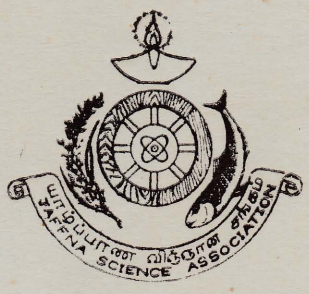
PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION

Presidential Addresses **1997**



JAFFNA, SRI LANKA

1998

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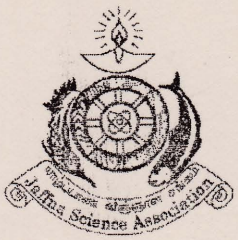


This volume is a record of the proceedings of the Fifth Annual Session of the Jaffna Science Association. This contains the Presidential address, addresses of the chairmen A, B, C and D that were presented at the Annual Session of the Association held at the University of Jaffna in August, 1997.

I wish to thank the Vice-Chancellor, Prof.P.Balasundarampillai, Dean, Faculty of Science, Prof.V.K.Ganesalingam, Head, Department of Chemistry, Prof.(Mrs.) R.Mageswaran and Head, Computer Unit , Dr.S.Mahesan, and the staff members of the Department of Computer Science and Computer Unit, University of Jaffna for their generous support .

Mrs.R.Mahesan

Chief Editor

May 25, 1998

CONTENTS

Reforms In Medical Education - An Action Plan

*Professor S.V.Paramewaran

"Reforms in medical education - An Action Plan" is an initiative to organise in a systematic and coordinated manner a series of activities leading to the adaptation of medical education to meet current and future requirements of society. As we approach the 21st century there is recognition that changes in the nature of medical practice require changes in the format and content of Medical Education.

1. Perspective of change in the health system

Serious improvements are still required in a majority of health care systems to ensure equal access to all who seek health care, as well as optimal protection against avoidable causes of unnecessary sufferings and death through disease. The search for the best possible care of the sick and suffering is needed and demanded now more than ever.

The increasing dissatisfaction of consumers with the delivery of health care is due to a combination of factors, including the higher expectations of those who are now better informed about their health. These expectations are universally expressed through a democratic process that leaves no professional group secure from public opinion and criticism.

2. Present image and future role of the medical profession

Dramatic changes will be required in medical practice; these will call for important interventions, including equally dramatic changes in medical education.

The physicians of tomorrow should be able to respond better to the needs of communities. They will, therefore, need to possess the competences necessary to promote healthy lifestyles and to communicate with consumers and community leaders in order to obtain their involvement.

Changes in undergraduate medical education will not affect the delivery of health care for a further 10 to 15 years. Therefore, national authorities, training institutions, and professional associations are urgently called upon to initiate and support movement that will educate the next generation and re-educate those who are now in practice to respond to the changing needs and demands of their society.

Presidential Address * President - Jaffna Science Association

It is higher education that bears the responsibility for preparing health professionals for the prospective needs and demands of society. It should also be born in mind that education is a reflection of the values of society.

The medical profession should not only anticipate the nature of the education that is required, it should also contribute to finding appropriate ways to make the best possible use of health professionals. Medical schools and other university institutions can and should use their potential and resources to this end.

3. Challenges for higher education.

In the absence of such initiatives, forces outside the academic and professional world may well take the lead and impose changes that may not fully involve medical education and the medical profession. It may be argued that health is too important to leave entirely in the hands of health professionals. However, the quality of care, seen from a scientific perspective, as well as from the point of view of ethics and social justice, may be seriously compromised if those responsible for higher education in medicine and the health sciences do not become more actively involved in shaping the future of health professionals.

Because there are conflicting forces in any institutional change, we should open a wide dialogue and search for a consensus among all parties concerned in the changes that are required in booth the health care system and in medical education, and by involving them in developing appropriate strategies to achieve such changes.

The search for and the provision of appropriate medical education in a given health system may, indeed, facilitate or precipitate a cascade of changes in the education of all health professionals and in health care delivery patterns.

4. The change process

The prime emphasis of the Reform is on changing undergraduate medical education.

It should be noted that the organizations such as Wolrd Health Organization, World Federation of Medical Education have been involved at improving the relevance of medical education and the way students learn medical education. Many workshops have been organized, a large number of assignments have been carried out by consultants, and numerous fellowships have been awarded. All these efforts have been made to support Member States in their endeavours to reorientate medical education more specifically towards social relevance.

The proposal is based on the principle of using a comprehensive and systematic approach in the management of change and consists of:

A. Setting standards and developing tools for assessment.
B. Strategies for changes.
C. Follow-up through monitoring world-wide.

5. Tools for Assessment.

Setting standards in medical education is a prerequisite to the other two components designing and implementing the strategies for change and following through monitoring. An understanding of the meaning of "quality medical education" must be reached, in order to design and apply meaningful strategies for its achievement and how it should be monitored.

The assumption is that, if countries and institutions were able to determine objectively the extent to which proposed changes apply to them, they would be more readily inclined to reorientate their medical education.

The quality of graduates, the product of its medical education reflects how well a medical school fulfils its mandate.

A new mandate for medical schools

Although the mandate of a medical school may vary from place to place and from time to time, four areas of concern are of major importance:

A. active participation in the improvement of the quality and coverage of health care services;

B. guarantee of the relevance of education and research to priority health needs;

C. a constant endeavour to apply and disseminate efficient learning process in health sciences;

D. firm involvement in quality assurance and assessment of technology.

The fundamental values provide a new mandate for a medical school that would be more responsive to society and would accept a dual responsibility: an intra-institutional responsibility that stresses educational development (B and C) and extra-institutional responsibility that stresses the improvement of the health care system and delivery of service (A and C).

The values should influence the setting of standards in medical education and they should serve as the goals of the strategies
for change.

6. The search for references and objectivity.

When the standards for the quality of medical education have been decided, it will be helpful to determine the criteria and indicators which will permit a quantifiable evaluation of the extent to which ongoing education meets these new requirements.

The list of indicators should be established as the result of wide consultation, to ensure that it will be meaningful and acceptable to policy-makers and programme managers. It will be at the discretion of each medical school, to decide which indicators to retain that best reflect their particular mandate. While the fundamental values of medical education should remain inviolated, the adaptation of guidelines for data collection and quantitative assessment and thus the quest for quality in medical education should continue.

7. Strategies for Action.

Why change medical education and what should be changed are two questions that have begun to be addressed reasonably well. The change is now to explore more systematically how change can be brought about.

Formulating strategies for fundamental change in medical education is a complex undertaking. One reason for this is the requirement to involve multiple parties in achieving change in an area where self-interest is intense and deeply rooted. Another reason is the wide range of support required by medical schools as they try to move into new ground.

Because of the complexity of the change process in medical education and because of the variety of determinants that may influence it, depending on the peculiarities of the political and sociocultural context, there is no unique prescription for change in every situation. While the itineraries leading to the goal of the proposed new mandate may vary from place to place, the goal should essentially be the same.

Several strategic approaches should be considered as optional entry points towards change. They are not mutually exclusive. In fact, for a medical school that is willing to embark on reform the selection of one particular strategic approach is simply an indication of the point at which it wishes to start the long process of change that will eventually incoorportate most of the other strategic approaches. The choice may depend on local opportunities and resources that will help to maximize initial success.

Possible Strategies for change:

1. Optimizing human resources for health.
2. Search for national consensus.
3. Initiative by the university.
4. Population perspective.
5. Addressing an important problem of public health.
6. Problem-solving education/Problem based learning.
7. Using information/communication technology.
8. Continuing medical education.

Let us now review the main features of each strategy.

7.A. Optimizing human resources for health.

Where the health infrastructure is weak, reorientation and strengthening of basic, post-basic, or continuing medical education, may be most successful within the wider framework of making optimum use of health professionals as an essential condition for successful health development. - our situation.

A pragmatic three-step approach is here proposed for the application of this strategy.

1. Make a rapid diagnosis of the health manpower situation in the whole or a part of the country.
2. Take actions that will have an early impact on the training and use of the health professionals.
3. Plan projects for more fundamental and long-lasting change, particularly in the reorientation of educational and health service institutions.

In practical terms, the strategy consists of drawing up a comprehensive plan for optimal employment of health professionals and indicating the specific role and place of medical education. It will be important to recognize that the fate of medical education is closely linked to the fate of the development plan for those who are involved in the health services.

This approach is offered as an "eye-opener" to decision-makers who are concerned with allying pragmatism with a systems approach in the recruitment, training, maintenance and use of health professionals. It may also demonstrate how a medical school can take on new responsibilities for the effective use of health professionals and, as a result, how it can reorientate its education appropriate. The strategy is broad

and may seem to be complex and difficult to follow, quite distant from the original target, i.e. changing education. However, by using this alternative route intelligently, the foundation can be laid that will support relevant and sustainable change in medical education.

7.B. Search for national consensus:

Here the issue of changing medical education and medical practice should be brought into the open and debated publicity. Representative from the political world, the health professions, health services administration, universities, and consumer groups should be invited express their opinion about the medical profession and what they expect from it.

The probability of a successful outcome largely depends on whether the parties concerned can reach a compromise in defining a set of standards in medical education and medical practice, as well as the means for identifying any significant deviation of the local situation from their perception of the "ideal".

Such a plan with agreed objectives, activities, methods and a time frame, should be supported by the establishment of a core group that would be responsible for monitoring implementation.

7.C. Action at the University Level.

The major part of the effort to promote re-orientation in medical education toward the health needs of society is ultimately to be expressed at the level by effecting modifications to the educational programmes relating to the undergraduate and continuing medical education and also as these relate to service and research responsibilities. Without resolve to change at the institutional level little will transpire whatever the external pressures. Given interest in change within the institution, only then any outside support can be highly effective.

Issues that might be identified by the institutions themselves in paving the way for reforms:

1. Asses the current medical educational programmes in terms of their relevance to the health needs of the society.
2. Consider the relevance of the medical educational programmes to the health and health man power policy of the country.

3. Review with medical teachers and students their willingness to undertake such assessments and to do so collaboratively with those responsible for national health services.

4. Assess the role the medical school can play in planning the future of the national health services and in the implementation of those plans.

5. Assess the possibilities of shifting the settings for learning so that community-based and hospital based settings are used in a balanced way.

6. Consider the curriculum and teaching methods in terms of the extent to which they involve problem solving rather than didactic methods.

7. Consider incorporating the training of teachers in teaching and assessment as an integral part of development of teaching staff.

8. Assess the role the doctors of the future might play in planning and managing comprehensive primary health care programmes and whether their current competences correspond to their future roles, including the leadership role.

9. Consider ways in which medical students could work together with students of other health professions in order to strengthen the potential for team work.

10. 10.Consider the steps necessary to bring about an awareness of the above issues among teaching staff and students.

11. Give thought to advocating the need for change to the public and to leaders in policy making.

Consideration of these issues constitutes the first steps of international reform. Having identified which of these steps they would undertake, institutions would then move toward development of plans of action, including defined targets and time frames.

7.D. Popular perspective.

One of the important aims of education is to serve people.

Medical education should be appraised for its capacity to improve the health status of a given population and/or of target groups exposed to specific health risks.

This strategy capitalizes on the potential capabilities of training institutions to plan, implement and evaluate community health programmes.

The population perspective and the multidisciplinarity necessarily entailed in this approach imply that teachers and researchers may need to acquire new skills for setting up community health programs, particularly in community diagnosis, epidemiological analysis, and health management.

More important, the training institutions would be expected to use its resources and potential for the benefit of the community. By doing so it would accept a shift of emphasis in teaching, research and service, from disease to health, from the hospital to community-based settings, from cure to prevention and promotion, and from solo practice to team work.

While staff in departments of basic, clinical, and behavioural sciences would all be associated in this move, the incentives to cooperate would have to be carefully worked out. Moreover, training institutions would have to learn to work in full partnership with the health services, local authorities and professional groups in planning and carrying out programmes of community health intervention. This strategy should lead to a critical appraisal of the role of physicians and other health professionals in preserving health and, subsequently, to a call for change on the part of medical educators and medical students.

7.E. Addressing problem of public health.

A medical school may take the initiative or it may be given the opportunity to take a leading role in the study and control of a health problem either because it poses a real threat or because of public concern. Such a problem could be, for instance, AIDS, malaria, gastroenteritis, alcoholism, drug abuse, etc.

The practical involvement of a medical school in the struggle to resolve a major problem may trigger a reflex of self-criticism implicating the institution's capacity to cope with the situation, either as an institution per se and/or through its graduates.

This strategy consists of transforming that awareness into a movement to reform targeted educational, and research/development programmes so that they can properly address a specific public health problem and, subsequently, other programmes, in the light of the community's health priorities.

