EVERYMAN'S SCIENCE

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3. Prof. P. C. Mahalanobis (1950)
4. Dr. H. J. Bhabha (1951)
5. Dr. J. N. Mukherjee (1952)
6. Dr. D. M. Bose (1953)
7. Dr. S. L. Hora (1954)

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EDITORIAL

THE PINK REVOLUTION

Everyone knows about the Green Revolution that freed India from dependence on food grain imports to feed its people and the White Revolution that has made India the highest producer of milk in the world. Also well known is the so-called Blue Revolution that refers to the phenomenal rise of the Information Technology (IT) sector, telecommunication and the electronic media which have given a tremendous boost to the country's development. People are aware that this Revolution is rapidly changing the economy. They are, however, less aware about two other sectors that are poised to make great impacts. One is the Brown Revolution of the leather sector that is reaching unprecedented heights. The other sector, the subject matter of this write up, is pharmaceuticals which is ready for a great leap forward to usher in the Pink Revolution.

The Indian pharmaceutical market that has doubled in the last 6 years is attracting increasing interest because the underlying factors that push growth appear robust. The pharma industry is poised for tremendous growth because of the following factors. In India, the real average income is increasing steadily, it has nearly doubled over the last two decades. If one examines data for various countries as regards average income and spending on pharmaceuticals, it is found that the latter is generally around 1.2 per cent of average income and the correlation is almost linear. Thus, as the real GDP of India grows at a compounded annual rate of around 7.5 per cent, the per capita disposable income will rise from the present level of about US $470 to US $760 in 2015. Accordingly, spending on pharmaceuticals will also grow. Experts are of the opinion that nearly 30 million households currently in the low income category will move up whereas the people in the middle income group will enjoy the steepest rise with addition of some 60 million households. Nearly 140 million are expected to move above the poverty line. All this will create opportunities for mass therapy as well as specialized drugs. The total population will also grow to create more demand.

It has been estimated that by 2015 there will be an additional 2 million beds in the hospitals and 0.4 million physicians. Perhaps by then well over 200 million will receive healthcare. With increase in income levels there will be a shift towards increasingly stressful life style and new disease patterns that will need newer drugs. While medicines and healthcare made available will lower child mortality and enhance longevity, increased life span will also imply newer ailments and more pharmaceuticals to combat them. There will be significant increase in chronic diseases. By 2015, diabetes will increase from 2.8 per cent to 3.7 per cent, coronary heart diseases from 3.3 to 4.9, obesity from 1.3 to 2.7 and some additional 50 million will suffer from hypertension. Although this implies greater need of specialized medicines, there will always be great scope for mass therapy.

Experts estimate the drivers for the market growth as follows : upward shift in income—40 per cent, growth of medical infrastructure—20 per cent, increased health insurance penetration—15 per cent, gradual shift in disease profile—10 per cent, population growth and other factors—15 per cent.

There will be great demand of patented products in the main therapeutic areas—neuropsychiatry, oncology, anti—infective, gastrõ—intestinal and cardiovascular. These, to account for 60-70 per cent of the total patented products offer great scope for R and D in Indian laboratories. Opportunities for mass therapy and speciality drugs will remain nearly equal and the growth of the

Indian pharma industry will not be restricted to urban areas. The rural sector may account for thirty percent by 2015.

Fortunately, local pharma players are dominant in India and both large and midsized players have been able to compete effectively with multinational companies. Indian companies have also launched new therapies. In India, eight of the top 10 drug companies are domestic as against only 4 in Brazil and none in Russsia and China and the multinationals now account for only 22 per cent of the market, down from 26 per cent six years ago. The downward trend should continue if R and D in the pharma sector receives adequate support. Price levels in India are often pegged at around 10-12 per cent of US prices and are often much lower than in many developing countries, even the neighbours, Pakistan, Bangladesh and Sri Lanka.

Implications of the expanding pharma market, however, are not all pleasant. An estimated 30 per cent of pharmaceutical products in the market today are spurious and these would also grow. As mentioned earlier, enhanced longevity and age-related health problems would be beneficial to the pharma industry, but there will be greater stress on the society where there is a continuing disintegration of family units and traditional values. The need for healthcare will give a boost to alternate therapies, Ayurveda and Homeopathy will draw much greater attention and so will medicinal and aromatic plants. However, as is well known there are spurious products which are no better than placebos and, sometimes, actually harmful. There will be greater need of R and D, quality assurance and standardization as well as clinical trials.

