions like Universities where the highest form of knowledge has to be cultivated. It is not the number but the quality of students, it is not the quantum of knowledge but the character of the training which is received, that determines the position of the University. It is paramount duty of the University to discover and develop unusual talent. No University is worthy of its reputation which does not enroll among its professors men best fitted to advance the bounds of knowledge. No University can rightly be regarded as fulfilling the purpose of its existence, unless it affords to the best of its students, adequate encouragement to carry on research, and unless it enables intellectual power, whenever detected, to exercise its highest functions.

How much of this vision is being translated into a reality today? Are the universities fulfilling their 'paramount duty to discover and develop unusual talent'? Are we making a conscious effort to recognize intellectual power amongst our students? More importantly, are we facilitating such intellect to exercise its highest functions? I must be candid and confess that the answers cannot be in the affirmative. With the ever expanding syllabi and curricular contents, the students of today are swamped with the factual information that

they have to digest within a short period. The aim is to recall some or most of these facts correctly in response to questions asked in the examination, so as to ensure a successful outcome. However, accumulation of factual information and the ability to recall do not constitute the essence of education. The information must be synthesized to generate knowledge. More importantly, the knowledge must be distilled to impart wisdom. T.S. Eliot expressed it so succinctly when he said:

Where is the wisdom
we have lost in knowledge?

Where is the knowledge
we have lost in information?

True education therefore does not just aim at the memory storage of a finite number of facts in the cerebral cortex; it must get deeper into the mind so as to become permanently internalized in the thought and behavioural processes. It is then and then alone that knowledge and wisdom become inseparable twins for a life time.

Although information overload may contribute partially or even substantially to the inadequacy of the universities to recognize, nurture and develop superior intellect and talent amongst the students, it cannot be the sole reason to account for this. Such a responsibility squarely devolves on the teachers also. Do we have teachers of calibre and competence to ignite such a spark amongst their students? It is a matter of some regret that a majority of even those who do effectively share knowledge with the students, play no personal role in the advancement of such knowledge. It seems that quest of new knowledge through research has been largely divorced from the duties and functions of a teacher. Gone are the days when Vice-Chancellors like Sir A. Lakshmanaswami Mudaliar and Sir Asutosh Mookerjee transcended the narrow provincial or even national confines and brought professors of undisputed academic scholarship and unchallenged research leadership to their universities so that the young students be exposed to such intellectual giants. We now seem to compromise with mediocrity, hardly realizing that teaching without high quality research leads to intellectual stagnation both in the teacher and the taught. A stagnant intellect is like an extinguished candle. Can it ever light any other candle?

The present day portrayal of a contemporary teacher is in stark contrast to that depicted in the report of the University Education Commission (1948-9) chaired by Dr. Radhakrishnan:

‘... the right kind of teacher is one who possesses a vivid awareness of his mission. He not only loves his subject, he loves all those whom he teaches. His success will be measured not in terms of percentage of passes alone, not even by the quantity of original contribution of knowledge—important as they are, but equally through the quality of life and character of men and women he has taught’.

With considerable humility, I shall only like to add that the measure need not be confined to the transformation in the quality of life of the students, but must extend, through them, to create an impact on the quality of life of the people and the society of which the students are a part. It is axiomatic that the quality of education along with that of services in the social sector including health is not only an indicator but also a determinant of the quality of life of the people. A time has therefore come to move beyond the narrow confines of

routine financial audit in the universities and include the concepts of academic audit, i.e. process of education, and social audit, i.e. outcome and impact of education. Such an overarching assessment of quality of education is in turn likely to enhance the quality of life.

In the contemporary society, more so in India and the developing countries, acquisition of knowledge must lead to social and community development, ultimately effecting an improvement in the quality of life. One of the major dichotomies in the recent times is the disassociation of the content of life from the quality of living. At a higher plane, the quality of living must include art, literature, architecture, music and every activity which harmonizes man with his environment and imparts a sense of beauty and purpose to life. Arts and humanities are therefore essential components of education. Such harmony should also extend to interaction between man and society: social harmony is largely governed by social and behavioural sciences. Sociology, anthropology, and psychology along with related disciplines constitute such a facet of education. To all this must be added the fulfilment of basic needs such as health care, housing, food, drinking water and environmental sanitation. This constellation of primary needs coupled with population stabilization ensures human survival so as to enable man to enjoy nature and indulge in a purposeful social interaction. In fact, this provides a new paradigm of national development in which every citizen must be equally involved, more so the younger generation who obviously holds a higher stake in the future.