Teachers and researchers in medical schools may not always be the most appropriate people to administer public health programmes. However, they could perhaps learn to do this by sharing leadership responsibilities with more knowledgeable individuals and groups and thus be exposed to fundamental issues in health care: the search for relevance, fair coverage, priority-setting, appropriate use of technologies and research findings, etc. They would also have the opportunity to tailor their training and intervention activities appropriately.

Training institutions (and their units/departments) that were willing to adapt their training, research and service activities to serve the interests of people facing a critical health situation, could be offered incentives and rewards by policy-makers as well as by the communities.

In this strategy a medical school uses the opportunity to become involved in the control of important public health problems to reflect on its mandate and on the reorientation of its educational programmes.

7.F. Problem-solving education/Problem-based learning.

The content of the curriculum, the process of learning and the learning environment should be adapted to enable learners to acquire competence in identifying the priority health problems that they will encounter in their future practice. They should also be assisted to acquire competence in using essential information in the decision-making process for the analysis and solution of these problems. The objective is to prepare doctors to think critically, to make informed decisions, and to assume responsibility for sound health management practices.

This is, in essence, problem-based learning (PBL)

However, the strategy should not restrict itself to the introduction of any particular clinical or public health problem as a basis for curriculum development; this by itself may not necessarily guarantee relevance in medical education. What is of critical importance is to ensure that there is an interactive relationship between the priority health needs and problems in the community, the expected role of the medical practitioner, the educational content and process, and the involvement of the training institution in actually solving these problems.

This is what is meant by problem-solving education (PSE)

This strategy advocates a shift from a discipline-based, or even task-based curriculum towards problem-based instruction; and from a teacher-centered towards a student-centered approach. With these shifts, the departure from the conventional methods of medical education becomes dramatic. The intention is to prepare students to think much more critically and therefore to become much more able to decide what is appropriate for their own educational and, it is hoped, for the society they intend to serve.

This strategy illustrates the potential role of educators in changing medical education, given that the training of teachers in new educational methods is frequently a powerful booster to the change process. However, problem-based learning and, even more so, problem-solving are more than didactic innovations. Above all, they offer a unique opportunity to ensure that education is appropriately matched with real-life situations and that the institution consistently performs its dual role of increasing the relevance to real health needs of both its medical education and the health services.

Using information/communication technology.

The use of infomatics in medical education may serve many purposes. One of the most important is that access to a common bank of data allows medical schools to come to grips with priority health issues in the community. This strategy uses informatics to this end.

This strategy requires that medical schools be provided with appropriate hardware and software to enable them to become active in community-based health intervention programmes. The power-brokers in medical education should then be able to appreciate that the potential of information and communication technology will enable them to exercise more effective control and leadership in the development of health care. The strategy should allow them to venture outside their usual sphere of hospital and disease-centered activities to discover areas of deficiency and to assume new or increased responsibilities for the conduct of more relevant research, service, and education.

Having been made aware of new realities and challenges in the system of health care delivery, medical educators and health managers would jointly come to realize the kinds of changes that are needed in the medical profession and in medical education and stimulate each other to undertake these changes promptly.

7.G. Continuing Medical Education.

This strategy consists of actively involving medical schools in identifying what medical practitioners need to learn in order to cope with new challenges in the health care system. The strategy will also involve medical schools in the search for suitable and appropriate educational methods that would be both effective and acceptable to practitioners to meet these challenges.

What is really at stake is the acquisition by medical practitioners not only of new scientific knowledge and an acquaintance with new technologies, but also of the skills and attitudes necessary to function properly in practice patterns that are in line with defined social and health policies and standards of quality assurance.

It is essential that the objectives for continuing education be set after a careful review of current medical practice and how it affects the health of the population. A meeting of medical practitioners, health care managers, and representatives of consumers would be a useful means towards this end.

In the process of planning, implementing and evaluating programmes of continuing medical education in close collaboration with professional associations, medical schools could learn a great deal about relevance in medical education and efficient learning.

This intense interactive process with a variety of partners should help medical schools to realize how far undergraduate medical education deviates from the ideal and inspire them to undertake a fundamental shift in their educational programme.

7.H. Establishing an experimental track with a new curriculum

In this strategy, the introduction of innovative educational methods with a group of student volunteers would be treated as a scientific experiment by the medical school. The new educational programme would run in parallel with the existing one. Indicators and criteria for comparison between the two tracks would be set.

The new parallel track should operate on one or more of the following basic principles: community-orientation; problem-based learning/problem-solving education; multiprofessional education; and close partnership between the training institution and the health care system.

Each innovation would be planned according to clearly specified technical procedures to allow for proper monitoring and evaluation of the experiment.

Expected outcomes may be expressed in terms of the competence the learners want to acquire, student and faculty satisfaction, career choice of new graduates, contribution of the training institution to community health development, etc.

The feasibility of this strategy depends on a number of conditions. These include the capability of the medical school to control the parallel track as an experiment, by controlling possible biases that might undermine its validity; the existence of sufficient technical, material, human, and financial resources to launch and maintain a separate track; and the willingness to learn from the experiment and apply the lessons learnt.

7.1. Educational Priorities For Medical School

The growth of medical knowledge and the vast differences between nations in resources for health care, demand a re-examination of the priorities, principles and purposes of medical schools.

What knowledge should they import in the time available?
Should their emphasis be on scientific training of the mind, or on preparation for delivering a service? Should they prepare doctors ready to practise independently on graduation or simply those who are ready for further post-graduate training? Will the graduates work single-handed or as part of a complex system?

A fundamental review of priorities is required.

1. Science or Service?

   The science component of M.E. must be reviewed for its applicability to health care and medical practice.

2. Competence in preparation for further learning.

   Medical students must be helped to acquire the habit of life-long learning.

3. Competence in individual diagnosis and management.

   Curricula must be designed to ensure that students have the opportunity to achieve this objective.

4. Competence in Community Health.

   Students must acquire the ability to promote health as well as deal with disease, not only in individuals but also in population.

5. Competence on Collaboration.

   The medical curriculum must be re-oriented to ensure that medical graduates learn to work effectively as members of a team.

Stellar Evolution

*Professor K.Kandasamy

Introduction

The sky that we see at night is not different from the sky our ancestors saw. But it is an illusion. Careful observations tell us that the sky and the stars in the sky are changing continuously. In other words they are evolving. The Stellar Evolution is a branch of study in Cosmology, which deals with the changes that take place in the sizes, luminosities, structures and so on of stars as they age. In the early days Cosmology was considered as a branch of study of Philosophy and Theology. But Cosmology gained the state of Physical Sciences when the law of gravitation was formulated by Newton in 1766. Scientists believe that activities to understand the stellar evolution, also began from this time. Since then, the interest and activities of scientists in the study of Cosmology have been greater. Today cosmology has evolved as a matured discipline in Science. Its links with other disciplines in science such as Physics, Biology and Mathematics make it an inter disciplinary study. The study of Stellar evolution is one such inter disciplinary study of Cosmology and Physics. Today studies on the stellar evolution and related phenomena such as gravitation have emerged as a separate discipline in Physical Sciences, and is called Astrophysics.

During the last century and the early part of this century the interest and research activities in Astrophysics were in a low phase as the attention of most of the Physicists was diverted to new areas like Solid State Physics, Nuclear Physics and Particle Physics. But now the interest in Astrophysics has been renewed due to the progress made in the theory of evolution, discovery of Quasars (Quasi-stellar objects) and Pulsars (A variable radio source of small angular size that emits radio pulses in very regular periods that range from 0.03 to 5 seconds) and the availability of high speed computers, high quality telescopes, modern spectrometers and high energy and satellite facilities. The telescopic and spectroscopic studies provide valuable information about the features of galaxies billions of light years away and throw light on the nature of the universe when it was young. Particle accelerator studies provide information regarding high energy environment of early universe. The COBE (Cosmic Background Explorer) satellite launched into the earth orbit in 1989 provides information about the nature of the background radiation that was created during the childhood of the Universe and now filling the whole Universe uniformly. In recent years studies in Stellar evolution gained momentum because of an expectation of a possible link between creation of particles and the unification of fundamental forces in the high energy environment.

*Chairman, Section A of Jaffna Science Association

Cosmological Models.

In the early days researchers in Astrophysics adopted a model called the static model to explain cosmological phenomena. This model was first used by Newton. Later the great Physicist Albert Einstein shortly after formulating the general theory of relativity in 1915 showed that the observed large scale average uniform distribution of matter in the universe is in near fit with his theory of general relativity if the universe is static. In otherwords Einstein supported the static model of the Universe. But Alexander Friedmann recognised and pointed out an error that was made by Einstein in his analysis of the problem and showed that the static Universe is unstable thus predicting the possibility of an expanding universe. During 1930s Edwin P. Hubble, in his experimental studies of measuring the separation of remote galaxies and the red shift of the spectral lines of these galaxies found that the galaxies appear to recede from one another and that the most distant ones recede at the greatest rate. This behaviour of the Universe can be compared to the expanding surface of an inflating balloon. Further Hubble found that the rate of recession of two galaxies is proportional to their separation. The proportionality constant is called the Hubble's constant and an estimate of the age of the Universe is possible using the Hubble's constant which is about 15 billion years. After the findings of Hubble, a large number of Cosmological models were proposed by researchers. These models were based on the assumptions of large scale uniformity and continuously changing nature of the universe. But these models differ in their predictions about the future of the universe and can be divided into two classes namely steady-state models and evolutionary models.

All evolutionary models accept changes in appearance and condition of the universe and assume that all positions in space in the universe as identical. Steady- state models also accept changes in appearance and condition of the Universe. Further these models not only assume identical nature of all positions in space but also assume identical nature of the universe at all times. In the initial days the prediction of evolutionary models on stellar evolution appeared to be in serious conflict. Due to an error in the estimation of the magnitude of Hubble's constant the age of the universe predicted by evolutionary models was not long enough for a star like Sun to evolve to its present stage. This situation in late 1940s encouraged the British Scientists Hoyle, Bondi and Gold to propose a Steady-State model. The Steady-state model require continuous creation of matter in order to equal the depletion of universe caused by its expansion. In this respect the Steady-state model predicts creation of one hydrogen atom within 1 km cube in every 10 years. This is too small to identify. But two other pieces of evidence cast doubts upon the validity of the Steady-state model. One of these is the radio sources in the universe which are more dense in the past than they are now. The other is the QSO (Quasi Stellar Object) which are also more numerous in the distant past than they are now. Further the steady-state model is not consistent with the existence of cosmic back ground radiation which is widely regarded as the black body radiation left over from the early stages of the universe. The cosmic back ground radiation measurements using satellite and ground based experiments by

Arno.A Penzeas and Robert W.Wilson in 1965 showed that the back ground radiation is the same in all directions and the spectrum to be very close to that of the radiation emitted by a black body at a temperature of 2.7 K. It is worth mentioning here that the above experimental work won the Nobel prize in Physics for the year 1978. These experimental observations provided direct evidence for the evolutionary nature of the universe and lent strong support for the evolutionary model. Further, recent accurate measurements of the Hubble's constant enabled the Physicists to invalidate the contradiction between the age of the universe predicted by the model and the length of time required by stars like the Sun to evolve to the present stage.

The evolutionary models can be classified into three types based on how they characterise the universe using parameters such as curvature of space k, deceleration q_o and average density of matter ρ in the universe. If one of these parameters is known others can be computed using the general theory of relativity. Attempts to choose a model of the universe based on the measurement of either k or q_o has not been successful. In principle the average density of the universe can be estimated using available cosmological information. The present estimates suggest that the universe will continue to expand as in the past. It further suggests that the expansion may be started from somewhere in the space at a definite time. This is the basis of Big-Bang model.

Big-Bang Model

The Big-Bang model was first proposed in its modern form by G.Gomow in 1948. According to the Big-Bang model the universe was created about 15 billions years ago in an explosion of a super dense and hot object, called cosmic singularity.

The explosion, called Big-Bang, was not similar to an explosion of a bomb. When a bomb explodes pieces of debris fly off into space from central location. If one could trace all the pieces back to their origin then it is possible to find out where the bomb had been. We cannot do this in the case of Big-Bang because it was the explosion of space ,not simply of an object.

The present Physics theories such as the general theory of relativity, quantum mechanics and field theories are not capable of explaining the Physical nature of cosmic singularity or the situation within Planck's time, 10^{-43} second, after the Big-Bang. Thus the physical processes responsible for the birth of the universe or the nature of the Universe within the Planck's time are not yet known. Physicists look forward to the development of improved theories some times called quantized gravity or supergrand unified field theories to explain the birth of the universe and the nature of the infant Universe.

The infant Universe was in a highly compressed state with density greater than $5x10^{12}$ kg m^{-3} and at a temperature higher than 10^{30}K. At such an extreme pressure and temperature atoms and molecules cannot exist. Even the particles we are familiar with such as neutrons and protons would be fragmented. It is believed that only photons, electrons, positrons and quarks existed at that time. Infant Universe was then like a boiling vessel and this state of the Universe could be called as cosmic primeval fireball.