Today, in terms of scale, the Indian pharma market is ranked 14th in the world. By 2015 it will rank amongst the top ten in the world, overtaking Brazil, Mexico, South Korea and Turkey and the incremental growth projected is US $14 billion over the next decade which would be only behind the US ($200 billion) and China (US $23 billion). Quality assurance would, obviously, be a bigger problem then.

Ideally the Pink Revolution should not simply mean a surge in the production and consumption of pharmaceutical products, nor even a vigorous indigenous R & D programme but a state of affairs where a vast majority receive better healthcare and stay in the 'Pink' of health.

Hem Shanker Ray

"A Mind is a Fire to be Kindled, Not a Vessel to be filled"
—Plutarch

PRESIDENTIAL ADDRESS

WHY STATISTICS ?

PROF. P. C. MAHALANOBIS,* F.R.S

I naturally feel honoured at my election as General President. I remember, several years ago, I discussed with a friend of mine, at that time a member of the Executive Committee of this Association, the possibility of having a separate section for statistics. My friend, who has been always appreciative of the importance of Statistics, readily agreed to have an informal talk with his colleagues. A little later he informed me that there was no chance of my proposal being accepted, and with a smile told me that some of his colleagues had remarked : "If Statistics is to have a section, you may as well have a section for Astrology." Evidently, Statistics and Astrology were bracketted together in the mind of many of our scientists. The forecasting of future events is, of course, a common feature ; and the basis was felt to be equally unscientific. And yet, the section for Mathematics was converted into the section for Mathematics and Statistics in 1942 ; a separate section was created for Statistics in 1946 ; and this year, a person engaged in statistical work has been elected General President. I am aware I have not been accorded this honour because of my personal attainments. I accept it as a mark of recognition of the growing importance of Statistics.

A great change has taken place in the climate of scientific and public opinion about Statistics. One may ask how has this change been brought about ? In other words, why is importance being increasingly attached to Statistics ? It may be appropriate, therefore, to try to explain : Why Statistics ?

DESCRIPTIVE STATISTICS

Historically modern statistics is the result of the fusion of two originally distinct disciplines–one primarily descriptive, concerned with the collection of data ; the other essentially analytic, associated with the concepts of chance and probability. From time immemorial men must have been compiling information for peace and war. Statistics is in this sense as old as statecraft. Harald Westergaard noted : "Etymologists may find the root of the word "statistics" in the Italian word stato, and astaltista would thus be a man who had to do with the affairs of the State. "Statistics" would consequently mean a collection of facts which might be of interest to a statesman, whether they were given in the form of numerical observations or not". (Contributions to the History of Statistics, London, p.2, 1932). At each upsurge of social and political development or during war, there is a rapid growth and expansion of statistical practice. I shall give three examples from my own country.

ARTHASĀSTRA OF KAUTILYA : 3RD CENTURY B.C.

The *Arthasāstra* of Kautilya [Translated by Dr. R. Shamasastry, 3rd edition, Wesleyan Mission

* General President, Thirty-Seven Indian Science Congress held during January, 1950 at Pune.

Press, Mysore, 1929.] claims to date from period 321-296 B.C., that is, the Maurya period which reached its peak in the time of the great Asoka. It contains a detailed description for the conduct of agricultural, population, and economic censuses in villages as well as in cities and towns on a scale which is rare in any country even at the present time. The detailed description of contemporary industrial and commercial practice points to a highly developed statistical system. In Chapter XXXV (p. 158), instructions are given about the classification of villages. Specific directions are also given for a detailed census of land and field (p. 158) :

"It is the duty of Gopa, village accountant, to attend to the accounts of five or ten villages, as ordered by the Collector-General.

