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## SCIENCE NEWS

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### 70TH SESSION OF THE INDIAN SCIENCE CONGRESS, TIRUPATI, 1983

#### Summaries of Presidential Address and

#### Sectional Presidents Addresses of Mathematics & Astronomy, Statistics, Physics, Chemistry, Botany, Physiology, Agricultural Sciences and Zoology.

#### **Man and Ocean: Resources and Development**

##### Address of

#### **General President Prof. B. Ramachandra Rao, Seventieth Session of Indian Science Congress.**

The focal theme of the seventieth session of the Indian Science Congress held at Tirupati (3-8 January, 1983) is *Man and the Ocean: Resources and Development*. Professor B. Ramachandra Rao was the General President of the Indian Science Congress Association.

In his presidential address Prof. Rao dealt with the ocean, its resources and development at both macro and micro levels taking into account various developmental issues: socio-economic, technological, educational, national, international, legalistic and other major variables. He felt the need to accelerate the pace of science and technology for exploiting the natural, biological and physical resources of the ocean to serve the manifold problems of the human race, which is still living in primitive conditions and suffering from various kinds of socio-economic constraints. The developmental aspect of the ocean was considered from the following broad perspectives: usefulness for transportation, source of food and other organic and inorganic materials, fresh water and energy, habitation, industry and business activities, transmission of energy and functions of waste disposal, health welfare and recreation, education and training, gaining of knowledge and understanding of national security and international relations. If the natural resources of the land both renewable and non-renewable are getting depleted, we have to look forward to the potential resources of the ocean to meet the emerging and foreseeable threats of food problems, protein deficiencies, and the shortage of mineral, fuel, energy, oil, etc. without disturbing the ecosystems.

Looking retrospectively, oceans have been a potential source of food, energy and transportation from the dawn of human civilization. This becomes evident from the fact that our earlier settlements of population took place primarily on the coastlines. The people of ancient days looked at the rivers and sea with

respect and awe. From archeological evidence, we could infer that the ancient civilization was successful in harnessing the potential resources of rich coastline for food, energy, trade and other developmental activities. India with its long coastline of 5800 miles had always been a sea-faring nation. Indian merchants carried on trade with several countries all over the world by using indigenous sea craft.

While science and technology has accomplished magnificent task in our generation in various areas especially in space research by sending man to the moon, we have not achieved any significant breakthrough, in the development of our oceanography. In fact, we have not paid adequate attention to develop the necessary infrastructure and capability in this area. It is conceivable that most of the ocean resources could not be exploited because of their inaccessibility, lack of technological effort and comparatively high cost of development.

After dealing with under-water landscape, Prof. Rao stressed the need for developing underwater vehicles and instrumentation and moved on to deal with the physical properties of the ocean and the part played by them in ocean currents, ocean energy, coastal erosion, marine life and ecosystem. He dealt with air-sea interactions with a view to improving our understanding of the world climatic conditions and even to make short-term weather forecasts. He examined, in detail, the chemistry of the ocean, the life in the ocean and moved on to the biological, physical and energy resources which are awaiting development. He focussed the need for the application of science and technology, but recommended a cautious approach to conserve and maintain the environmental equilibrium.

Due to our inability to perceive oceans in terms of living organism we went on disturbing their ecosystems and treated them as dumping grounds for waste and disposable materials of every kind, from sewage to radioactive wastes. There has been a continuous deterioration of the ocean environment induced largely by man-made processes and occasionally by sporadic natural processes such as volcanoes and

earthquakes. Perhaps, we have to evolve a coherent environmental policy for conserving and maintaining the marine ecosystem without causing any dislocation to our industrial and agricultural activities. It is possible to control the oceanic pollution by promoting multi-disciplinary studies and working out operational strategies and modalities of action to control the pollution.