Shortly after the Planck's time the new-born Universe or the primeval fireball was subjected to a violent expansion called inflation of the universe. The inflation occurred because no force could successfully resist the expansion driven by the high energy thermal motion and pressure of the radiation confined within the cosmic fireball. The model predicts that the inflation lasted nearly up to 10^{-35} second after the Big-Bang. During the inflation stage the Universe expanded enormously, perhaps by a factor of 10^{50}. Further the inflation placed much of the material that was originally near to our location far beyond the edge of the observable Universe today. This separation between the interstellar material occurred not because of their motion but because of the expansion of space.

As new-born Universe began its adiabatic expansion it had to work against its own gravitational force of attraction. This was done largely at the expense of thermal energy it possessed. It resulted in the rapid drop in temperature of the Universe. As the temperature of the Universe started declining, particle like protons, neutrons and neutrinos resulting from proton - electron collision were created. This occurred when the Universe was just a minute old. At this stage the temperature of the Universe had dropped to 10^{9}K. Further drop in temperature occurred as the Universe continued to expand allowing the protons and neutrons to combine and to create helium and deuterium nuclei. This occurred until the temperature dropped to 10^{8}K. The temperature dropped to around 10^{8}K when the Universe was only 3 minutes old. During this time nearly 20% of the stellar material had been converted into helium. A very small fraction of deuteron was also created. During the next one million years nothing special happened in the Universe. During this time the photons were moving randomly and making collisions vigorously with protons, helium nuclei and electrons. This state of matter is called plasma which is opaque and hot. Thus the Universe was opaque for nearly a million years after its birth. Further during this time the average density of photons was greater than the average density of matter. The Astronomers call this situation ' radiation dominated Universe'.

At the end of one million years after the Big-Bang the temperature had dropped to 3000K. The radiation was no longer absorbed by the materials and was able to pass freely throughout the Universe. Thus the Universe became transparent. It is believed that this unabsorbed radiation is the background radiation in the Universe now and that it first came into existence one million years after the Big-Bang. This background radiation was first detected in 1965 by Arno Penzias and Robert Wilson of Bell Telephone Laboratories. Further after the temperature of the Universe had dropped

below 3000K the radiation photons no longer had enough energy to prevent the combination of electrons with protons. Therefore electrons and protons everywhere began combining to form hydrogen atoms. Further, during the one million years life of the Universe a large portion of radiation photons were converted into matter and antimatter by the pair production process. As such at the end of one million years of its life the average matter density in the Universe had become larger than the average density of radiation photons. Astronomers call this situation of the Universe as 'matter dominated Universe'. This is the prevailing state of the Universe.

Further drop in the temperature of the Universe made the neutral atoms to coalesce into gas clouds. Nearly after a billion years of the birth of the Universe the gas clouds started to evolve into stars and galaxies.

Galaxies

The galaxies are the basic structural units of the Universe. Their distribution in space is not uniform; usually they form clusters of galaxies with spherical shape consisting of tens of thousands of galaxies.

The Big-Bang model does not give any clue regarding the processes which are responsible for the formation of galaxies. But the most widely accepted theory of galaxy formation is the theory of gravitational instability. This theory says that the galaxies condensed out of the interstellar gas cloud formed in the Universe. In the early Universe if in a region the matter density happened to have a density higher than that of its surrounding region then it would gravitationally attract strongly to itself than ambient material. If such a region was free of gas or radiation pressure then it would contract under its own gravity and hence would increase in density. This condensation process would create an object similar to a droplet out of the Universe that previously was quite homogeneous.

The mass of the droplet probably ranged from 10^6 solar masses(globular star cluster) to 10^{15} solar masses (aggregate of galaxies). If the mass of the droplet is about 10^{11} solar masses then it is a called protogalaxy. Initially the protogalaxies would expand with the rest of the Universe but at a slightly lower rate. After few hundred years it would stop expanding and in effect get detached from the rest of the Universe. At this stage it is called a galaxy. Galaxies differ in their shape, size and population of stars in them. In general the galaxies are classified into three types:

(a) Spiral galaxies

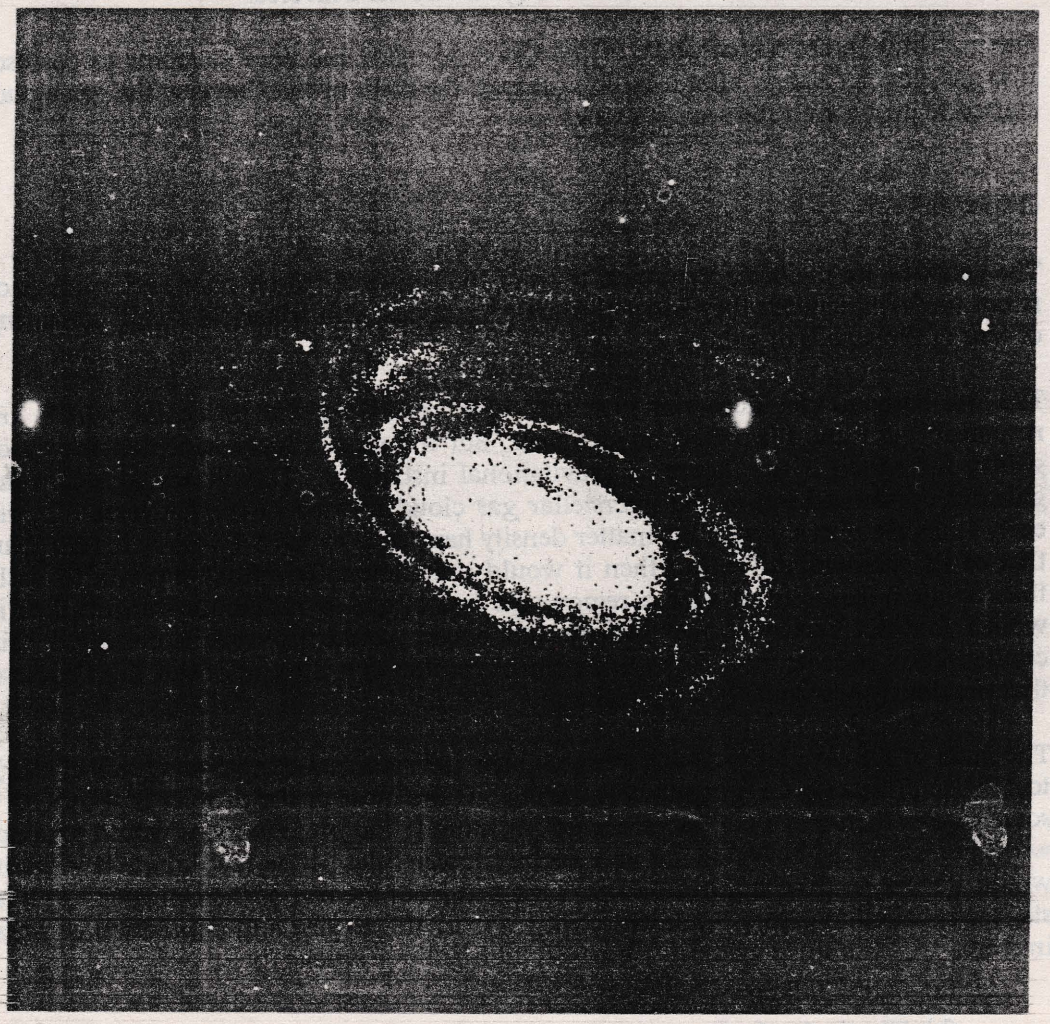
(b) Elliptical galaxies

(c) irregular or featureless galaxies.

The spiral galaxies (Figure 1) have a disk shape bulge at their central part with spiral arms. These galaxies contains both young and old stars. The spiral arms are rotating

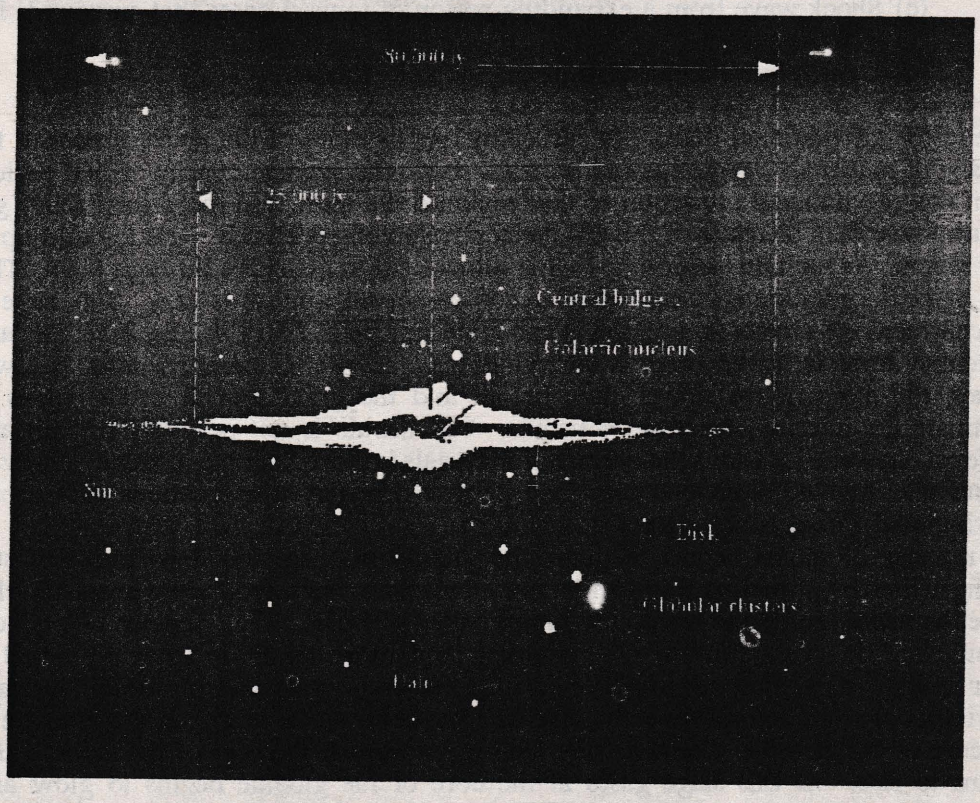
about their centre and sweeps large amount of interstellar gases. The spiral arms are usually rich of interstellar gases and thus the most active region for star formation. More than two-third of visible galaxies in the Universe are spiral galaxies.

Figure 1: The Spiral Galaxy M81 (also called NGC 3031)



Our galaxy (Figure 2), called Milky way is also a spiral galaxy. It's disk shaped centre has a diameter of 80 thousand light years and a thickness of two thousand light years. It consists of nearly 100 billions stars. The sun is located in the disk between two arching spiral arms about 25 thousand light years from its centre.

Figure 2: Our Glalaxy (edge-on view)



Elliptical galaxies are spheroidal in shape and have no spiral arms. They are virtually devoid of interstellar gasses. There is no evidence for the existence of young stars and for the formation of new stars.

As has been mentioned earlier , galaxies are condensed out of the interstellar gas clouds in the Universe. During this condensation if the rate of star birth is high then the gas gets converted into stars before a disk shaped central region is formed and thus results is an elliptical galaxy. Instead if the rate of star birth is low then much of the gas condense to o form disk shaped central region and thus resulting is a spiral galaxy.

Formation of Stars.

Like galaxies stars are probably formed from the interstellar gas clouds due to gravitational instabilities. But the size of gravitational instability is small. The gravitational instabilities may be caused by one of the following processes:

(a) Density wave created by the rotation of the spiral arms of the galaxies.
(b) Shock wave from a supernova explosion of a star
(c) Shock wave from a expanding region of ionised gases that surrounds hot massive stars
(d) Density wave created by the collision of galaxies.

Due to the gravitational instability caused by one or more of the above processes the density of matter in a region could increase above the average density of that region. Then the gravitational attraction of that region drive more and more interstellar gas clouds towards it. Because of this the concentration of gas clouds starts to build up in that region. As such this region no longer allow light to penetrate through them. This will make the gas clouds in this region to cool down and appear as dark. This stage of concentrated gas clouds in a region is called dark nebula. Dark nebula is opaque and its temperature is lower than its surroundings. As the temperature falls to lower values, the atoms move slower than before and the gravitational forces begins to dominate the internal structure of nebula. The nebula is not perfectly smooth and uniform. In some locations the density of materials is more than the average density of the nebula. Around these locations the gravity is stronger. The locations with strong gravitational forces easily attract slowly moving gas atoms in their surrounding. As the number of atoms begins to grow the gravity at these locations becomes still stronger thereby attracting more and more atoms from the surrounding areas. At this stage the nebula begins to break into lumps called globules. The diameter of a typical globule may be several million miles and may contain matter about a few times that of solar mass. A globule is unstable against its own gravitational force. Inward gravitational attraction makes it to contract. The contraction increases the pressure at the core of the globule. Consequently the temperature at the core of the globule also begins to rise. At this stage gases at the core of the globule begins to glow and radiation starts to leak out from the contracting sphere of gas. This will give a dull red colour to the globule and it is called protostar.