Scientific method and its application generate appropriate technology and contribute effectively and efficiently to fulfil these primary needs. In *The Discovery of India*, Jawaharlal Nehru articulates this philosophy in his inimitable style:

The real problems for me remain problems of individuals and social life, of harmonious living, of a proper balancing of an individual's inner and outer life, of an adjustment of the relations between individuals and between groups, of a continuous becoming something better and higher, of social development, of the ceaseless adventure of man. ... In the solution of these problems the way of observation and precise knowledge and deliberate reasoning, according to method of science, must be followed. ... A living philosophy must answer the problems of today.

Addressing the Indian Science Congress session in January 1947, a few months before the dawn of independence, Nehru was more candid and perhaps more impatient. He firmly reiterated the view that:

'For a hungry man or a hungry woman, truth has little meaning. He wants food. And India is a hungry, starving country, and to talk of Truth and God and even of many of the fine things of life, to the millions who are starving, is a mockery. We have to find for them, clothing, housing, education, health and so on, all the absolute necessities of life that every human should possess. So science must think in terms of the few hundred million persons in India'.

The immense power of science and technology in not only preserving but shaping the destiny of free India, is well demonstrated in our achievements. Not only have we attained self-sufficiency in agriculture but are now exploring avenues of export. Our spectacular success in atomic energy and space have put us amongst the most advanced nations. The peaceful uses of nuclear energy include our enhanced capability in the diagnosis and management of several common diseases such as goitre. The advanced composite materials used in Agni, are also transforming the lives of thousands of polio afflicted young children, as these very materials are being used to manufacture very light calipers weighing only 300 gms, thus providing joy and bouyancy to the users. The technologies generated in Missile programme, Light combat aircraft (LCA), Electronic warfare system, and battle tanks are now being explored for their use in the development

of cardiac pace makers, bone implants and laser surgery—thanks to the vision and imagination of our scientists led by another alumnus of this university, Dr. A.P.J. Abdul Kalam.

Nevertheless, science has never been, and shall never be static. Scientific activity is both cumulative and progressive. Are we preparing the young minds to harness the vast potential of science that is unfolding itself at the dawn of the twenty-first century? Have we succeeded in developing the requisite scientific temper in the youth? Have we created a new generation of young minds who can follow the courage of their conviction, provided such certitude is based on sound reasoning and logic and is derived through the pursuit of scientific method? Have we dispelled the role and place of superstitions from their minds? Have we succeeded in motivating ‘young people to bring a scientific attitude of mind to bear on all our problems’, as was stated in the Technology Policy Statement of 1983? Have we assessed the quantum and impact of our efforts ‘to ensure an adequate supply, within the country, of research scientists of the highest quality, and to recognize their work as an important component of the strength of the nation’, as stated in the Scientific Policy Resolution of 1958? Unfortunately, we cannot respond either positively or convincingly to any of these questions. So, what has gone wrong, and more importantly, why?

Without under-estimating the enormous complexity of the issues involved, let me make an honest attempt to respond. In the post-independence India, we created a chain of first rate laboratories, research institutes, and defence research establishments without caring to establish strong linkages either between academic departments and research establishments, or between them and the industry. This enormous infrastructure of research and development (R&D) had to draw heavily from the pool of first rate talent amongst the faculties of the universities. Furthermore, with advanced equipment and technology concentrated in the research laboratories, even a few bright and motivated teachers left in the universities, not only became isolated but also were deprived of the academic competitiveness and financial support for good quality research. How can these frustrated and sequestered scientists serve as role models for the brilliant minds who enter the universities?

Even within the universities, a few senior scientists may have succeeded in securing large research grants sometimes through considerations other than academic merit. The result, unfortunately, is a process of empire building with no willingness to share equipment and facilities with other colleagues. Still worse, the young minds who look towards them as mentors, eventually end up as bonded labour. Thus, academic feudalism has replaced traditional liberalism; mediocrity has not only overshadowed excellence, but while doing so, it has also ensured its complete eclipse.