It may be recapitulated that the United Nations Convention on the Law of the sea, has recognised India as a 'Pioneer' investor in ocean mining and perhaps this imposes a heavy responsibility on us for organising an efficient educational and research infrastructure in the area of oceanography for the preparation of highly skilled manpower to meet the demands of the country as well as other developing societies which might have to draw upon our resources in the foreseeable future. At the same time, let us not overlook the fundamental fact that marine development is heavily dependent on technological achievements. Much more needs to be done for development of indigenous technology for the exploitation of various developmental resources from the ocean.

While presenting an overview on new developmental advances in oceanography, within the national, international, legalistic, political and socio-economic frameworks, Prof. Rao was primarily moved by one consideration, viz. how oceans could eliminate hunger, squalor, disease, imbalances, etc. in the foreseeable future. Whether one admits or not, oceans are the last frontiers of knowledge of human and social developments holding a rich promise for the establishment of an ecologically balanced human environment and rich quality of life. To put the issue a little explicitly the human development and ocean development are interlinked and we should endeavour to accelerate the pace of their development in an integrated fashion.

The following are the frontier areas where major breakthrough in oceanography are possible in the foreseeable future:—

- (i) revolutionary developments in the area of remote sensing technology for prospecting oil and mineral and biological resources of the sea with the use of satellites, special aircraft and research vessels;
- (ii) deployment of ocean monitoring equipments extensively for collecting, analysing data on the marine environment;
- (iii) innovative developments in the frontier areas of underwater archeology;
- (iv) exploration into the behaviour pattern of sea life with the help of under-water acoustical techniques;

- (v) a foreseeable possibility of revolutionary breakthrough in the area of marine pharmacology;
- (vi) understanding of the genetic behaviour of sea life in relation to their immunity to fatal diseases like cancer;
- (vii) establishing innovative technologies for underwater communication systems and linking it with the land-based communication network;
- (viii) building a new complex and sophisticated system of transportation which will be self-sufficient, self-energising and immune from disasters; and
- (ix) an emerging possibility of colonization on the sea floor by human population living on floating or submersible vehicles with an access to modern facilities.

### Mathematics & Astronomy

**Ramanujan and Basic Hypergeometric series—by Prof. R. P. Agarwal, Department of Mathematics and Astronomy, University of Lucknow, Lucknow 226 007.**

The present address is aimed at exhibiting the "profound and invincible originality" of some of the works of the celebrated Indian Mathematician Ramanujan and its compact on several branches of analysis e.g. partition theory combinatory analysis and basic hypergeometric series.

To assess the depth of Ramanujan's institution in the discovery of the type of identities which form the subject of this address we start with two of his most beautiful identities, viz. for  $|q| < 1$

$$\sum_{n=0}^{\infty} \frac{q^{n^2}}{(q)_n} = \prod_{n=0}^{\infty} \{(1-q^{5n+1})(1-q^{5n+4})\}^{-1}$$

and

$$\sum_{n=0}^{\infty} \frac{q^{n(n+1)}}{(q)_n} = \prod_{n=0}^{\infty} \{(1-q^{5n+2})(1-q^{5n+3})\}^{-1}$$

Ramanujan did not know how to prove them. Prof. Hardy, baffled by these identities, tried to prove them, but in vain. These were communicated by him to P. A. MacMahon for his comments. Though MacMahon could not prove them, yet he observed that they are equivalent to the following remarkable partition theoretic interpretations.

It was in 1917 that Ramanujan, while scanning certain old volumes of Proc. London Math. Soc., came across some work of L. J. Rogers which contained analytical proofs of these identities.

It was, however, not until 1929 that G. N. Watson gave the first elegant proof based on the use of basic hypergeometric series. Since then such hypergeometric series have been profusely used to rediscover, coordinate and discover such seemingly isolated identities of importance in the theory of numbers, partitions and combinatory analysis.