The protostar is also unstable against its own gravity. Therefore it will continue to contract. This will increase the pressure and temperature at the core of the protostar to higher and higher values. Finally when the temperature at the core of the protostar reaches $4x10^7$ K the hydrogen burning is ignited. That is at this temperature the hydrogen nuclei will have enough energy to overcome the Coulomb barrier for their fusion into helium nuclei. This process is called thermonuclear fusion. When four hydrogen nuclei are fused into a single helium nuclei there will be a release of energy equivalent to their mass difference. The amount of energy release due to hydrogen burning at the core of the protostar is enormous. This will build up gas pressure at the core of the protostar. If the pressure build up is enough to balance the gravitational attraction towards the centre of the protostar then a quasi equilibrium condition will be established. Thus the contraction is halted temporarily and a star is born.

Lives of small stars like Sun.

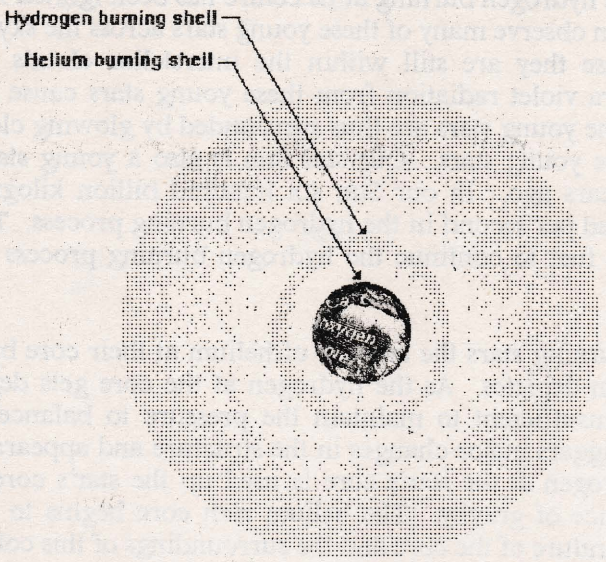
A star in which the hydrogen burning at its centre has been ignited recently is called a young star. We can observe many of these young stars across the sky. We can identify them easily because they are still within the interstellar clouds from which they emerged. The ultra violet radiation from these young stars cause the gases in these clouds to glow. The young stars are thus surrounded by glowing clouds. Most of the stars in the sky are young stars. Our star Sun is also a young star. Sun was born nearly 5 billion years ago. In our Sun six hundred billion kilograms of hydrogen nuclei are consumed per second in the hydrogen burning process. The Sun has ample stock of hydrogen fuel to continue the hydrogen burning process for yet another 5 billion years.

In the hydrogen burning stars the amount of helium at their core builds up while the supply of hydrogen depletes. As the hydrogen at the core gets depleted, the energy created becomes insufficient to maintain the pressure to balance the gravitational attraction. This triggers major changes in the structure and appearance of these stars. When all the hydrogen at the star's core is used up the star's core become unstable against the influence of gravity. The helium rich core begins to shrink. This will increase the temperature of the core and the surroundings of this collapsing core. This will ignite hydrogen burning in a thin shell around the core.

Now the star has a new source of energy and fresh supply of fuel. At this stage initially the star begins to expand. At the same time, the gravitational contraction of the helium rich core forces the core temperature and pressure to increase. When the core temperature reaches 2×10^8 K the helium nuclei in the core fuses into carbon and oxygen nuclei. This is called the helium burning stage. The helium burning at the core generates energy at the core and prevent further contraction of the core. At this stage the star is subject to two burning processes. The helium burning at the core is surrounded by a shell of hydrogen burning. This will make the star to expand to a larger size. Its volume will increase billion fold. As the star's outer layers are pushed further and further away, the density and pressure in the outer layer of the star decreases and in response the temperature also decreases. The star at this stage is big and cool and it will appear red. Then the star is called red giant.

Five billion years from now our sun will evolve into a red giant and will have an expanded size of diameter 200 million miles. At that time the red giant sun will include mercury, Venus and earth within it. As we may expect after few billion years of becoming as red giant all the helium at the star's core will be used up and the helium burning will stop. The star's core once again become unstable against the gravitational contraction. This will again increase the pressure and temperature of the carbon- oxygen rich core and ignite the helium burning in the surrounding shell. The helium burning shell is surrounded by hydrogen burning shell (Figure 3).

Figure 3: The Structure of an Old Low-Mass Star



In a star with mass equal to the mass of the sun this is the last stage of the nuclear burning. This is because their mass is not sufficient to increase the temperature and initiate any other thermonuclear fusion at the core. In these stars while the carbon - oxygen rich core remain inert, the helium and hydrogen burning shells creep outward. This configuration is unstable. The volume of the star begins to pulsate gently and with each expansion the star experiences slight cooling. This will reduce the rate of nuclear burning and energy output. Therefore the star will start to contract. This will again increase the temperature and the rate of nuclear burning. The increase in energy output causes the star to reexpand and the cycle starts again. The period of this cycle is about one thousand years. Finally this convulsion become so great that the outer layers of the star gets detached from the core and float gently in the space. The ultra violet radiation from the core make the expanding outer layers to fluoresce and glow. This event is called planetary nebula. After about 50000 years, this nebula gets thin and disappears from view. Meanwhile the core (dead star) contracts gradually until its size is reduced roughly to the size of the earth and radiate its energy. This stage of the star is called white dwarf. This shall be the final stage of our sun. A white dwarf is a dead star.

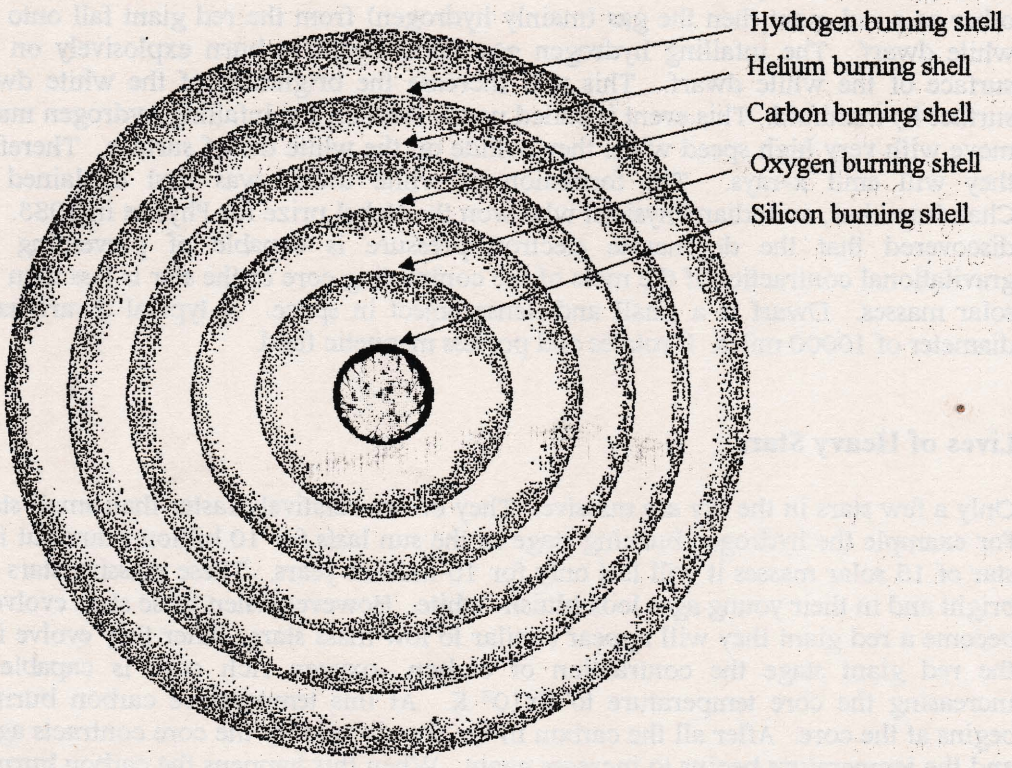
About half of the stars in the sky are binary stars, i.e. pair of stars. During the evolution of a binary star if one of them had evolved as into a white dwarf and the other as a red giant then the gas (mainly hydrogen) from the red giant fall onto the white dwarf. The infalling hydrogen gas atoms begin to burn explosively on the surface of the white dwarf. This will increase the brightness of the white dwarf surface by manifold. This event is called nova. Further, the infalling hydrogen nuclei move with very high speed when they collide on the white dwarf surface. Therefore they will emit x-rays. The formation of white dwarf was first explained by Chandrasekhar, an Indian Physicist who won the Nobel prize for Physics in 1983. He discovered that the degenerate electron pressure is capable of preventing the gravitational contraction if the mass of the contracting core of the star is less than 1.4 solar masses. Dwarf is a small and dense object in space. A typical dwarf has a diameter of 10000 miles. It rotates and possess magnetic field.

Lives of Heavy Stars.

Only a few stars in the sky are massive. They evolve relatively faster than small stars. For example the hydrogen burning stage in the sun lasts for 10 billion years but in a star of 15 solar masses it will last only for 15 million years. These massive stars are bright and in their young ages look bluish- white. However when these stars evolve to become a red giant they will appear similar to low mass stars. After they evolve into the red giant stage the contraction of carbon -oxygen rich core is capable of increasing the core temperature to $6x10^8$ K. At this temperature carbon burning begins at the core. After all the carbon in the core is used up the core contracts again and the temperature begins to increase again. When this happens the carbon burning is spread to a thin shell around the core. When the temperature increases to $1.5x10^9$K oxygen burning gets ignited at the core. During the oxygen burning the core gets accumulated with silicon nuclei. After the oxygen burning is completed at the core further contraction of the silicon rich core increases the temperature of the core and its surroundings and ignites the oxygen burning in the surrounding shell. When the core temperature increases to $3x10^9$ K silicon burning at the core is ignited. During the silicon burning the core is populated with iron (Figure 4).

Iron nuclei have the maximum binding energy per nucleon. Therefore further nuclear burning at the core is not possible. At the end of the silicon burning stage a massive star with an inert iron rich core surrounded by several thin shells are left. In these thin shells different thermonuclear reactions will still occur. Usually these shells are crowded close to the core of the star.

Figure 4: The structure of an Old High-Mass Star

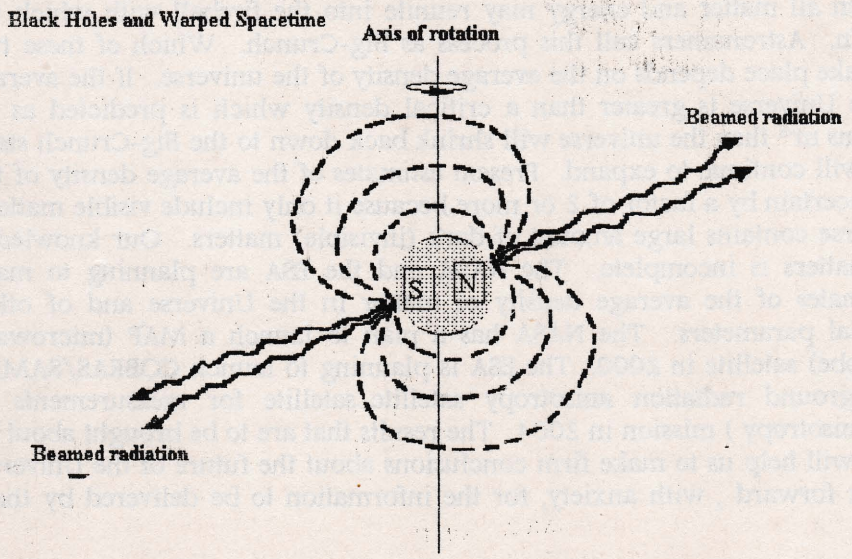


If the mass of the iron rich core is greater than 1.4 solar mass electron degeneracy pressure will not be able to stop the gravitational contraction of the core. Further contraction of the core is therefore possible. If the core contracts further, at a temperature of 5×10^9 K the electrons in the core combines with protons and convert them into neutrons. These neutrons occupy much smaller volume than the original volume of iron nuclei and electrons from which they formed. Therefore suddenly the core collapses. This sudden core collapse releases a vast amount of energy and triggers a violent explosion of the star. The energy liberated during the collapse is very much greater than the total energy released by the star since its formation. During the explosion the brightness of the star increases hundred million fold and ejects outer layers of the star into space at supersonic speed. This event is called supernova. The ejected gases glow and fluoresce. The supernova is not a big nova.