"By setting up boundaries to villages, by numbering plots of grounds as cultivated, uncultivated, plains, wet lands, gardens, vegetable gardens, fences (vata), forests, alters, temples of gods, irrigation works, cremation grounds, feeding houses (sattra), places where water is freely supplied to travellers (prapa), places of pilgrimage, pasture grounds and roads, and thereby fixing the boundaries of various villages, of fields, of forests and of roads, he shall register gifts, sales, charities, and remission of taxes regarding fields.

"Also having numbered the houses as tax-paying or non-taxpaying, he shall not only register the total number of the inhabitants of all the four castes in each village, but also keep an account of the exact number of cultivators, cowherds, merchants, artisans, labourers, slaves, and biped and quadruped animals, fixing at the same time the amount of gold, free labour, tool, and fines that can be collected from it (each house)."

In Chapter XXXVI (p. 160) similar instructions are given about the statistics of the Capital City (P. 160) :

"A gopa shall keep the accounts of ten households, twenty households, or forty households, he shall not only know the caste, gotra, the name, and occupation of both men and women in those households, but also ascertain their income and expenditure."

One striking feature in the Arthasastra is the emphasis on the need of checking and verification by independent agents working in secret without the knowledge of the original enumerators (Chapter XXXV, p. 159) :

"Spies, under the disguise of householders (grhapatika, cultivators), who shall be deputed by the collector-general for espionage, shall ascertain the validity of the accounts (of the village district officers) regarding the fields, houses and families of each village—The area and output of produce regarding fields, right of ownership and remission of taxes with regard to houses, and the caste and profession regarding families.

"They shall also ascertain the total number of men and beasts (janghagra) as well as the amount of income and expenditure of each family."

Detailed instructions are given in other places about the standards of weight and measures, measurement of space and time ; national accounts; and the duties of Government such as the treasury; mining operations and manufacture ; commerce ; forest produce ; tolls ; weaving ; agriculture ; livestock ; armoury ; infantry ; chariots ; etc. etc. Specific duties are in fact described for no less than 25 different Superintendents by designation.

AIN-I AKBARI : CIRCA 1590 A.D.

In another peak period of Indian history, in the time of the great Akbar, we find a description of a highly developed statistical system in Ain-i-Akbari which is pratically the administration report and statistical returns of his government as it was in 1590 A.D. In the introduction to the second volume,

H.S. Jarrett observed : [English translation by H. Blochmann (Vol. I, 1873) and H.S. Jarrett (Vol. II, Vol III, 1894) published by the Asiatic Society of Bengal : Vol II, p. vii..]

"It will deservedly go down to posterity as a unique compilation of the systems of administration and control through the various departments of Government in a great empire, faithfully and minutely recorded in their smallest details, with such an array of facts illustrative of its extent, resources, condition, population, industry and wealth as the abundant material supplied from official sources could furnish."

The approach is definitely scientific. For example, the author discusses various standards for the measurement of length, and describes how Akbar "seeing that the variety of measures was a source of inconvenience to his subject, and regarding it as subservient only to the dishonest, abolished them all," and brought the Ilahi gaz in general use (Vol. II, Ain VIII, pp. 58-61). In the same way standards are developed for the measurement of land. It is noted that "a measure of hempen rope twisted which became shorter or larger according to the dryness or moisture of the atmosphere" (pp. 61-62). Therefore, "the jarib was made of bamboos joined by iron rings. Thus it is subject to no variation, and the relief to the public was felt everywhere while the hand of dishonest greed was shortened." (Ain IX, pp. 61-62). Other measures of area and volume as well as the standardisation of currency receive minute attention.

Ain-I-Akbari gives the area, revenue valuation, strength of army, and other details for about 15 subahs (provinces) comprising over 130 sarkars (districts) and over 3000 mahals (townships and sub-divisions) extending from Assam and Arakan to Afganistan ; the average yield of 31 crops for 3 different class of land ; annual records of rates based on the yield and a price of 50 crops in 7 subahs (provinces) extending over 19 years (1560-61 to 1578-79 A.D.) ; daily wages of men employed in the army and the navy ; labourers of all kinds ; workers in stables, etc. ; average prices of 44 kinds of grains and cereals, 38 vegetables, 21 meats and games, 8 milk produces, oils, and sugar, 16 spices, 34 pickles, 92 fruits, 34 perfumes, 24 brocades, 39 silk, 30 cotton cloths, 26 woolen stuffs, 77 weapons and accessories, 12 falcons, elephants, horses, camels, bulls and cows, deer, precious stones, 30 building materials, weight of 72 kinds of wood, etc.