Fresh impetus to an analytic study of the Rogers—Ramanujan identities was provided by the remarkable works of W. N. Bailey in 1947 who based it on the simple general identity:

$$\sum_0^{\infty} a_n c_n = \sum_0^{\infty} b_n d_n$$

where

$$b_n = \sum_{r=0}^n a_r u_{n-r} v_{n+r}; \quad c_n = \sum_{r=n}^{\infty} d_r u_{r-n} v_{r+n}$$

By giving suitable values to the sequences  $u_n, v_n, a_n$  and  $d_n$ , L. J. Slater in 1952 made a systematic study of numerous new identities of the type given by Rogers and Ramanujan.

A major breakthrough in displaying effectively the interaction between a general theory of basic hypergeometric series and numerous identities in partition theory and combinatory analysis was made during late seventies by some of the recent works of G. E. Andrews, who discovered  $k$ -dimensional analogue of the Rogers-Ramanujan type of identities and gave their partition theoretic interpretation. He, in fact, broached upon the more general problem of the existence of identities of the type—

$$1 + \sum_{n=1}^{\infty} A_{k,a}(n) q^n = \prod_{n=1}^{\infty} (1 - q^n)^{-1}; \quad n \neq 0, \\ \neq a \pmod{2kH}$$

Nontrivial basic hypergeometric expressions for  $A_{k,a}(n)$  for  $k = 2, 3, 4$  are known. The question of the existence of nontrivial  $q$ -series expressions for the  $A_{k,a}(n)$  when  $k \geq 5$  was answered for  $k = 5$  by G. E. Andrews, in 1975, and an almost complete answer for  $k > 5$  has been provided in 1980-82 by the works of A. Verma and V. K. Jain, who effectively used the theory of basic hypergeometric series given by R. P. Agarwal and A. Verma as early as 1967-69.

A renewed impetus to the elegant and useful interaction between partition theory and basic hypergeometric series was given by the latest "discovered" works of Ramanujan. The pages of a manuscript entitled "Ramanujan's 'lost' note book", sorted out by G. E. Andrews in 1976 from a collection in the Cambridge University Library, containing a variety of  $q$ -identities. A brief survey and classification of these identities has been made by Andrews in his paper entitled "An introduction to Ramanujan's 'lost' note book" published in 1979 in American Mathematical Monthly. An exhaustive treatment, which includes solution and interpretation of these identities, has been given by him in a series of three remarkable papers published in Advances in Mathematics in 1981.

Very recently, R. P. Agarwal has shown that one of the "key" results of Andrews, from which he deduced numerous identities of Ramanujan, can be placed in a well known hypergeometric setting which leads to further new extensions of the type given by Andrews. Agarwal's method is not only very simple but has also led to a better understanding and further extensions of Ramanujan's and Andrews' work.

The address is concluded with a mention of some unsolved problems and suggestions for further fruitful work that may help to unravel Ramanujan's mysticism and unparalleled originality as a formalist.

## Statistics

**"Stochastic Problems and Methods in Population Genetics" by Prof. Prem Narain, Indian Agricultural Statistics Research Institute, New Delhi-110 012.**

The Presidential Address of the Section of Statistics deals with some stochastic problems and methods in population genetics as well as with the role of statistics in relation to the Focal Theme "Man and the Ocean—Resources and Development". According to Darwinian theory, species evolve by accumulating adaptive mutant genes and the characters controlled by them. A fundamental problem of population genetics in relation to evolution is therefore, essential to study the behaviour of frequency of mutant genes over time due to natural selection and other systematic forces. Since the populations are not necessarily very large, the gene frequency is also subject to random fluctuations. This makes the process of the change in gene frequency a stochastic one which can only be studied with the help of mathematical and statistical techniques. In this connection, some concepts like probability of fixation of a gene and distribution of time until fixation which