The burned out neutron rich core contracts to a small volume and the gravitational force could be balanced by the neutron degenerate pressure if the mass of the burned core is not very large. This stage of the star is called neutron star. The neutron star is relatively denser and smaller when compared to white dwarf. The mass of a typical neutron star is about 2 solar masses, but its diameter is only 3km. The neutron stars

rotate much faster than white dwarf and have very powerful magnetic fields. The number of neutron stars that exist in the sky is low compared to the number of white dwarfs there. It is not possible to observe neutron stars with a telescope. But they could be identified from pulses of radio waves emitted by them. The emission of radio wave pulses is due to their rapid rotation and strong magnetic fields. Thus these rotating neutron stars are also known as pulsars (Figure 5).

Figure 5: The Model of a Pulsar



The Crab pulsar is the fastest pulsar and is located at the crab nebula. This nebula is the remnant of the supernova that occurred in July 1054. This is one of the youngest pulsars in the sky.

Neutron degenerate pressure is capable of preventing the collapse of a star core if its mass is less than 2.5 solar masses. There are no forces to prevent the gravitational contraction of the burned cores which are massive than 2.5 solar masses. In these massive stars, the entire core material contracts to a point object called black hole. For these point objects the gravitational attraction is very strong and escape velocity is greater than the velocity of light. As such even the light will not be able to escape

from the gravity of these objects and they appear dark. That is why they are named as black holes.

Possible Future Evolution.

The universe is still expanding but at a reduced rate compared to the rate in the past. Most of the galaxies are still producing stars but many others have exhausted of their supply of gas. In about thirty billion years from now galaxies will be much darker and filled with dead or dying stars. If the universe continue to expand forever then it will eventually grow dark and cold. Astronomers call this state of Universe as Big-Chill state. Alternatively if the gravitational force is able to eventually reverse the expansion then all matter and energy may reunite into the fireball with which the universe began. Astronomers call this process as Big-Crunch. Which of these two process will take place depends on the average density of the universe. If the average density of the Universe is greater than a critical density which is predicted as 14 hydrogen atoms m^{-3} then the universe will shrink back down to the Big-Crunch state. Otherwise it will continue to expand. Present estimates of the average density of the Universe is uncertain by a factor of 2 or more because it only include visible matters. But the Universe contains large amount of dark (invisible) matters. Our knowledge about dark matters is incomplete. The NASA and the ESA are planning to make accurate estimates of the average density of matter in the Universe and of other relevant critical parameters. The NASA has a plan to launch a MAP (microwave anisotropy probe) satellite in 2000. The ESA is planning to launch COBRAS/SAMBA (cosmic background radiation anisotropy satellite/satellite for measurements of background anisotropy) mission in 2004. The results that are to be brought about by these projects will help us to make firm conclusions about the future of the Universe. Physicists look forward , with anxiety, for the information to be delivered by these missions.

Paradoxes- A Learning Tool

*Dr.S.Mahesan

"I am telling the truth;
nothing but the truth"
- A hired witness

When I happened to read a book "Riddles in Mathematics" by Northrob, I found it interesting and useful. The book was about paradoxes-revealing many aspects in Mathematics in an interesting way through paradoxes. I thought it must be introduced to students- particularly to G.C.E(O/L) and (A/L) students, and even to undergraduates. It would enhance the power of thinking and the analytical ability I would like to take this opportunity to share some of the aspects which I found interesting and beneficial.

It is the human nature that we are attracted by unusual or abnormal or extraordinary things, or by things which are less probable or usually impossible. We are easily attracted by a person walking on his hands; we are wondering about Leaning Tower of Pisa and so on. Reason for this is that it is our nature. When we hear of something which we think never be true our attention will go for it. In view of this, there is no doubt that paradoxes will get our attention: Paradoxes are unusual as they are giving abnormal or unusual results.

What are Paradoxes anyway? A Paradox is anything which off hand appears to be false but actually true; or which off hand appears to be true but actually false. i.e. a Paradox is something which is self-contradictory. Contradictions are useful; they are used in theorem proving because they themselves are not contradictions. They are enjoyable; so are Paradoxes. Simple and obvious example is that the earth and the sky perceived as a disk and a hemispherical lid.

One can say "I am playing" "I am singing", or "I am thinking" which can be either true or false; but can one say "I am lying"?. It is an interesting statement and any book on paradox never fails to quote this statement: " I am lying"; It is interesting because if it is true then he is lying. That means: what he has said is false - which means that he is NOT lying. If he is not lying the what he has said is right; so he is lying!. In other words

if it is true then it is false
if it is false then it is true.

It is indeed interesting, isn't it?.

Chairman's Address *Chairman, Section B - Jaffna Science Association

Similarly, there is a rule called *Rule of exception:* which is as follows:

Rule of Exception:
Every Rule has an exception.
Exception:
Rule of Exception has no exception

If the rule is true then the rule itself must have an exception; so does it have, and which says the very same rule has no exception. Is it a contradiction or perhaps not? Once again it proves the fact that contradictions are enjoyable. Really!
Now let us consider two examples which appear to be false:

Example 1:

Two mothers
Two Daughters
One Granddaughter
One Grandmother

Can sit comfortably in
Three Chairs!

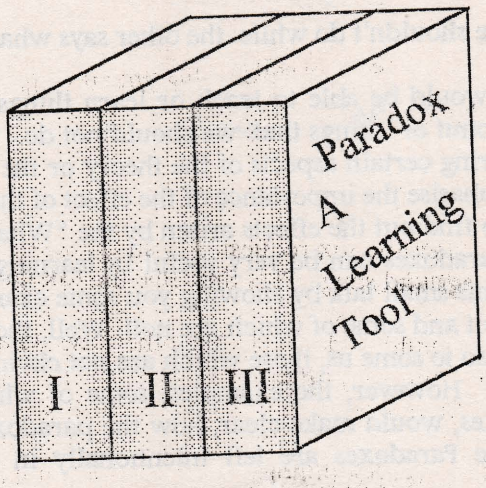
Example 2:

Let us imagine a certain set of 3 volumes of books stacked on a library shelf. A bookworm starts at the out side of the front cover of volume-I and eats its way to the outside the back cover of volume-III. If each volume is one inch thick, the worm must make a 3 inch long hole, right?

The Answer is No!, why?

Both results may off-hand appear to be wrong but they are right. In Example-1, when the persons involved are the trio-mother, daughter and grandmother they can sit

on 3 chairs one each, can't they? In Example-2 the answer is only one inch long. Have a look at the figure given below how a set of three volumes are stacked - it has proved that a hasty decision may give a wrong result but looks right:



Stack of Three Volumes

The above examples have shown that the paradoxes are enjoyable. They are in fact not just enjoyable but give way to explore a given problem, make us understand the problem and give way to understand the ways to solve a problem. *What makes understand things right may be wrong or false.* Thus, as a matter of fact, Paradoxes can be a learning tool. The motto of modern education is *Play to learn* (or *Enjoy learning*) emphasising the fact that the learning should be enjoyable. The joyful learning makes things easy. Nowadays the children in kindergartens are taught in this way -- they play to learn. It is not only true for kindergarten children, but it is true for any student of any age. One must enjoy what he/she studies or rather he/she must find an enjoyable way to learn. Use of Paradoxes is an enjoyable method. As mentioned above, they are not just a pleasant tool, but an urge to explore things to understand certain aspects of theories, and to remember the importance of the aspects.

There are two ways of learning: One is *what to do or how to do*, and the other ways is *what not to do or how not to do.* Scholars say one of the two Indian epics "Ramayana" teaches us how we should live what we should do and the other epic "Mahabarat" warns how we should not live; what we should not do. I would like to quote here the two versions of a primary school story about "crow and fox with *vadai*". From these two versions of the story we can see the revealing of these two concepts.

In version I : While the crow was trying to eat the *vadai*, the fox was requesting the crow to sing a song, and the crow tried to sing while holding the *vadai* in its beak only to drop it down and to get cheated.

In version II : When the fox requested to sing, the crow took the *vadai* in its legs and sang. This time it's the fox that got disappointed.

One version says what we shouldn't do while the other says what we should do.

By using Paradoxes we would be able to teach or learn things that we should not forget or we should not omit or things that we should not do. We can (deliberately) make paradoxes by ignoring certain aspects of the theory or the results the Paradoxes are about in order to emphasise the importance of the effect of those aspects. They can also be used to analyse to find out the effects arisen by the "What if" or "What if not" questions. In fact the paradoxes can be very useful in learning and for learning. I would like to conclude this small talk by showing you some examples of Paradoxes -- Some of which are explicit and some of which are not! Well, those which are explicit to some of us may not be so to some us, those which are not obvious to some of us may not be so to some of us. However, the examples, some of which are presented by making deliberate mistakes, would make clear, how the paradoxes can be a learning tool! The answers of the Paradoxes are left intentionally in order to make your analytical mind wake-up.

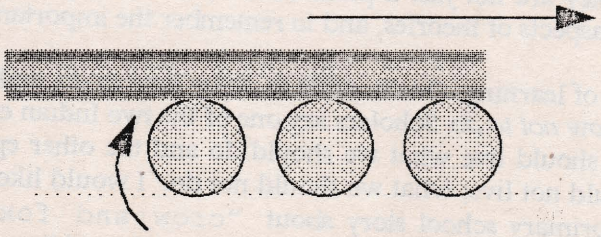
Enjoy and learn!

PARADOX 1:

$$10 + 10 = 100$$

It may look wrong! But it is right. You know why!

PARADOX 2:



Each wheel is of 1 metre perimeter. When they they roll through a complete cycle without slipping, the log will move 1 metre along the direction shown, right? No, it will go longer.

PARADOX 3: Here is a story of two orange-sellers. The trick that worked on DAY1 didn't work on DAY2. Try to find out why!

DAY1

A had 20 oranges tried to sell 2 for Rs 100/= to earn Rs 1000/=.	B had 30 oranges tried to sell 3 for Rs 100/= to earn Rs 1000.

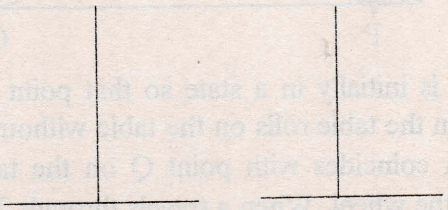
But they didn't succeed, suddenly putting the 50 oranges sold 5 for Rs200/= and earned Rs 2000/=, and shared with no !

DAY2

A had 30 oranges tried to sell 2 for Rs 100/= to earn Rs 1500/=.	B had 30 oranges tried to sell 3 for Rs 100/= to earn Rs 1000.

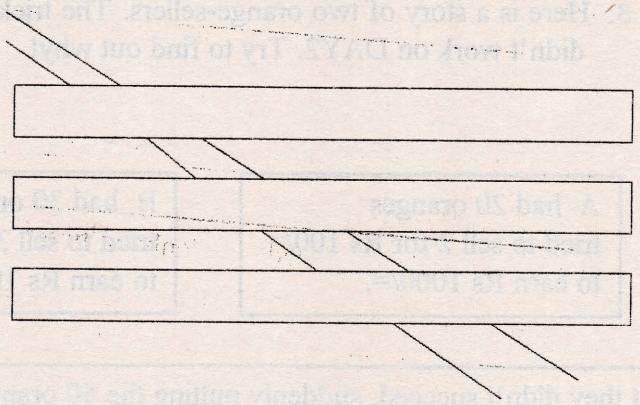
The story was the same as Day1: sold 60 oranges at 5 for Rs but earned only Rs.2400/= instead of Rs 2500/= as SO What Went Wrong?

PARADOX 4 (a):



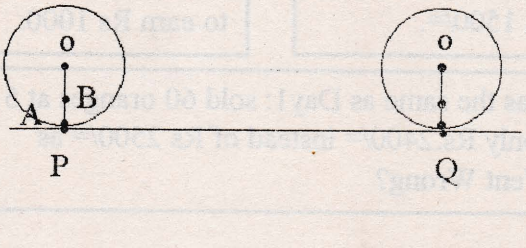
The vertical line looks longer than the horizontal one in each of the above figures. But indeed, it not so in one the figure.!

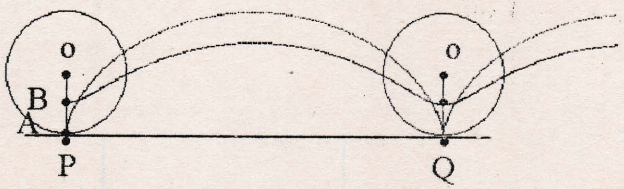
PARADOX 4(b):



Of the two cross-lines lying behind the three bars only one is broken, the other is NOT. You don't believe it, do you? Find out which one is the one, and think why?