As if all this was not enough, the bureaucracy has made vital inroads in the management of universities as well as other teaching and research institutions. Thus the earlier dictum of G.B. Shaw that ‘He who can, does. He who cannot, teaches’ needs to be amended to state that ‘He who can, does. He who cannot, teaches; and he who cannot teach, manages’. The scientists do recognize and respectfully acknowledge the managerial competencies of the bureaucrats, but in turn the scientists do expect recognition of their own technical competence and expertise. The power, perks and privilege of a bureaucrat may not pose a major attraction to a motivated scientist but he should at least be entitled to enjoy self-respect and dignity of his profession. In other words, a sense of freedom and autonomy for all constituents of the university, within the framework of rules and regulations, is a *sine qua non* for academic excellence.

It applies equally to the professors as also to those who are graduating today. All of you must have the courage of conviction, borne out of your inner strength, and expressed with humility that comes with scholarship. This could not have been more forcefully or candidly expressed as in the speech of Sir Asutosh Mookerjee in 1923 at Lucknow:

No University can flourish unless its Professors possess that priceless treasure which we call freedom of thought. If I were a University Professor, I would without hesitation, decline to mould my opinions in matters of history, economics, religion, philosophy and science to suit the arrogance or ignorance of a Minister of Education. Once you have framed a constitution for a University, leave it free. If you find that the constitution has failed, let the Legislature interfere and alter the constitution. But it is a contradiction in terms that you have a University, entrusted by the state with the discharge of the very responsible duty of promotion of higher education and yet you contemplate interference on every possible and impossible occasion. That position is intolerable...

Admittedly, the ambience of Raj when this statement was made, was strikingly different from the present democratic setup. Yet, the supremacy of academic autonomy needs to be upheld for all times.

In conclusion, may I draw upon our common cultural heritage of *Gita* and with deep humility echo what Lord Krishna told Arjuna as the final advice:

Vimrshyaitad aseshena

yatha icchasi tatha kuru

Ponder over these (words) in entirety,

and then act in accordance with your desire.

Index

Abdul Kalam, Dr., A.P.J. 121, 207

Abdullah, Sheikh Mohammed 134

age of darkness 96

age-related degenerative diseases,

Facts contributing to 160f ageing a bio-social interface 154; biology of 161f; bio-social dimensions of 153ff; evolutionary perspective 155; indices and dependency ratios 163; Neuronal 161; and neuro-biological processes 161; population, concerns and constraints 155f; socio-economic perspectives of 166ff

Agnipurana and plant science 106

agro-economy and industrial growth 185; and reproductive ecology 182 ff

agrotechnologies, and environment 184; and reproductive health 184

Akbar, Royal munificence to physicians 100

Alauddin, the Second 98

All-India Institute of Medical Sciences 2, 18, 109

Andhra Pradesh Educational Institutions (Regulation of Admission and Prohibition of Capitation Fee) Act, 1983 143

Animal husbandry, progress in 121

Antarctica, first expedition to 121

Aristotle 81, 90

Athurvaveda 96

Auger, J. 189

Aurelius, Marcus 1

average yield of wheat per hectare, in India 74

Ayurveda 68, 81, 82, 96, 98. 100. 103; cross-fertilisation with Unani

system 100

Ayurvedic system 98

Babur 99

Bacon, Francis 78, 82

Bacon, Roger 91

Bajaj Committee, 1987 11, 66; report of 66; see Expert Committee on Health Manpower Planning, Production and Management 132

Bajaj, J.S. 89, 110, 185; on health as an indicator and determinant of quality of life 126

Barucha, Justice S. P. 151

basic sciences, as applied to medicine 106

Bentinck, Sir William 6; ana development of medical education in India 105

Barani, Ziyuddin 97

Bharatiya Janata Party (B.J.P.) on family planning programme 32

Bhargava, P.M. 95

Bhava Prakash 100

Bhore Committee 18

Bhore, Sir Joseph 6

biomedical research, and public accountability, ethics of 87; contemporary issues 83f; excellence in, landmarks 86f; historical perspectives 96f; measures to strengthen 89; relevance and excellence in 80ff; parametric reference framework of 81

bio-medical sciences 93ff

bio-technology, progress in 121

Birth Control League, Bombay 26

birth control clinics in Bangalore and Mysore 26; in Madras Presidency 26

Bose. Jagdish Chandra. 107: and transmission of excitement in plants and animal tissues 107; on stress and strain in the living and non-living 107