have proved to be fundamentals, have been discussed with different approaches. The average age of a mutant as well as the equilibrium distribution under steady flux of mutations have also been discussed in relation to the current literature on population genetics. In contrast to the usual diffusion equations used for solving these population genetic problems, a conditioned diffusion approach has been suggested as more useful. The theoretical and numerical results discussed are also of crucial importance in the breeding of animals and outcrossing of plants for effecting genetic improvement in quantitative characters. The Focal Theme of the Congress is primarily concerned with the exploration of physical as well as biological oceanic resources and its utilization in relation to man's needs. The biological resources mainly found in the seas are crustaceans, molluscs and fishes. Of these, fish is an important item of diet for a large population of our country and meet their protein requirement. It is, therefore, necessary to ensure the availability of comprehensive and reliable marine fisheries statistics on regular basis. The estimates of catch and fishing effort are however, obtained by statistical sampling techniques evolved by the Indian Agricultural Statistics Research Institute, New Delhi and adopted by the Central Marine Fisheries Research Institute, Cochin. In addition to providing reliable statistics on fishery for planning, administrative and executive actions, it is equally necessary to undertake research on marine fisheries statistics. It has been stressed that for a fruitful application of statistical methods to marine fisheries, close and active collaboration between statisticians on the one hand and fishery scientists on the other is very necessary.

### Physics

**Microwave Spectroscopy—Molecular structure and non-bonding molecular forces—by Prof. Krishnaji, 14-B, Bank Road, Allahabad 211 002**

The microwave technology developed during the second world war for radar and related equipment has powerfully influenced the developments in science after the war, much of which has been very quickly fed back into the technology. The microwave region comprises that part of the electromagnetic spectrum which lies between the far infrared and the conventional ultra high frequency radio region. The boundaries are not rigidly defined but approximately the wavelength lies in the millimeter and centimeter region. The energy quantum lies in the range of  $10^{-15}$  to  $10^{-17}$  ergs. Since microwave sources are highly monochromatic and

tunable in frequency a microwave spectrograph has extremely high resolution. The entire electronic nature of the generator and detection system permits exceptional precision in the measurement of frequency. The detection sensitivity is also very high. Under reasonably good conditions a resolution 100 kHz at 30 GHz is easily possible, frequencies are measured with the accuracy of one part in  $10^7$  and detection sensitivity of  $10^{-10}$  cm<sup>-1</sup> is possible. This performance is far superior as compared with spectrographs in other regions.

In the microwave region normally, the transition between rotational energies of molecules are observed directly, with nuclear effects appearing as first order perturbation. Stark and Zeeman effects in rotational spectra are easily observed. Likewise, only in this region have nuclear quadrupole perturbations of pure rotational spectra been resolved. New information on intermolecular forces is obtained through measurements of the shapes of spectral lines in the microwave region. In addition to the more precise testing of previously developed theories on these subjects, the accurate determination of such important molecular and nuclear parameters as bond angles, interatomic distances, molecular dipole and quadrupole moments, atomic masses nuclear spins, nuclear magnetic and nuclear quadrupole moments has been made possible. Paramagnetic resonance is very conveniently observed. From paramagnetic measurements important information can be obtained about crystal structure and in some instances about chemical bonding and the nature of electronic state of ions in the crystal. A variety of fascinating phenomena which were never observed earlier have been observed with the help of powerful microwave technique. Since the microwave range covers about 9 octaves, it is probably the largest spectral region in which uniform basic technique is applied to a common class of phenomena. *Here, in fact, the detailed property of the whole molecule emerge more strongly than in any other spectral region.*

A Stark modulation microwave spectrograph has been very widely used for studying molecular structure, intricate and fine intramolecular motions through the hyperfine structure of the microwave spectrum. Measurement of dipole moments through Stark splitting is one of the most powerful ways of determining this important parameter. It has been possible to determine dipole moments with this method with an accuracy of 1 in 5000. Impurity and instability of the substance do not influence the results in this case and the values obtained are for specific isotopic form of the molecule in known vibrational states.

Rotational lineshapes under most laboratory conditions are attributable to molecular collisions. The collisions in general induce rotational transitions as well as rotational phase shifts. However, since the average kinetic energy of molecules at room temperature exceeds the rotational energy changes in the microwave region, collisional transitions in microwave region are highly probable and should account for the dominant contribution to the microwave line widths.