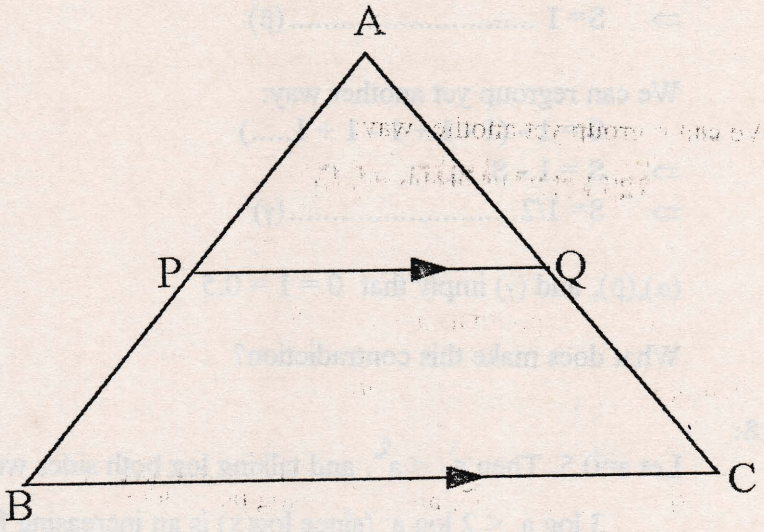
PARADOX 5:





The wheel which is initially in a state so that point A on the perimeter coincides with the point P on the table rolls on the table without slipping and after a complete cycle the point A coincides with point Q on the table, making PQ=2πR, where R=OA, radius of the wheel. When a travels through 2πR, doesn't B travles through the same distance, and doesn't it yield the result PQ=2πR=2πr, where r=OB <R. What's the problem?

PARADOX 6:



PQ is parallel to BC. Thus, $BC/PQ = AB/AP$, which yields

$BC.AP = AB.PQ$ ..... (α)

Multiplying bothsides (α) by $BC - PQ$ we get

$BC^2.AP - BC.AP.PQ = AB.BC.PQ - AB.PQ^2$

$\Rightarrow BC^2.AP - AB.BC.PQ = BC.AP.PQ - AB.PQ^2$

$\Rightarrow BC(BC.AP - AB.PQ) = (BC.AP - AB.PQ).PQ$..... ($\beta$)

Let $r = BC.AP - AB.PQ$

Then (β) becomes

$$BC.r = r.PQ$$

by cancelling r bothsides, we get

$$BC = PQ.$$

Is it....? Remember the cancellation law..?!

PARADOX 7:

Let us consider an infinte sum: S = 1-1+1-1+1-1 .....

and let us group the addens as follows:

$S = (1-1) + (1-1) + (1-1) + ...$

$\Rightarrow \quad S = 0 + 0 + 0 + ...$

$\Rightarrow$ ... S=0.....(α)

And Let us us group the addens as follows:

$S = 1 - (1-1) - (1-1) - (1-1) - \ldots\ldots\ldots$

$\Rightarrow \quad S = 1 - 0 + 0 + 0 + \ldots\ldots\ldots$

$\Rightarrow \quad S = 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(\beta)$

We can regroup yet another way:

$S = 1 - (1 - 1 + 1 - 1 + 1\ldots\ldots)$

$\Rightarrow \quad S = 1 - S$

$\Rightarrow \quad S = 1/2\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(\gamma)$

$(\alpha),(\beta)$, and (γ) imply that $0 = 1 = 0.5$

What does make this contradiction?

PARADOX 8:

Let $a=0.5$. Then $a^3 < a^2$, and talking log both sides we have

$3 \log a < 2 \log a$ (since log(x) is an increasing function)

cancelling log a bothsides, we get

$3 < 2$

why not?

PARADOX 9:

Consider the follwing two problems:

Set1	Set2
$x^2 + 3xy + y^2 = 11$	$2x^2 - 3xy + y^2 = 4$
$x^2 - xy + y^2 = 3$	$x^2 + 2xy - 3y^2 = 9$

Set1 yileds another equation

$11(x^2 - xy + y^2) = 3(x^2 + 3xy + y^2)$

which is

$2x^2 - 5xy + 2y^2 = 0\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(\alpha)$

(1,2) is a solution (α) ,and thus a solutiong of (is it?) Set1:

Let us see:

$1^2 + 3.1.2 + 2^2 = 11$

$1^2 - 1.2 + 2^2 = 3$

Correct, isn't it?

Now consider Set2:

Set2 yileds the equation

$9(2x^2 - 3xy + y^2) = 4\ (x^2 + 2xy - 3y^2)$

which is

$2x^2 - 5xy + 3y^2 = 0$.....(β)

(1,1) is a solution (β) ,and thus a solutiong of (is it?) Set2:

Let us see:

$2.1^2 - 3.1.1 + 1^2 = 4$

$1^2 + 2.1.1 - 3.1^2 = 9$

which results in 0=4 and 0=9.

So, what went wrong?

PARADOX 9:

It is not strange to say $\sqrt{x-y} = i\sqrt{y-x}$, where $i = \sqrt{-1}$

Now take x = a and y = b, then we have $\sqrt{a-b} = i\sqrt{b-a}$.....(α)

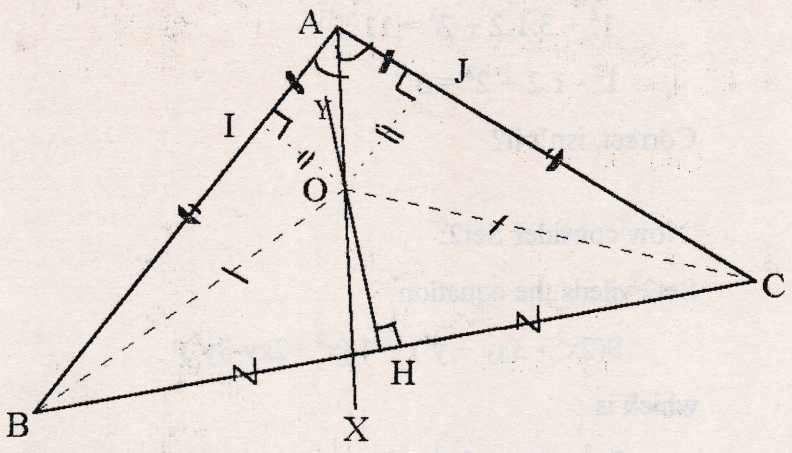
and take x = b and y = a to get $\sqrt{b-a} = i\sqrt{b-a}$.....(β)

Now then (α) * (β) gives $\sqrt{a-b}.\sqrt{b-a} = i^2\sqrt{b-a}.\sqrt{a-b}$

and by cancelling $\sqrt{a-b}.\sqrt{b-a}$ both sides we have $1 = i^2$. i.e. 1 = -1

Are you ok?

PARADOX 10:



HY - Perpendicular bisector of BC
AX - Bisector of angle BAC.
They meet at O.
OI is perpendicular to AB
OJ is perpendicular to AC

Now, since HO is perpendicular to BC

$\Delta BOH \equiv \Delta COH$

$\Rightarrow OB = OC$ .....(α)

and since AO is common hypertenuse and IAO=JAO

$\Delta AIO \equiv \Delta JAO$

$\Rightarrow AI = AJ$ .....($\beta 1$)

and $OI = OJ$ .....($\beta 2$)

and since OB=OC and ($\beta 2$) and ΔBOI & ΔCOJ are right angled triangle

$\Delta BOI \equiv \Delta COJ$

$\Rightarrow BI = JC$ ..... (γ)

Then ($\beta 1$) and (γ) imply $AB = AI + BI = AJ + JC = AC$

i. e. $AB = AC$

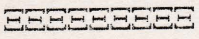
That is any triangle is an isosceles triangle.

Believe it or not, nothing the wrong in the above argument provided the diagram is drawn in this way.

PARADOX 11:

Adjectives can be classified as two categories: Autoligical and Heterological. An adjective whose meaning applies to itself is autological, and an adjective whose meaning does not apply to itself is heterological. The adjectives like short, English, single, polysyllabic are autological because short is short, English is English,. Single is single, polysyllabic is polysyllabic, and the adjective like long, French, hypenated, monosyllabic are heterological because long is not long, French is not French, hypenated is not hyphenated, monosyllabic is not monosyllabic.

Now consider the adjective heterological: if it is autological then heterological is heterological. If it is heterological then it is not autological. Then it must be heterological. If heterological is heterological then it must be autological. If it is autological then..... .... Someone should stop this argument otherwise it goes forever like this!!!. Oh where we made the loop.



War And Health In Jaffna

*N Sivarajah

The war in the North-Eastern Province (NEP) of Sri Lanka had been insidious. So had been the decline of the Health services and the Health of the people of Jaffna.

The effects of war started with the war in the early 1980s and continues into the late nineties.

The prolonged conflict has resulted in a serious dislocation of the health infrastructure that once served this area. The war has resulted in

- damage destruction and closure of the main hospital. (the Jaffna Teaching hospital was closed from June to November 1990 and all hospitals in the Jaffna district, except Thenmarachchi and part of Vadamarachchi were closed from November 1995 to April 1996.
- One of the largest District Hospitals in the island (District Hospital Tellippalai) with 340 beds and cancer treatment unit was closed down in 1990. Out of these beds, 84 psychiatric and children's beds were shifted to Manipay.
- damage destruction and loss of medical equipment
- exodus and displacement of medical personnel
- breakdown of routine maintenance of equipment in health institutions
- disruption of power supply and shortage of fuel
- breakdown in training of paramedical and field health staff.
- reduced and erratic supply of food, nutritional supplements (thriposha), drugs, vaccines and requirements for preventive health work (malathion, Tropical Chloride of Lime etc)

Morbidity

A severe breakdown in the preventive health programmes has resulted in increase in the incidence and prevalence of several diseases which are uncommon or less common in the rest of the country.

- Malaria which was almost non-existent in the Jaffna District (except in persons returning from Vanni District) is now rampant.
- In 1982 there was an outbreak of Poliomyelitis among the refugees returning from South India which spread rapidly within the local

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population. In that year there were 96 cases of poliomyelitis in the Jaffna district.

- Due to the breakdown in sanitation and shortage of Public Health staff there had been a massive increase in the incidence of water borne diseases like typhoid, infective hepatitis etc.
- Available evidence, points to a deterioration of the nutritional status of the people, especially among children and pregnant women.

Quite recently, an investigation of the health conditions of returnees from Vanni district and settled down in Urathi - showed an alarming increase in the incidence of

Malnutrition	-	66.0%
Anaemia	-	55.5%
Scabies	-	15.3%
Avitaminosis	-	13.9%
Malaria	-	9.7%
Worm infestation	-	9.7%

Malaria

Malaria, which was mainly a disease prevalent in the Vanni district, gradually spread in to the peninsula. The number of cases increased by five times between 1990 and 1991. (Table 1)

Table : 1 Incidence of Malaria - Jaffna District : 1983 - 1996

Year	Number of cases	P v	P f	Mixed
1983	2354	2282	676	05
1984	1859	1718	133	08
1985	2393	2315	72	06
1986	4053	3786	284	33
1987	2185	2036	137	12
1988	10885	10518	353	14
1989	4253	4103	147	03
1990	4565	4193	369	03
1991	23371	20389	2875	107
1992	23844	21747	2063	34
1993	20711	19239	1430	42
1994	52385	48181	4148	56
1995	36957	33358	3577	22
1996	25474	21913	3537	24

Source :. Deputy Provincial Director of Health Services, Jaffna.

The spread was assisted by closure of Elephant pass and by people having to stay overnight at Nallur and Kilali on their way to Jaffna from Colombo. Another contributory factor was the reduction in supply of malathion to Jaffna and virtual abandonment of spraying activities.

In the early 1980s, the malaria cases in Jaffna were mainly imported from Kilinochchi. Today its almost entirely local transmission. Between 1983 and 1994 the malaria cases increased by 22 times. In 1996 one in 17 people in Jaffna have had malaria.

War injuries

Following the mass exodus out of Jaffna, in October 1995, the people returned to Jaffna in late April 1996 into a so called 'cleared area'. During the one year period between May 1996 and April 1997, 296 persons were admitted to the Jaffna Teaching Hospital with war injuries. 207 (69.9%) of them were as a result of blast injuries which included injuries due to landmines, claymore mines, shell blasts and hand grenades.

The particulars of these injuries are given in table 2.

It should be noted that these figures are only of patients admitted to Teaching Hospital, Jaffna. These figures do not include these treated at other hospitals, out patient departments and the dead.

Mortality

Maintenance of mortality data in a war torn area is mostly incomplete, since a fair number of deaths are unreported, misrecorded or missed.