Bose. Subhas Chandra, on population stabilization 27

caloric intake 170, 171; per capita 174

Camus, Albert 118

capitation fee i 50

carbon dioxide release and environmental damage 183

Centchroman (a weekly pill for female contraception) 76, 86, 87

Chakrabarti.C. 95

Chandrasekhar S., Nobel laureate, 202

Charak 106, 110, 111; and plants and their therapeutic uses 106

Charak Samhitd 5,197, 103; on age 153; on *madhumeh* 110; on human life, division of 153

Chawla. R.P. 192

Child mortality rate 4

Clinton, Bill 15

Commercial Social Marketing Programme (CSM) 50

Commission on Medical Colleges 9

Commonwealth Health Ministers Conference at Bahamas 12

communicable diseases, prevalence of 159

communication strategies and informatics and datamatics 75

community health services in Maharashtra and Gujarat 15

Comprehensive Family Welfare Programme 51

congruence of goals and convergence of services at community level 39

Constitution (Seventy-ninth Amendment Bill No. LXXX), 1992, 38

Constitution (Seventy-second Amendment) Bill, 1991, 66

contraceptive research, biomedical and behavioural 76f

Control of Acute Respiratory Infections (ARI) 38

Copernicus 81

Council for International Organizations of Medical Sciences (CIOMS) 87. 88

Crawford, D.G. 105

D.B.C.P. and banana plantation workers in the Philippines 188

D.D.T. and male reproduction in animal species 191; and risk of breast cancer in women 191

Dawkins, Richard 96

decentralisation planning and differential strategies 34f

Declaration of Helsinki 87

Defence Research Development Organization 121

Demographic diversity in India 156

Demographic shifts and age-structure in the world 156

Demographic transition 158-59

Demographic trends 25; in India 26, 71 f

Demography and Democracy 31

Developed and developing countries, purchasing power in 182

Dewy, John 122; on scientific theories 122

Dhyana Yoga (technique of mental relaxation) 68, 110

Diabetes mellitus 110; and Ayurvedic medicine 110; training courses in primary health care in 135f; treatment of 112;

Diarhocal Diseases Control (DDC) 38

Discovery of India 205

Disease management system 69

Doctor-nurse ratio 9

Doctor-patient relationship and professional ethics 23

Earth Summit, Brazil, 1992 182

East India Company 6

Eighth Plan on medical education 143

Elgood.C. 100

Eliot, T.S. 203

Environment degradation and per

Capita consumption 182 environmental racism, confronting of

186; and pesticides 186 environmental challenges and indus-

Rail and agricultural development

183 environmental damage by industrial

Countries 182f environmental mutagens and germ

Cell stage in the male 185 environmental pollutants 185: and

Reproductive health role in human

Reproduction system 185 estrogenic pollutants in animals, and

Reproductive changes 190 Euclid 82 Expert Commission on Population

Projection 72

Family Planning Programme, monitoring and evaluation mechanism 52!'; financial resources 53; agenda of nineties and beyond 561'; and unorganized sector and cooperatives 51; plan-wise expenditure on 54:

Fawaid-ul-Akhyar 100

Fazl, Abul 100

Female life expectancy, in Kerala 157; in Uttar Pradesh 157

Finsch 154

Firishta, Muhammad Qasim 98, 99

Food consumption, per capita increase in 184

Food, per capita availability of 74

Gadgil formula for allocation of central assistance for family welfare programme

Gadgil, D.R. 170

Gandhi, Indira, on yoga 68

Gandhi, M.K. on education 169

Garry, V.F. 192

Gas emissions, greenhouse 183

Gautama 201

General Medical Council of Great

Britain 17 Goethe 91 Gold, R.Z. 189 grain, per per capita consumption in

India and America 184 Green Revolution 121

Haldane, J.B.S. 82; on definition of science 82

Harappan culture, pottery of 108

Harvey, William 81, 82

Hatha Yoga 68, 110

Health Manpower Planning, Expert Committee on 10

Health Manpower Planning, Production and Management, Expert Committee on 10; Report of 10f; *see* Bajaj Committee