The theories for low pressure line shapes can be divided into two groups: (i) perturbation theories and (ii) non-perturbative theories. Perturbation theories have the advantage that they can be put in an easily computable form. The two theories which have been mostly used are the Anderson theory and Murphy Boggs theory. Anderson's theory has the advantage of incorporating collision induced transitions as well as collision-induced phase shifts. This theory however, has a drawback that an arbitrary interpolation scheme has to be used for the interruption function in the region where perturbation theory is not valid. We have put Anderson's theory in a computable form for all kinds of non-bonding intermolecular forces and have used the same reasonably successfully in calculating microwave line widths for known molecular parameters. In many cases we have fitted the experimental line width and determined the molecular quadrupole moment. The molecular quadrupole moments are often used by theoretical physicists as crucial test of the molecular wave functions proposed by them.

The Murphy Boggs theory, although not a conventional perturbation method, is a first order treatment. In this treatment, the effects of collision induced phase shifts are ignored. This has been considered a reasonable approximation for pure rotational line widths in the microwave region. A significant advance in theoretical formulation for the lineshape problem has been made very recently by Mehrotra and Boggs. This is a more general theory in which the effects of collision-induced phase shifts have been considered in a more rigorous way. This theory is being applied to microwave line width as well as shift. Among the recent experimental developments for studying rotational line-shapes, mention may be made of microwave refraction spectroscopy, balanced bridge spectrometry, computer controlled lineshape fit method and transient nutation spectroscopy.

At Allahabad University a high sensitivity Stark modulation microwave spectrgraph and another high sensitivity video microwave spectrograph has been set and a large number of interesting molecules have been studied for their structure, dipole moment, molecular quadrupole moment, nuclear hyperfine structure, and chemical bonding. Precision linewidth of spectral line

have been studied. This has led to practical application in interplanetary communication, microwave materials and microwave instrumentation. This work has also contributed to a more detailed and closer understanding of molecular structure, molecular motions, molecular collision, physical and chemical properties of earth's upper atmosphere, planetary atmosphere and wide range of observable properties of gases.

### Chemistry

**Investigations on Phenothiazines by Prof. H. Sanke Gowda, M.Sc., Ph.D., D.Sc., F.N.A.Sc., Department of Chemistry, University of Mysore, Mysore 570 005.**

Phenothiazines are of great importance, because they play a prominent role in chemotherapy, industry and chemical analysis. Their synthesis and properties are surveyed. Nineteen phenothiazines are investigated for their indicator properties. The formal and transition potentials are determined. The potentials decrease with increasing sulphuric acid concentration. The substitution of H or Cl in position 2 of the phenothiazine ring by CN or CF<sub>3</sub> increases the formal potential. The transition potentials are found to be slightly lower than the formal potentials. The molar absorptivity of their coloured radical cation is reported.

With the use of some of the phenothiazine indicators, an elegant cerimetric method for the determination of ascorbic acid present in citrus fruit juices and in vitamin C tablets and injections has been developed. For the first time, the titrimetric method for the determination of hydroquinone, metol and ascorbic acid with N-bromosuccinimide and hydroquinone and metol with chloramine-T has been proposed. Very accurate values for iron(II) in the presence of many interfering organic and inorganic substances are obtained in the vanadometric titration of iron(II).

Chlorpromazine hydrochloride and prochlorperazine maleate have been introduced as sensitive reagents for the detection of occult blood in faeces and in urine.

Phenothiazines are proposed for the spectrophotometric determination of noble metals such as gold, palladium, platinum, ruthenium and osmium. An elegant method for the simultaneous determination of Pd(II) and Au(III) in alloys and minerals has been proposed. Extractive spectrophotometric methods have been introduced for the determination of micro amounts of W(VI), Mo(VI) and Co(II) based on the formation and extraction of tungsten(V)-thiocyanate-chlorpromazine, molybdenum(V)-thiocyanate-

mepazine and cobalt(II)-thiocyanate-promethazine ion association compounds.