It is no wonder that speaking of Abul Fazl, Jarrett has remarked (II, p.v), that "regarded as a statistician, no details from the revenues of a province to the cost of a pineapple, from the organization of an army and the grades and duties of nobility to the shape of a candlestick and the price of curry-comb, are beyond his microscopic and patient investigation.

In Ain XI (pp. 62-63) a detailed account is given of the classification of land based on the yield of crops. A distinction is made between yields in the two seasons "spring harvest," and "autumn harvest." Further more, yields are given for three different grades of soil, "best, middling, and worst ;" and the average of the three grades is calculated as "the medium product of a bigha." For the spring harvest, figures are given for from 10 to 20 crops ; and for the autumn harvest, for 20 or 30 crops.

One interesting practice deserves notice. The ten ser tax (Dahseri) is thus described : "His Majesty takes from each bigha of tilled land ten sers of grain as a royalty. Store houses have been constructed in every district. They supply the animal belonging to the State with food, which is never bought in the bazaars. These stores prove at the same time of great use for the people ; for poor cultivators may receive grain for sowing purpose,

or people may buy cheap grain at the time of famines..... They are also used for benevolent purposes ; for His Majesty has established in His empire many house for the poor where indigent people may get something to eat." (Vol. I, 1927, p. 285).

The optional payment of revenue in the form of grain may deserve serious consideration as an alternative method of grain procurement in these days of food rationing in India.

SURVEY OF EASTERN INDIA : 1807-1815 A.D.

In the first decade of the 19th century, when the British regime in India was rapidly expanding and growing in strength, a comprehensive survey of Eastern India was undertaken by Dr. Francis Buchanan under orders of the Board of Directors of the Hon'ble East India Company dated 7th January 1807. The terms of reference cover an amazingly wide ground as can be seen from the extracts reproduced in Appendix (1). The Survey was pursued by Dr. Francis Buchanan for 7 years when only a portion of the territories under the Government of Bengal Presidency was investigated. The material was sent to London in 1816, and Montgomery Martin published in 1838, a selection in three volumes comprising over 2400 closely printed pages.

The book still makes fascinating reading. To whet your curiosity, I shall describe some of the items collected about the people of Patna city and the surrounding region. Information is given, for example, about the number and proportion of families in different consumption levels such as, families that use milk daily ; that use milk in the chief season ; that use milk on holiday ; that use milk seldom. In the same way, information is given by categories of families according to the use of different kinds of dress, bedsheets, blankets ; the consumption of meat, milk, vegetables, spices, oil, salt, rice, wheat, sweetmeats etc ; different kinds of fuel and oil ; different types of conveyance ; state of education ; etc.

The utilization of land is shown by giving the areas separately for a large number of categories such as houses, trees, kitchen gardens, vegetables, etc. As regards agriculture, separate acreage figures are given for the area under 200 different combinations of crops, single and mixed. A general table is given for the value of the produce in the case of commercial crops ; and both quantity and value in the case of cereals and food crops together with estimates of the marketable surplus ; and number of livestock under different categories together with the annual production of milk with prices.

There are tables showing the proportion of rent paid by different sections of the population ; the economic position of farmers with proportion of indebted families ; and the number of artisans classified into 108 different categories. The manufacture of cotton cloth receives special attention ; and detailed estimates are given of the number of weavers ; looms ; monthly production ; earnings and profit for different kinds of cloth. Finally, there are tables of exports and imports (for the region surrounding Patna city) in which separate figures are given 140 different categories of commodities.

The report everywhere shows the critical attitude, keen scientific spirit, and the experimental approach of Dr. Buchanan. The wealth and reliability of the information (as far as this can be judged from internal evidence) make this report one of the most remarkable surveys of all times. There is nothing in any subsequent survey in India to approach the one conducted by Buchanan 140 years ago.

It is not entirely fortuitous that the three surveys mentioned above were associated with three

great periods of political and socio-economic expansion in India. The statistical system is a visible mark of the political framework of each country. The statistical organization, therefore inevitably follows the rise and fall of the wider administrative system. I shall examine later the position of statistics in the changing conditions of India at the present time.