Table 2: War injuries admitted to Teaching Hospital Jaffna. (May '96 to April '97)

Type of injury	Number	Percentage
Blast injury	207	69.9
Gun shot injury	51	17.2
Not recorded	38	12.9
Total	296	100.0

Mortality due to war injuries

While a war is going on, total mortality as a result of the war injuries is always incomplete. The number of deaths among the parties at war is often conflicting. The claims made by each of them varies.

The completeness of the recording of deaths even among the civilians , especially during the exodus is also doubtful.

However the records available at the Teaching Hospital Jaffna shows that for the one year period May '96 to April '97, 263 persons were brought dead to the hospital. This amounts to five deaths on admission per week. During the pre-war period, this was around one per week.

A breakdown of the 263 deaths is given in table 3.

Table 3: Persons found dead on admission to Teaching Hospital Jaffna (May '96 to April '97)

Cause of death	Number	Percentage
Blast and firearm injuries	172	65.4
Disease	35	13.3
Poisoning	14	5.3
Hanging	7	2.7
Drowning	6	2.5
Road Traffic Accident	4	1.5
Not recorded	25	9.5
Total	263	100.0

Infant and Maternal Mortality

The rates calculated from reported infant and maternal deaths in the Jaffna District is given in table 4. In this table the the rates for Jaffna district obtained from the Deputy Provincial Director of Health Services is compared with the National figures.

Table 4 : Infant & Maternal Mortality Rate in Jaffna District and Sri Lanka 1980 - 1995

Year	Infant Mortality Rate (per 1000 live births)		Maternal Mortality Rate (per 10 000 live births)	
	* Jaffna	# Sri Lanka	*Jaffna	#Sri Lanka
1980	n.a	34.4	n.a	6.0
1981	n.a	29.5	n.a	6.0
1982	19.0	30.5	6.0	6.0
1983	31.0	28.4	6.0	6.0
1984	39.0	27.2	6.0	4.0
1985	30.0	24.2	8.5	5.0
1986	29.0	23.2	9.0	5.0
1987	26.2	22.6	13.4	4.0
1988	25.0	20.2	22.0	3.0
1989	24.6	18.4	12.0	3.0
1990	27.1	19.3	21.0	4.2
1991	33.7	17.2	7.0	5.0
1992	27.6	18.2	10.0	
1993	29.4		9.0	
1994	38.7		5.0	
1995	29.0		10.0	

Source : * *Jaffna District Health Plan. Deputy Provincial Director of Health Services, Jaffna*
Annual Health Bulletin 1994 , Ministry of Health Colombo

Two decades ago (in 1974) the Infant Mortality Rate in Jaffna District was 21.1. This was the lowest among the 22 districts in Sri Lanka and was claimed to be lower than the IMR in Washington D C (*Attention please, 1979*). The district with the highest IMR was Nuwara Eliya with an IMR of 119. The IMR for Jaffna rose to 38.7 in 1994. As there is considerable under reporting the present IMR it is probably much more than the reported figure.

The maternal mortality for Jaffna is higher than the national figure. Prior to the war (up to 1983) the Maternal Mortality Rate for Jaffna was the same as the national figure. But since the war it gradually escalated and in 1988 it was 7 times the national figure and in 1990, 5 times the national figure.

Table 5 : Infant Mortality Rate in Sri Lanka by District - 1974

District	IMR (per 1000 live births)
Nuwara Eliya	119.0
Kandy	91.7
Badulla	72.5
Matale	68.2
Ratnapura	66.0
Kegala	60.1
Kalutara	52.9
Sri Lanka	51.2
Galle	50.9
Batticoloa	45.4
Colombo	43.6
Matara	41.6
Amparai	39.1
Kurunagala	38.4
Anuradhapura	37.2
Mannar	36.1
Hambantota	34.4
Trincomalee	32.3
Moneragala	30.8
Puttalam	29.3
Vavuniya	24.3
Polonnaruwa	23.8
Jaffna	21.1

Source: *Department of Census and Statistics. In statistical profile of children 1977. Sri Lanka Department of Census & Statistics, Colombo 1978.*

Nutrition

When a shortage of food occurs the first to be affected are children and elders. The prevalence of Acute undernutrition (wasting) and chronic undernutrition (stunting) among children in Jaffna District are given in table 6.

Table 6 : Malnutrition in Sri Lanka & Jaffna

	* 1975/76	# 1987	@ 1993	% increase (+) Decrease (-)
Acute undernutrition (wasting)				
Sri Lanka	6.6 %	12.9 %	n.a	+ 98 %
Jaffna	3.7 %	n.a	18.9 %	+ 411%
Chronic undernutrition (Stunting)				
Sri Lanka	34.7 %	27.5 %	n.a	- 21 %
Jaffna	28.4 %	n.a	31.4 %	+ 11 %

n.a : *not available*

* *Sri Lanka Nutrition Status Survey (Sept.95 - March 76) prepared by US, Department of Health Education and welfare, Public Health Service in cooperation with Ministry of Health, Government of Sri Lanka (CARE / Sri Lanka and US agency for International Development.).*

\# *Sri Lanka Demographic and Health Survey 1987. Ministry of Plan Implementation. Colombo 1988.*

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As shown in table 7, in 1975/76 the division of Superintendent of Health Services (SHS) Jaffna had the lowest prevalence of Acute undernutrition among all the SHS divisions in the country. It was in fact almost half the prevalence of the mean acute undernutrition for Sri Lanka.

This situation has drastically changed following the war. Acute undernutrition has increased by over 400 %.

Birth Weight

The birth weight of babies is a good indicator of maternal nutrition. Children with a birth weight < 2500 grams are considered Low Birth Weight babies. An increase in the birth of low birth weight babies indicates among others a deterioration in maternal nutrition and failure of the preventive heath care services.

The Jaffna District Nutrition Survey *(Sivarajah N, 1993)* of 1993 showed that 19% of the children born during the years 1990, 91 & 92 had a birth weight less than 2500 grams.

Table 7 : Percentage of children acutely malnourished by areas of Superintendent of Health Services (SHS)- 1975/ 76

S.H.S. Division	% Acutely undernourished
Ratnapura	8.8
Kandy	8.5
Batticoloa	8.4
Galle	8.2
Matale	7.2
Kegalle	7.1
Anuradhapura	6.9
SRI LANKA	6.6
Kalutara	6.2
Matara	6.0
Badulla	5.8
Vavuniya	5.8
Kurunegala	5.7
Puttalam	5.1
Colombo	4.9
Jaffna	3.7

Source: *Sri Lanka Nutrition Status Survey (Sept.95 - March 76) prepared by US, Department of Health Education and welfare, Public Health Service in cooperation with Ministry of Health, Government of Sri Lanka (CARE / Sri Lanka and US agency for International Development.).*

The increasing trend of the birth of Low Birth Weight babies is shown in data on birth weight available for children born in the University Field Project area of Kokuvil & Kondavil.

The percentage of LBW babies is generally lower in this area than in the rest of the peninsula. However, the trend in the birth of low birth weight babies is significant as shown in table 8.

It is interesting to note that there has been an increase in incidence of LBW babies following the IPKF operation in 1987 and Economic blockade in 1990.

Disability

It is said the war leaves behind

- an army of widows
- an army of cripples
- and an army of thieves

Table 8 : Percentage of Low Birth Weight Babies born in University Field project area

Year	% L B W
1981	4.7
1982	3.3
1983	3.6
1984	3.1
1985	6.4
1986	7.0
1987	7.1
1988	10.2
1989	8.0
1990	7.1
1991	6.3
1992	10.6
1993	11.0
1994	9.8
1995	8.9
1996	11.0

Data on disability as a result of the war in the Jaffna District is incomplete

Disability as a result of the war could be physical or mental disability.

The Jaipur Foot Workshop which provides prosthesis to those who have lost limbs was inaugurated in 1987. During the past 10 years it has provided artificial limbs to 1614 persons. 80% of them have been for persons who had lost their limbs as a result of war injuries.

Land mines have been another major cause of disability and death. The Jaipur Foot Workshop had been providing at the rate of 128 artificial limbs per year for the past 10 years to those who had lost their limbs in war. During the past few months (May - July 1997) 5 - 10 people are loosing their limbs every month as a result of land mine

injuries. This figure excludes the military and militants who lose their limbs in land mines.

Several studies have been carried out in Jaffna on psychological effects of war.

A study done on War Trauma on children in Jaffna (*Somasundaram D J et al 1995)* showed that nearly half had experienced 5 - 9 war stresses and a quarter over 10 war stresses.

64 % had developed recognizable psycho-social sequelae. 25% had major depression. 13% had relationship problems, 15% had alcohol & drug abuse problem and 18% had functional disability.

In another study carried out on school children (under 12 years) in the Vaddukoddai cluster *(Arunakirinathan T' et al 1995)* it was found that 77% had atleast one sleep disturbance, 46% had separation anxiety. At least one depression symptom was found in 75%.

Medical Institutions

In 1983 the Jaffna District had 55 Medical Institutions with 2672 beds. In 1995 this figure dropped to 34 medical institutions with 1531 beds (Table 9).

Table 9 : Availability of Medical Institutions and Beds

Type of hospital	* 1983		*1986		*1989		#1996	
	No	Beds	No	Beds	No	Beds	No	Beds
Teaching Hospital	1	1015	1	1015	1	1021	1	600
Base Hospital	1	216	1	232	1	203	1	264
District Hospital	6	783	5	625	5	580	4	356
Peripheral Unit	10	430	7	329	7	331	6	206
Rural Hospital	4	91	4	93	4	100	2	47
CD & MH	12	122	9	88	9	83	7	58
CD	21	-	14	-	15	-	9	-
TOTAL	55	2672	41	2382	42	2318	34	1531

*Source : * Annual Health Bulletin 1983, 1986,1989*
 # Jaffna District Health Plan. Deputy Provincial Director of Health Services, Jaffna

The Jaffna Teaching Hospital which had 1021 beds, is now functioning with half the number and very few consultants.

The health staff who work in the medical institution have also decreased. In 1981 there were 139 Medical Officers. In 1995 there were only 89 (Table 10). It has further dwindled in 1997.

In 1981 there were 242 nurses and in 1995 the number increased to 420. But when availability of nurses in other districts with Teaching Hospital is compared (Table 11). It is seen that in Colombo district there are 169.4 nurses per 100,000 population which in Jaffna district we have 46.4 nurses per 100,000 population.

Table 10 : Availability of Health Staff

Health Staff	1981	1985	1989	1995
Medical Officers				
Number	139	151	110	89
* Rate	16.7	17.0	11.5	9.8
Nurses				
Number	242	367	419	420
* Rate	29.1	41.1	44.0	46.4
Public Health Staff				
Number	233	182	143	123
* Rate	28.0	20.4	15.0	13.6

* Rate : per 100,000 population

Source : *Annual Health Bulletin 1981, 1985, 1989 & 1995, Ministry of Health Colombo*

Public Health Staff Includes :

Public Health Nursing sisters, Public Health Inspectors & Public Health Midwives

Table 11 : Availability of Nurses in Districts with Teaching Hospitals

District	No. of Teaching Hospitals	Number of Nurses	Rate (per 100,000 population)
Colombo	7	3548	169.4
Gampaha	1	1056	66.8
Kandy	2	1445	110.6
Galle	2	824	82.7
Jaffna	1	420	46.4

Source : *Annual Health Bulletin Sri Lanka 1995. Ministry of Health Colombo*

A more acute situation exists in the case of PHIs & PHMs. There are only around 60 PHMs working in the Jaffna district whereas there should be 300 of them. Similarly

there are less than 20 PHIs where there should be 100 PHIs. Most of the PHIs now working are retired and reemployed or on the the verge of retirement.

The shortage of Nurses, PHM & PHIs is due to inadequate training of their categories of staff during the past several years.

The intake of nurses to the NTS Jaffna for the past 10 years is given in table 12. Although the Jaffna NTS has a capacity to train 50 nurses per year the average annual intake for the past 10 years has been 32.

Public Health Inspectors are trained at the National Institute for Health Sciences. at Kalutara. During the past 10 years very few persons from the North - Eastern Province have been admitted to the course.

Table 12 : Intake of Nurses at NTS Jaffna 1986 - 95

Year	Intake
1986	43
1987	-
1988	59
1989	147
1990	-
1991	-
1992	9
1993	-
1994	-
1995	62
Total	320

PHMs for the NEP are trained at NTS Jaffna & Batticoloa . The number trained during the past 10 years is given in table 13.

Table 13 : Intake of students for Public Health Midwives Training -1986 - 1995

Year	Intake	
	Jaffna	Batticaloa
1986	12	8
1987	-	-
1988	55	64
1989	77	51
1990	-	-
1991	n.a.	n.a.
1992	-	-
1993	-	36
1994	-	-
1995	-	-
Total	144	159

Note : n. a . - Not available

Here too even though the training capacity of each school is 50 per year on an average 15 students have been admitted to each school per year.