Charge transfer complex of PH with picric acid was prepared and characterised. The yellow colour of the complex was used for the spectrophotometric determination of PH in phenothiazine drugs.

Co-ordination complexes of Cu(II), Pd(II), Pt(II), Ru(III) and Rh(III) with eight phenothiazines have been prepared and characterised by elemental analysis and conductometric, spectral, thermogravimetric and magnetic susceptibility data. Tentative structures have been assigned to the complexes.

### Botany

**"Biosystematics" by Prof. M. S. Chennaveeraiah, Department of Botany, Karnatak University, Dharwad 580 003.**

Biosystematics has emerged as a distinct branch of Botany, which is primarily a comparative discipline of classificatory value. It has attained vast dimensions in the last 40 years involving different aspects of studies like cytology, genetics, breeding systems, variation patterns, anatomy, palynology, chemical aspects, numerical and of late at molecular level through gel electrophoresis, microcomplement fixation, DNA hybridization and gene splicing.

The author and his associates have been pursuing biosystematic study from the last two decades and some important findings are mentioned here. Many species of the genus *Nervilia* in Orchidaceae were included earlier in the genus *Pogonia*. Smaller and many chromosomes of the species of *Nervilia* stand in contrast with a few and large chromosomes of the species of *Pogonia* thus revealing chromosomal identification of the two genera. Cytoanalysis in Palms has shown that the leaf type has correlation with chromosome number.

The studies in the genus *Aegilops* have revealed genome-karyotype relationship. The genomes of all the species are recognisable on the basis of karyotypes and do not support the lumping of two genera *Aegilops* and *Triticum* together. The karyotypes in different species of *Capsicum* show both uniformity and diversity suggesting a need to lump the different species together.

The breeding behaviour in different species of non-tuberiferous species of *Solanum* has revealed that although certain species are crossable, genetic barriers exist between them resulting in hybrid *inviability* and considered as good species. Contrary to this, *Solanum indicum* is a highly variable species, morphologically,

karyologically and otherwise, 4 types could be recognised which could be treated as varieties.

The leafy horticultural plants commonly known as crotons are usually propagated by vegetative means. Crosses were made involving different cultivars and the  $F_1$  progenies showed a wide spectrum of variation both in chromosome number and leaf characters. Although they are hopeless cases to evaluate biosystematically, they have a great potentiality affording tremendous scope for evolving new cultivars of horticultural value.

For the analysis of populations, it is often difficult to perceive the variables, but it makes so simple to express the data in a graphical form. When pictorial scatter diagram was applied to 40 collections of 9 species of *Eleusine*, it was clear that each species has a distinct association of characters. Combined phytochemical and karyological studies in species of *Garcinia* have revealed that each species and each cytotype is a distinct chemotype and *xanthochymus* is a species of *Garcinia* and not to be treated as a genus by itself.

Based on their taxonomic exercises, the biosystematists are mainly of two categories—'lumpers' and 'splitters'. Lumping or splitting has to be done judiciously, not creating annoyance to the trained taxonomists. There is also a third category namely 'vascillators' who sit on the fence. Taxonomy is basic and one cannot become a good biosystematist without being a taxonomist and *vice-versa*.

### Physiology

**New Areas of Thrust in Physiology by Prof. E. I. George, Department of Physiology, University of Kerala, Kariavattom 695 581.**

The emphasis in the presidential address is on the possibility of contributions, psychology can make in economic growth, national development and social change. A note of caution is first made against psychologists running the time honoured usual path of classical experimental psychology laboratory work and teaching the same number and type of papers and being content with research mainly on standardisation of psychological tests. A careful review of the increasing interests shown by psychologists all over the world in problems closely related to man's struggle for existence is made.