DEVELOPMENT IN OTHER COUNTRIES

The practice of descriptive Statistics gradually developed, with ups and downs, in all countries of the world. Aristotle's work contained references to information about no less than 158 states[1]. Besides public administration Statistics was in much use in commerce. Certain forms of commercial insurance existed in Babylonia, Greece and Rome, and in the middle ages in Italy. By the end of the 18th century, life insurance was becoming prevalent in Western Europe. All this led to important statistical studies. In 1662, for example, John Graunt used the register of deaths (Bills of Mortality) in London to investigate population trends. Since then in Europe, the study of Statistics has been closely associated with actuarial Science. On the break-up of the feudal system, the expanding national economies required increasing use of factual information for the formulation of financial, military and political policies. This process has continued down to the present times. In fact, the need of fighting a total war led to an unprecedented expansion in statistical activities in the last ten years to which I shall again refer.

GAMES OF CHANCE AND PROBABILITY

I must now turn to the analytic side of Statistics. Curiously enough, the first phase of development occurred in connexion with games of chance, particularly the theory of the equitable division of stakes for which early solutions were given by Cardan and Galileo in the 16th century. A little later, Pascal and Fermat developed more general methods on the basis of permutations and combinations. In this way the concept of probability, based on chance, gradually became the subject of much mathematical investigations culminating in the work of Laplace in early 19th century.

THE TOSSING OF A COIN

The concepts were fundamentally new and deserve consideration. A simple example is the tossing of a coin (which is assumed to have no bias favour of turning up either heads or tails). At each throw, it is completely uncertain whether the coin will turn up heads or tails. And yet, if the coin is thrown a large number of times (or, alternatively, if a large number of coins is thrown at the same time), it is practicaly (but never absolutely) certain that heads and tails would turn up approximately in equal numbers. The larger the number of throws (or the number of coins thrown at the same time), the greater is the chance of heads and tails being equal in frequency. Starting from a situation which is entirely indeterminate and uncertain, it is thus possible to reach conclusions with considerable (but never complete) certainty.

Several points require to be emphasized. First, it is quite impossible to predict anything about a single toss of a single coin ; the prediction (of roughly equal frequency of heads and tails) refers to one whole set of throws. That is, prediction belongs not to any individual throw but to a group or assemblage of throws as a whole, Secondly, the existence of fluctuations or variation is inherent in the very nature of the situation. The relative frequency (that is, the proportion of heads and tails) will never remain exactly equal, but will inevitably fluctuate from one throw to another. Thirdly, because of the existence of fluctuations or variations, it is never possible to make any absolutely certain prediction. For example, however large the number of throws, the coin may turn up heads (or tails) all the time. In principle, even if

the coin is tossed a million or a billion (or a larger number of) times, in the very long run, sometimes the coin should (and must) turn up heads (or tails) on the million or billion (or all) occasions. [This is of course, very very unlikely to happen which merely means that the probability is extremely small but, in principle, not zero.] In other words, the prediction is essentially a prognosis which is likely to hold only "in the long run". Fourthly, and this is a very important point, although the prediction is never absolutely certain, it is possible to estimate the limits of uncertainty.

The proportion of heads and tails in the tossing of a coin is thus recognized as a statistical variate which is intrinsically subject to variations or fluctuations. The proportion of male and female births is exactly analoguous to the proportions of heads and tails in the tossing of a coin. Before birth, nothing is known about the sex of the individual child, and yet the prediction of a roughly equal frequency of the two sexes can be made with practically the same confidence as the equal frequency of heads and tails. [Laplace discussed in a memoir of 1781 the number of male and female births in Paris for 26 years (251, 527 males and 241, 951 females) from the point of view of probability (Histoire de I' Academie for 1778)]. Any inference about the results or any prediction is, therefore, necessarily uncertain ; but the margin of uncertainty is itself capable of estimation.