Health Services - Multiprofessional. education as an essential component of 125 ff;

Health and family welfare in post-Independence India, a critical overview 28ff

Health and family welfare infrastructure, effectiveness of 64

Health and Indian system of medicine 68

Health care information, education and communication 75

Health care management and decision making 75

Health care, a team concept 126f; and Indian system of medicine 67f; essentials of

Health manpower development and family planning 11

Health manpower functioning, technical inputs in 68ff

Health manpower planning 9f

Health manpower resources 75

Health of people, significant factors in 128

Health planning and population stabilization, agenda for nineties and beyond 78

Health research and multiprofessional education 139

Health team, composition of 126f

Health, an indicator and determinant of quality of life 125f; as indicator of quality of life 3;

health, definition propounded by WHO 62; infrastructure, network of 3; manpower 4; minimum needs as core content 63; two terms used in the traditional Indian system of medicine 62; environment and sustainable development 182

Health-related vocational courses 11

Hegel 59

Helsinki Declaration 87, 88

Howick 79

Human resources for health 40f

Human longevity, evolutionary perspectives on 155

Human reproduction and D.B.C.P. 187f

Humoural theory of *tridosha* 96

India Population Project 137f; performance assessment, vitality of criterion 138

Indian Birth Control Society 26

Indian Council of Medical Research (ICMR) 83, 170; financial allocations of 84

Indian Medical Council 7

Indian Medical Council (Amendment) Ordinance 1992 8, 147f

Indian Medical Service 6; start of 105

Indian National Congress (I), on family planning programme 31

Indian Space Programme, pioneering

Development in 121 Indian system of medicine 67;

Practitioners of 67 Indians, Vedic. and knowledge of

Pharmacognosy 106; and plant

Life, references to 106 infant mortality rate 3, 63; in Kerala

39, 157; in Orissa 39; in Uttar

Pradesh 157; trends in major states in India 65

Institute for Research in Reproduction, Bombay 85 insulin, and diabetes mellitus
110 Integrated Child Development

Scheme (ICDS) 39 International Institute of Population

Sciences, projections for future 29

James, William 122

Janaka, Maharaja 1

Jeevan Reddy, Justice B.P. 151

Jivaka, personal physician of Buddha

101 *Joslin Diabetes Manual* 111

Kant, Emmanuel 92

Kalra, R.L. 192

Karnataka Educational Institutions

{Prohibition of Capitation Fee) Act

145

Keynes 78

Kitab-Shawasoom Al-Hind 97 Krall, L.P. 111 Kuldip Singh, Justice 145, 151

Lakshamananaswami Mudaliar Oration

Leopardi 123 Leshner 79 life expectancy at birth, in different states 30

life expectancy, increase in 63 life span, in *Dwapar* and *Treta yugas*

153; in *Kaliyuga* 153; in *Satyuga*

153; in Biblical context 153; in Vedas 153; in *Charak Samhita* 153; in *Sushruta Samhita* 153

Lodhi, Sikandar Shah 98

Lokanathan, P.S. 170

Longevity and lifestyles, lessons from epidemiology 161

Macomber, D. 189

Madan, R. 89

Madan-ul-Shifa Sikandar Shahi 98

Madhumeh 110, 111

Maharashtra, annual out-turn of doctors in 14

Mahavagga, a Buddhist text, and surgery 101

Maternal and child health care (MCH) 40

Maternity mortality rate in India 64

McLeod.J. 189

McNamara, Robert 61, 157

Medawar, Sir Peter, on ageing 154

Median age at death 155, 157-58; in China 158; in India 158; in U.K. 158; upward shift in India 164

Medical practice, science and art of 196ff

Medical colleges, first three, in India 105

Medical colleges, opening of 148 medical education, and health care, essential interlinkages 3; free, structure of 152; development since independence 22; in India:

historical retrospect 5f; relevance and excellence of 2; role of private sector in 151; social audit of 19f

Medical ethics, 'ten commandments' of 104; quality of a physician 103f

Medical health, and socio-economic development 20; and primary health care, interlinkages of 20

Medical philosophy and practice, Indo-Greek influence on 97

Medicinal plants 67

Medicine, Ayurvedic, diabetes mellitus 11 Of;