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DEVELOPMENT AND MODERNIZATION - A SOCIOLOGICAL ANALYSIS

*Shanmugalingam, N

The Social Scientists showed an interest for modernity after the 2nd world war, this arose as a consequence of their interest for the societies that live in the Third World Countries. Prior to this of course one referred to such activities as 'evolution', 'progress', 'social thesis', but with the adoption of the word modernization, the above terminologies become defiled. Sociologists gave recognition to these two key words 'modernization' and 'development', as these terminologies are quite free from the faults which the earlier ones suffered. Above all, these two key words appear to have a relatively greater flavour of the future.

It must be said that the social scientists since the 2nd world war became more concerned with the concept of modernity and modern society, particularly in relation to modernization and development. This in fact paved the path for a vast amount of research and related publications. Further 'Sociology of Development' became a very important field of study to the social scientists.

An attempt is made in this address to define 'development and modernization' in the hope that this will give a better understanding , particularly to the theoreticians.

I must right at the beginning admit that there are many complexities when one tries to define 'development and modernization'. In spite of this, these two keywords continue to be used, particularly in literature concerned with the social dynamics of change. In fact, there are no other words in the English language which have so confused the scholars as these two words. Because of this , two schools of thought have developed; one in favour of the continued use of development and modernity; and the other against this. Both schools have sufficient data to support their views.

Let us examine the arguments presented by those who hold the view that it's best to withdraw them;

1. To them the meaning of development and modernization is blurred, because they have become pre-empted by popular speech. Further, they are used by all sorts of people to represent different behaviour and things, and this depends upon the intellectual and contextual background. In fact, when scientific terms become the matter of popular speech, they tend to lose their significance, particularly as a scientific concept.

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2. These words have also been used by multi-disciplines like, economics, political science,psychology, anthropology and sociology. By virture of its interdisciplinary approach, it certainly gives a different meaning and significance to the different users. If we are to put this in another way, the words convey very diverse concepts; and the words have been used by several disciplines each in their own way; hence, their usage in sociology proper became obscure.

3. The words 'modernization' and 'development' are also used by national governments and international agencies, particularly in policy research, as objective, 'value free' terms. Therefore, they have political implications and hence defined in terms of values. Further, these words are used in a circular manner to refer to different degrees of modernization and development.

   In addition, the literature available refers to a somewhat milder usage of the terms e.g.; the words 'underdeveloped countries' is no longer used and these words have been replaced by the term 'developing countries'. This, in fact, is a tactful description of the real situation. However , these alternate, milder terminologies do not mean much and are said to be logical misnomers.

4. In fact the , word 'development' has been very badly critized by the political left. The word, as it is used in North America, differs very much from its usage in Latin America. In the latter country, it came to be treated as an ideology designed to hide the realities of imperialism, exploitation and dependency. In fact, Frank, while referring to interests to development and underdevelopment, said that as a matter of fact development of underdevelopment. ie, of the relationship between the exploiters and the exploited.

   The word 'modernization' equally faces the same fate. The social scientists with Marxist perspective, have raised their criticism against it Modernization like development replaced a number of words that have been in use to refer to similar concepts. When the colonial system was in operation, terms like Angliazed for India and Gallicized for Indochina were used by the colonial rulers. Later, these words came to be substituted by 'Europeanization' to indicate western influence, French in Syria and Lebanon, British in Egypt and Jordan. The terms Americanization , and Westernization were in common usage to refer to Atlantic civilization . But even these came to be replaced by the word modernization. This word modernization has, in fact, over shadowed the old concepts, however it still carries the values, the words of its family once carried. After the war, the word modernization is being used to refer to the achievements made in western Europe and to the developed countries like Soviet Union and Japan. In this context one may say that modernization refers to the aspirations of the developing societies to have the same attributes of these modern societies.

5. The two terms, 'development' and modernization' have been used synonymously, and as having different meanings. The words 'modernization' and 'development' are used to refer to the process of economic growth. Sometimes, the term 'development' has been applied to refer to the process of economic growth and

'modernization' to various socio-cultural processes associated with them. Further, at some places, 'modernization' is treated as a state of development and at other times, 'development' is confined within the term modernization. As a consequence, one can see that these terms have become blurred.

It is also worth considering the context in which these words are used in literature. Apter for example considered modernization to refer to the level of industrialization. On the other hand , Lewis did not make any distinction between these two terms and in fact used these terms to mean one and the same thing. Lilewise Scalpino described these terms as interconnected social changes leading to economic diversification that occurred within an advanced industrial technology , with accompanied social mobility, and the shift toward impersonal and a rationalized social relationships and a concentration of the population in the cities. In the cities , the people had the opportunity for education, organization and communication.

The same view, i.e, that both terms refer to more or less the same thing was held by Lagos-Matus, Lewis, Nette and Robertson.

6. If we are to examine these two terms in the literal sense, the word modern refers to something which has replaced that was in practice before and which was the accepted thing. The adjective 'modern' and its non 'modernization', and the adverbial expression 'modernity' has been used indiscriminately and therefore stands blurred.

7. It must be pointed out that the confusion relating to the use of these two terms has become more aggravated due to a number of concepts, which were allowed to float in the literature now available, relating to the dynamics of change. Between 1940 & 1990 many articles have appeared to define ways and means to eliminate underdevelopment. In this vast literature the changes that took place have been referred by different levels namely, 'development' 'modernization', 'urbanization', 'industrialization', 'Secularization' and 'democratization'. But , unfortunately, these terms have been used without paying attention to clarity , both conceptually and empirically. Hence, one can see that there does not seem to be any agreement in the use of these terms, even amongst the scholars.

8. Further, one can also see that the confusion arises as a direct result of ideological overtones. Berger and his associates , for example, refer to three ideological responses to modernization,

   I. The ideologies which tend to endorse or legitimate modernization.

   II. Ideologies which were developed in opposition or resistance to modernization. These may be referred to as counter-modernization ideologies.

   III. The ideology to control or contain modernization in the name of values that are considered to be independent of the process.

Modernization embraces profound hope and aspirations to the process of modernization, for eg. the 'Cargo cult'. This concept was widespread in a wider area of Melanesia, in the early part of the 20th century. People believed that the white-man will come in step -up and give them goods; and as a consequence, all the people will become better-off. Here, one can link, happiness, hope and expectations to modernity brought to the East by the white people.

On the other hand, there are those who believe that modernization is bad; to them, modernization is a dehumanizing oppression that must be resisted at any cost and by all. Berger and his associates refer to this as a 'counter modernizing', ideology. This makes an attempt to preserve ones native traditions, for example the Ghost Dance of the Prairie Indians. In contrast to the 'Cargo cult', this ideology had a firm believe in myths. They believed their dead would return to chase away the whites and bring-back their traditional way of life. This idea of nativism took to a military from of action. Japanese for example wiped out all the western ideas; and at one time, succeeded in isolating Japan from modernism, until its restoration over a century ago. In the recent times, 'madhi revolution' in Sudan, where a man proclaimed as the Madhi promised to establish the universal empire of Islam. Likewise, there was Jihad against the British and their Egyptian allies.

Another ideological response to modernization seeks to control or contain it by reference to values that are conceived to be independent of the process. The proposers of this idea tried to bring a synthesis of modernization and counter-modernization, both in the theoretical sense and in practice. The events that occurred in the Third world countries can be quoted as an example of this. The people in this region are anxious to preserve their indigenous culture; but, at the same time, do not want to ignore modernization. As a consequence of this it became necessary to find a blend between modernization and counter-modernization. Mahathma Gandhi totally resisted all forms of modernity. This has changed very much in the present era after independence. Vinoba Bhava was are example of Gandian principles.

The Islamic word wants to preserve traditions, yet at the same time, wishes to retain what is called modernism.

Ideology is distinctly expressed from the tradition-modernity dichotomy as well. Scholars consider something as traditional when it is not modern. Further the tradition modernity dichotomy is not based on two sets of autonomous, empirical observations, but on one such set and the other as its logical implication.

There is no common understanding as far as the characterization of the modern man and society is concerned because scholars based their conclusions on different value-orientation and life experiences. There are some scholars like Lerner, Peshkin, Cohen and Johnson who regard individualism as the element of modernity. Whereas Parsons,

Banfield and Banfield consider collectivity orientation and ability to work for others as modern traits.

The tradition- modernity dichotomy are value laden and scholars recommend that modernity must be advocated , as against tradition. They give more importance to what is achieved at the end over what happens at the initial stage. Further, the scholars who advocate evolutionary theories, stress that progress takes place by intake of value-orientation that characterize modernity.

The tradition - modernity dichotomy is an ideology in one more sense. In the 19th century , following industrialization , the scholars were much concerned over the alienating effects of industrial work. But , today, the intellectual tradition is uncritical of the same , in fact, it is looked upon as the hope for the society at large. They even go further to say that if the western model of modernization is followed the Third world countries will achieve the same.

There is yet another ideology which defines modernity for the Third World Countries , based on the structural and Psycho-social traits of modern society and modern man found in the west.

It is regretable to note here that the learned have failed to see the cultural differences and the need for alternative development. The advocators of this view are more concerned about the evolutionary superiority over all their value orientations. At this juncture, it is worth recalling what Gusfield said 'the modernity theory smacks of an ideology of anti-traditionalism'.

In fact , in my view too, the search for the modern man is not a quest for truth, but for a form of market-research; a hunt, in other words, for committed workers and market oriented consumers. Tradition is not profit maximizing but modernity is,

One can therefore , see that there has been erosion of ,

i) A sense of common values of the past
ii) Projection of superiority of western civilization
iii) Desirability of the goal of economic growth
iv) Faith in scientific reason &
v) Intrinsic value of secular - this world as primary focus of orientation.

This is why, the post modernism emerged as a critique of modernism and , according to it, the common man has been marginalized. As a reaction to modernism & consequences of modernization, post modernity focuses on a paradigm of alternative, which would further focus on *feelings* in place of rationality , co-operation instead of competition , holism instead of specialization, and communality in place of individualism.

Scope of Development:

From the preceding analysis, it transpires that the process of development are comprehensive. When and wherever it is said that a given nation-state is developing , then and there it implies that the nation-state is developing in all domains of social life-economic, social and cultural-it does not refer merely to income or technological growth.

In fact , the whole socio-cultural matrix is involved in the process of development. That is why there is utility of multi-disciplines.

After the birth of 'Sociology of Development', we are able to analyze the concepts of 'development' and 'modernization' in a wider perspective, development of whole socio-cultural matrix and all that it stands for, including economic development.

'Development' and 'Underdevelopment' are historical processes; a clear understanding needs historical perspective. The study of society and that of history cannot be divorced from each other. The socio-cultural aspects of society are intricately linked with reality. So, the historical nature of this reality and social development and underdevelopment must be studied in relation to each other. Since the social development refers to the whole socio - cultural matrix, its subject-matter cuts across the boundaries of different disciplines.

Hence, an understanding of social development requires an inter-disciplinary approach.

1. It is because of the absence of an interdisciplinary approach, we are confronted with problems & confusions regarding these concepts.

   Therefore , I would like to reiterate the importance of a multi- disciplinary approach for development & modernization.

2. It is also important that the problem is analyzed in relation to proper ideologies.

   Sociology will try to identify the existing perspectives in the most appropriate manner.

Here , the main question is 'who controls over development ?' It is supposed that development requires the existence of a particular agent of change. This agent may differ from society to society; somewhere it may be entrepreneur (in the case of capitalist countries), or the state (in Socialist countries) or both in a mixed -economy.

It is the native-state which sets the goals of development & decides the means to achieve the goal set for .

Development through war or peace.....

All depends on who controls development . Here, we have to see the importance of political development & related factors.

As a consequence , the time has now come for us to break away the compartmentalized approaches, and to review the theories & meanings we already have.

For Example, take the popular theory of Rostow -'the stages of growth'. Here, Rostow, not only ignores the history of underdeveloped countries and the structure of their underdevelopment , but also wrongly presents the characterization of the development of developed ones.

It has been exhaustively proven that England and other countries did not develop, relying on their own efforts. These are the roots of prevailing misperceptions.

Now sociology has to formulate a working definition for the whole concept of development; as follows:

Working Definition of the concept of Development

1. Economic transformation, in the direction of sustained and rapid increases in the national product and the conquest of 'decision centres' in manufacturing, which give the country a measure of autonomy for guiding its future growth.
2. Social Transformation , in the direction of a more egalitarian distribution of income and widespread access of the population to 'social goods' such as education, health services, adequate housing, recreational facilities and participation in political decision making.
3. Cultural Transformation in the direction of reaffirmation of national identity and traditions. Emergence, in elite and masses alike of a new self-image which dispels feelings of second-rate nationality and external subordination.

I am confident that you will all agree with me that an inter-disciplinary approach is the key to a proper understanding of the concepts of development and modernization.