THEORY OF "ERRORS" OF OBSERVATION

The position is similar in the case of physical observations. However careful the observer may be, even the simple measurements of the length of a rod have been always found to vary. The average of a number of repeated mesurements, however, usually becomes more and more steady as the number of measurements increases. The deviation from the average, i.e., the "error" of each invidual measurement is sometimes positive and sometimes negative, and thus behaves like heads and tails in the tossing of a coin. In the 18th century the new concepts of probability began to be applied to the adjustment of astronomical observations and physical measurements which led to the growth of the theory of errors culminating in the work a Gauss and Laplace.

INDIVIDUAL VARIATIONS AND FLUCTUATIONS

If the height of a number of individuals is measured, these measurements again vary. This is equally true for very kind of measurement in Biology. Fluctuations or variations are thus intrinsic features of all measurements. In Biology, variation itself supplies the material for evolution. Variation is also the outstanding feature in all Social Sciences.

MEASUREMENTS AND OBSERVATIONS IN SCIENCE

A crucial point in the argument has been now reached. All contingent knowledge is based on mesurement and observations. Lord Kelvin remarked long ago,

"When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

[It is interesting to note that exactly the same idea occurs in the original meaning of the world *sankhyā* (literally, number) in Indian thought. The phrase *sankhyātā* occurs in the *Atharva-Veda* in the sense of "well-known." For more than three or four thousand years in India an intimate connexion has existed btween the concepts of "number" and "adequate knowledge." This is why I chose *Sankhyā* as the name of the Indian Journal of Statistics.]

Secondly, every set of measurements (in every field of Science—physical, biological and social)

is characterized by variation. The aim must therefore be to draw general conclusions from a particular set of measurements, taking variation itself into consideration and not ignoring it.

THE CONCEPT OF RANDOM SAMPLES

This is exactly the aim of the theory of estimation and statistical inference. Each set of measurements (with its characteristic variaton) is recognized to be only one out of many possible similar sets. Secondly, the totality of all possible sets of measurements (that is, the totality of all possible samples) constitute the "population" or "universe" in which we are interested. In order to reach conclusions about the population of universe, it is clearly necessary that a sample should be representative of the universe. The condition for such representativeness is supplied by the fundamental concept of "randomness". I do not think it is possible to define randomness, but some indication may be given as to its implications. Suppose it is desired to find the average height of a particular group of people. Obviously, it will not do to select individuals who are very tall or very short (or have any other special feature) as the results are likely to get biased. The only safe course is to choose the sample without reference to any previous knowledge about the individuals included in the sample. A random procedure ensures such selection free from bias. Once a random sample is available, it is possible to use the calculus of probability in a valid way to reach general conclusions about the statistical population or universe from which the sample was drawn. The concept of random sample is this pivotal in statistical theory.

UNCERTAIN INFERENCE

Knowledge based on a statistical or random sample is however necesarily incomplete, as it relates to only one out of many possible sample. Conclusions based on a random sample, although valid, must therefore, be necessarily uncertain. It is however the great merit of the calculus of probability that although statistical inference is uncertain, it is possible to estimate a valid measure of the degree of uncertainty. In practice this is usually secured by stating the chance or odds infavour of any particular inference or result being "true" (in the sense of the prediction agreeing with subsequent observations). Suppose extenstive agriculture trials have been made to compare the yield of two varieties of wheat. On avilable evidence, it is then possible to state the conclusion in some such form that the odds are 100 to 1 (or 1000 to 1, or some other odds) that variety A would give a higher yield than variety B. The very form of the statement indicates that, "in the long run", 99 times out of 100, variety A would give a higher yield. Necessarily, therefore once in 100 trials (not in very 100 trails, but again, "in the long run") variety A would give a lower yield. This lower yield may, however, occur in the very first trial. The risk is always there. Not only this, occasionally (or once in 100 trials "in the long run") the prediction must prove wrong, If it did not, then the whole basis on which the prediction was made would itself prove to be wrong. In statistical inference, we thus reach the fundamental paradox.

If statistical theory is right, predictions must come out wrong ; on the other hand, if predictions are always right, then the statistical theory must be wrong.