Among the areas of 'Thrust' in psychology, the main emphasis is on entrepreneurial behaviour and economic development, factors affecting development as also social and cultural change, role of psychological research in population control with special

reference to the social acceptance of different methods of control. The general characteristics of entrepreneurs are described in detail from various studies conducted in this regard. The efforts of Arthur Cole, Jenks, Cochran, Schumpeter and Alec P. Alexander are discussed with reference to Economic Analysis. McClelland's n-Achievement model and Evertt Hagen's Sociological Models are discussed in the light of evolutionary development of entrepreneurial behaviour in the developing and developed countries. A thorough analysis of Weberian theories on Entrepreneurial behaviour is also discussed. Further an attempt is made to describe the identification of entrepreneurial talents. In the over view of research, it is further elaborated from the work of a large number of authors from 1961 to the present day drawing from the studies conducted abroad as well as in our country.

The major objectives of such a programme of research will be to identify some of the important sociological and psychological variables which characterise entrepreneurial behaviour in different third world countries to explore cultural variations if any in the patterns of entrepreneurial behaviour.

The interpretations will be such as would help to develop more adequate theories of entrepreneurial behaviour with special reference to developing societies as also for developing effective strategies for training entrepreneurs for different areas of social function. One is not advocating theory building on a galloping empiricism. The programme shall develop a number of specific objectives and be focussed on hypotheses within general framework suggested above. The particular objectives and hypotheses are to be spelt out in the specified context, which shall emerge in the special cultural, economic and social variables to be defined during the explanatory phase of the study. One can list a group of definitive experimental variations, dependent variables would be entrepreneurial behaviour, among the individual variables will be intelligence (general intelligence) primary mental abilities, critical thinking and interpretation, creativity, general personality traits, using different personality inventories, special personality characteristics related to entrepreneurship like risk taking behaviour, goal orientation, initiative, social adjustment, family adjustment, versatility of interest, achievement motivation, situational anxiety, non-structural approach, sensitivity to problems, dissatisfaction with existing situation, leadership traits, time orientation, success orientation, self-concept, imagination, level of aspiration, future orientation and so on. Also family background variables, economic background variables, personal demographic variables can be used. Addi-

tional problems which can be investigated can be additional issues like the efficiency of different prediction system in identifying entrepreneurs, and models for creating entrepreneurial awareness in particular cultures, efficacy of different training, models and incentive conditions for developing entrepreneurial behaviour in particular cultures under different working conditions. For example (support systems, achievement motivation, training with reference to entrepreneurial behaviour, intervention strategies, behaviour modification analysing personal efficiency, culture based strategies, in managerial skills, etc.

If some of our outstanding research workers with appropriate experience and knowledge undertake this area of work, it will probably be the greatest contribution by psychology in providing a solution of our serious problems connected with economic development and social change in the country.

The other area of thrust is the the various aspects of population growth and fertility behaviour. Population explosion has thwarted and practically blocked, economic growth and national development. Periodic assessment of family size norms with scientifically standardised psychological tests is recommended. Examples of tests already standardised are also mentioned. A related problem is the psychological effects and perhaps the clinical and psychological consequences of various methods of family limitation methods particularly vasectomy and postpartem sterilization. Some studies are reported. But a larger number of well designed studies in different parts of the country—again on a national basis—is recommended. Abortion research, research on medical termination of pregnancy are few and far between. Except for two or three independent efforts, not many studies have been reported in this area. This is also an area of increasing interests.

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### Agricultural Sciences

**"Harvesting the Ocean" by Prof. D. K. Das Gupta, University College of Agriculture, Calcutta University, Calcutta 700 019:**

To feed the ever increasing population we must produce more food and, since the cultivable landmass is limited and production per unit land is reaching a plateau, we have got to look for other resources. The seas and oceans, covering two third of the earth's surface can, be expected not only to solve this problem but as also the problem of various raw materials much needed in industry.

Some 200,000 species of plants and animals living in the seas produce annually 2 to  $15.5 \times 10^{10}$  tonnes of

organic matter which is several times the land productivity on earth. But, not all of them are edible or industrially useful. The predominant life form in the sea is the plankton. Though these are minute plants and animals, they sustain all the other marine fishes and animals, being the starting material of the food chain. Apart from this, some of the planktonic organisms such as *Euchaeta* and *Calanus* can directly be converted into table delicacies.