Medicine, Indian, futuristic perception 109f

Medicine in mediaeval period 97

Mehta, Ashok 170

'Men and mice' 155

Michal, F. 88, 89

Micronutrient malnutrition 175

Minimum Needs Programme (MNP) 61,63

Modern and Western system of medicine 105

Mohammed-Bin-Tughlaq 98

Mohan, Justice J. 151

Mohini Jain Case 146-47,

Mookerjee, Asutosh 203, 205, 208

Moses, Marion on environmental racism in the USA 186; on DBCP 187f

Mudaliar, Sir A. Lakshmanaswami 5, 204

Mukherjee, Dr. R.M. 27

Mullan, F. 16; on health care reforms in United States 16

Multiprofessional education 20ff; and health research 139; learning settings 129; learning strategies 130; objectives of 126; phases of 131f; pre-certification phase 132;

rationale of 128

Murty, K. Satchidananda 92

Muslim rulers, and development of medical practice and health care in India 98

Narasimha Rao, P.V. 11, 12, 33; on gross manpower mismatch 12; on human development 176

National Development Council 24; and population control 24; Committee on Population 35; and population stabilization 33

National Development Council, Committee on Population 35f; terms of reference 35f; formation 35

National Education Policy 13; action plan 13

National Front (NF) on family planning programme 31

National Health Policy 4; demographic goals of 34

National Planning Committee on Population, resolution on population stabilization 27

National Population Policy 35, 57

National Tripartite Committee for Family Welfare 49

Nayaya school and four *pramanas* 115f

Nehru, Jawaharlal 27, 28, 116, 175, 207; on family planning 28; on the role of science and technology 79; on alleviation of poverty 175; support for establishment of birth control 27; on science and people of India 206, 207

Neo-Malthusian League, Madras 26

Nutrition Advisory Committee of ICMR 170, 171; Report of 170

Nutrition, health and poverty, an interactive interdependence 169ff

Obesity, risk factor in diabetes 161 f oceanography, progress in 121 old age pensions 164f older population, growth in India 156 organized sector and social marketing 50

Panchayati Raj 4

Panchayati Raj Bill see Constitution

(Seventy-second Amendment) Bill

1991 58

Pandiyan, Justice Ratnavel 151 Pant, Pitamber 170 paraprofessional, quantum increase in 11

Per capita consumption expenditure 177f

Pesticide, usage and birth anomalies 193; and health hazards in India 194; increasing use in India 186; and environmental racism 186

Physical quality of life index (PQLI) 60f

Plant science, and *Agnipurana* 106; and *Arthasastra* 106; and *Brahatsatnhita* 106

Plant life 106, 107; references of 106f

Plato 1, 87

Political parties, election manifestoes on family planning programme 31f

Population Control: Perspectives and Planning, background documents on 33

Population Sub-Committee, constitution of 27

Population control, role of women in 42f; role of youth in 41; role of voluntary and non-governmental organizations in 47; role of corporate sector in 48f

Population growth 156; and food supply 184; rapid, socio-economic implications of 184ff

Population policy 24; contours of 28

Population stabilization, 24ff; as priority objective 24; and socio-economic development 27; objectives and policy frameworks in Eighth Five Year Plan 33f; programme of action 38; and youth 41; and literacy among women 45

Population, world, present and future 157; and environment 182f

Population-doctor ratio 10

Potashnik, G. on effects of DBCP 188; on causes of sterility 188

Poverty alleviation and environmental protection 183

Poverty line 170, 171; in India, delineation of 170

Poverty, a universal phenomena 169; defining of 170; alleviation programmes, outcome and impact of 170; and hunger 172f; and health, concepts and constraints 174; measurement and alleviation of, during Eighth Plan 175; estimates and consumption expenditure 177; alleviation, futuristic approaches 178f

Practitioners of modern system of medicine 40

Practitioners of other systems of medicine - Ayurveda, Siddha and Homeopathy 40

pramanas, four 115, 116; acceptance in Nyayaschool 115

Primary health care providers 40-41

Primary health care system, chain of 63f

Professional and paraprofessional education, quality of 17f

Qasida fi Hifz-ul-Sehat 100 Qasim, Dr. S.Z. 60, 121

Quality of life, health as an indicator and a determinant of 60ff; indicators of 60; population stabilization as an essential prerequisite of 71ff; base level indicators of 73; and food 73; and housing 74f; and health services 128, and industrialisation 182; and quality of education 206