Next to planktons, come the fishes. About 20,000 species of fish live in the seas. The majority of them live in shallow water (fishing grounds). Out of the total world fish production of 72 million tonnes in 1980, India with a continental shelf of about 260,000 sq km produces only 2.42 million tonnes of the total world production.

Even with the limited exploitation of the seas, Indian fishing industry was responsible for a record export earning of Rs. 286.71 crores in 1981-1982 while providing livelihood for nearly 7.5 million people.

In view of the above and the fact that fishes are good sources of animal protein and various mineral nutrients, it is imperative to take stock of fish resources of the sea around us and find ways and means of raising their production. Apart from the fishes, the various forms of seaweeds or marine algae have a large number of uses in food, fertilizer, pharmaceutical, textile, cosmetics, leather and brewing industries. While the mineral resources of the earth are rapidly getting exhausted, the inexhaustible resources of the oceans are as yet untapped. Though sodium chloride, magnesium sulphate, calcium bicarbonate and magnesium bromide are the major dissolved salts present in sea water, the sea also contains gold, silver, and uranium. Ocean floors are often littered with nodules of phosphorites and manganese. Besides mineral resources, sea can provide us with inexhaustible supply of water which is an essential commodity for living and is in short supply. Development of adequate technology for seaweeds, mineral and water resources of the oceans will take care of many of the problems looming large on the horizon.

Coming from the seas and oceans to coastal regions, we find the same lack of expertise to utilize the coastal regions. We may take for example, the coastal saline tracts of Sunderbans in West Bengal. This area is under monoculture of rice in the rainy season and a second crop after paddy would be highly desirable. Recently, it has been found that excellent sugarbeet can be grown on this tract even with brackish water irrigation. A low cost technology for economic production of jaggery (*gur*) from sugarbeet has also been developed. This shows how technology can

solve some of these problems. What is true for coastal areas, is also true for utilizing the vast wealth of the oceans. A concerted effort by the different disciplines of science to assess the resources of the oceans and develop suitable technology for their utilization will solve many of the material problems of the planet earth and make living a bit easier.

### Zoology

**Chromosomes in Marine Fishes—by Prof. C. S. Das, P. G. Department of Zoology, Berhampur University, Berhampur 751 007.**

Chromosomes constitute the hereditary material of living beings and must necessarily provide insight into the mode of evolution of an individual or a group from the ancestral stock and its genetic kinship with the related lineages. Indeed the usefulness of chromosomal studies in the resolution of evolutionary and systematic anomalies is well known. However, the very meagre data, available on fish chromosomes and that too mostly on the fresh-water forms, need to be reinforced by chromosomal studies in marine members which not only constitute two-thirds of the total fish population but also conceivably constitute the ancestors of the fresh-water forms. Furthermore, an identification of sex chromosomes in fishes is of considerable importance in terms of our understanding of the evolution of the chromosomal basis of sex differentiation in vertebrates.

Admittedly the fish, unlike other vertebrate groups which are rather well defined, are highly heterogenous and diversified. Precisely why the fish systematics and phylogeny are in a state of utter confusion—indeed one can hardly hope for any consensus either on one or more parameters in a natural system of classification for the fishes. The fish taxonomists, notwithstanding this dilemma, can however have the consolation in the inherent evolutionary flexibility of this group of vertebrates presumably because of its being the first vertebrate group. Naturally the current studies make it clear beyond reasonable doubt that the evolution of chromosomal—hence genetic system in the fish group remains regulated by more than one type of chromosomal reorganisation—a reasonably strong indication of a polyphyletic origin for this group. Again, of equal interest—contrary to the lack of morphologically differentiated sex chromosomes in the vast majority of fishes, a good evidence of differentiated sex chromosomes can be found in several of the investigated species. However, the sex chromosome mechanism is variable (instead of being substantially orthodox in non-fish vertebrates) and hence indicative of its independent and simultaneous origin in different fish groups.