Radhakrishnan Commission 15; on post-graduate education 15; and medical education 6

Radhakrishnan, S. 1,2, 5, 6, 7, 205; on primacy of health 2; on universality of health as a shared human need 2; on social dimensions of health 2

Rajalakshmi, M. 89

Rajasthan Municipalities (Second Amendment) Bill 1992 37

Rajasthan Panchayats Act 37 Rama Rao, Smt. Dhanwanti 28 Raman, Sir C.V., Nobel laureate 93,

203; contributions to contemporary science 93 Ramchandran, C.R. 163 Rao, S.R.K. 62 Rao, V.K.R.V. 170 Registrar General of India, data on

Child loss 43 *Rehbar-i-Sehat* Programme 133ff;

Organization 134 reproductive abnormalities in men,

Reasons of 190; and action of xenoestrogens 190 reproductive ecology, definition of

185; concept of 185 reproductive health, conventional

Definitions of 185 *Rig Veda* 101, 108, 115; and *pramana*

115; supernatural powers of gold in 108; earliest reference of *salya* in 101

Royal Society, London 107 Russell, Bertrand 59, 61, 78, 114,

122, on values in human life 61;

Saha, Meghnad 5

Sahai, Justice R.M. 145, 151

salya tantra 101

salya, literal meaning of 100

Samajvadi Janata Party (SJP) on

Family planning programme 32 *sammohini*, use in surgery 102 Sanders, M. 189
sanjivani, use in surgery 102 Sarton, G.A.L. 79 science and technology in India, the

Spectre and spectrum of 92ff; in

The post-independence period 116;

Progress in India 114ff; science and quality of life 117 science as a social, political
and, economic instrument 118 Scientific Policy Resolution 119, 120

Scientific Policy Resolution of 1958

208 Scientific Policy Resolution of Govt. of India, 1958, 117; on quality of living
117 scientific temper and Vedic Indian

114 scientists of today, non-fulfilment of

assurances by Govt. of India 118 Shah, B. 163 Shakespeare, William 167; on seven

ages of men in *As You Like It* 167 Sharma, Justice Lalit Mohan 151 Sharma, S.P.
163 Shaw, G.B. 208 Singh, P.P. 192

Skakkebaek, his study on sperm concentration and semen quality 189 Sloan, F.A.
70 small family norm 38; disqualification

on ground of violation of 38 Social SafetyNet57 Special Nutrition Programme
(SNP)

39

sperm count in India 190 Steinwald, B. 70 Surgery, through the ages 100 Sushruta
101, 102, 106, 110, 111, 112 *Sushruta Samhita* 5, 97, 101, 102,

196; on surgery 101; on surgical

instruments 102; description of

final end in 154; on medical

practice 196

technical inputs in health care 69ff Technology Policy Statement of 1983

208 Technology Policy Statement of

Govt. of India 118, 120 theory of knowledge, Gautama on 202 Total Fertility Rate (TFR) 43, 44;

Present and projected in some of south-east Asian countries 44 traditional medicine, contemporary resonance 108; in mediaeval period 97; and basic sciences 106 Trevelyan, R.C. 123 'triple trouble syndrome' 165 Tughlaq, Feroz Shah 97

Universal Immunization Programme

(UIP) 38 University Education Commission

(1948-49), on contemporary

teacher 205 University Education Commission,

report of 5, 108 US Population Crisis Committee,

report of 59

Vagbhata 106

Vagbhata samgraha 5

vayu dosh 154

Vedic concept of science 92

Vidyasagara, Jivananda 101

Weaver, Warren 82; on science and

technology 82 Weisman, A.I. 189; on sperm

densities in men 189 western system of medicine, foundations of 5; foundations in India

105; widowhood, average age in India and

America 166 Woods, Charles 202 World Health Organization 88; report

on multiprofessional education

130;

Yoga, role in disease prevention 68 Yusuf-bin-Muhammad-bin-Yusuf, personal physician of Babur 99

Zakir Husain 5 Zian-ul-Abidin, Sultan 98