DEDUCTIVE LOGIC AND MATHEMATICS

There is a sharp contrast between statistical or uncertain inference and absolutely certain deductive conclusions. It is a significant fact that the concept of probability developed very late in the history of human thought, as far I know, only during the last two or three hundred years. Deductive logic, on the

other hand, is very old. Absolute certainty in fact has long been accepted as the essential characteristics of true knowledge. Pure Mathematics is the great historic example. In Pure Mathematics the conclusions follow inevitably from the premises, and all inferences are absolutely certain. This is why Bertrand Russel described Pure Mathematics as the class of all proposition of the form : "P implies Q". Deductive logic therefore, includes the whole of Pure Mathematics.

DETERMINISTIC VIEWS IN PHYSICAL SCIENCE

An invariable sequence of cause and effect is in many ways similar to the formal deductive process in logic and Pure Mathematics. In the Physical Sciences, with the help of the casual principle, the rigour of absolute certainty of mathematical reasoning was accepted for a long time as the ideal model. Newton in writing his great treatise on the principles of natural philosophy deliberately adopted the mathematical form. The possibility of constructing a rational model of the whole universe was a great triumph of the human mind. The growing complexity within the natural, and later in the biological and social sciences, however, led to the gradual replacement of the deterministic—mathematical model by probabilistic—statistical view. The change was brought about not by abstract reasoning but by the force of events within the field of Science itself.

THE ENTROPY PRINCIPLE

The Newtonian equation of motion become increasingly unmanageable with the increase in the number of particles requiring to be taken into consideration. It soon became necessary to study the properties of a system comprising a large number of particles. The object now was not to ascertain the motion of each single particle separately, but to investigate the collective properties of all the particles taken together. Concepts and results already available in the theory of errors of observation were passed into service to develop the kinetic theory of gases. A parallel development of the subject of thermodynamics led to the emergence of the entropy principle. The central concept in the second principle of thermodynamics is again randomness, so that the principle of the increase of entropy is recognized as nothing but the increasing degree of randomness of the physical universe.

THE UNCERTAINTY PRINCIPLE IN PHYSICS

A further shift to a statistical model occurred with the development of statistical mechanics culminating in the enunciation of the uncertainty principle by Heisenberg which denied the possibility of absolutely certain knowledge of both the position and the motion of particle at any given instant. From a theoretical point of view, the uncertainty principle would seem to make Physical Science essentially statistical in nature. The belief that complete certitude is an essential condition for genuine knowledge, however, still persists in certain quarters. The uncertainty principle is looked upon as belonging to the region of the very small, and therefore not inconsistent with the deterministic view of the world as a whole.

I doubt whether the above view is tenable. If Science is based on observation and measurement and if each set of measurements is a statistical sample, then all scientific conclusions must be of the nature of uncertain inference (with, in principle, a known margin of uncertainty). The contrast can be clearly seen in the distinction between a mathematical constant and a statistical or physical quantity based on observations. The ratio of the circumference to the diameter of a circle is a mathematical abstraction and, therefore, not subject to any fluctuations. All physical quantities, on the other hand, are based on observation and

measurement, and are therefore statistical estimates, necessarily subject to a margin of uncertainty. On this view, all scientific predictions must be characterized, in principle, by a margin of uncertainty.

INDUCTIVE LOGIC

It may be observed at this stage that J. S. Mills' empiricism is a departure from rationalism only in form in as much as the aim of Mills' inductive logic still remains "certain" inference. Similar attempts were made much earlier in India to go beyond the purely formal deductive process, Sir Brajendranath Seal has given an interesting account of the doctrine of inference in the *Positive Sciences of Ancient Hindus* (1915). All these attempts, however, had certitude as the aim of inference. But in Indian thought, it was recognized, in one sense, that this aim is unattainable in practice. B. N. Seal noted for example :

> "Ultimately we all have to fall back on the rational practice of thinking persons, and such persons are always content to act on practical certitude instead of hankering after an unattainable apodectic certainty in the affairs of life. This same practical certitude is also the ultimate warrant of the Deductive–Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark."[2]

FALLIBILITY OF SCIENTIFIC KNOWLEDGE

I have been trying to place before you the view that all scientific knowledge (being based upon evidence which is formally incomplete) is only probable and never absolutely certain. All predictions based on scientific knowledge must, therefore, be fallible ; and must in fact prove wrong, in the long run, to the anticipated extent. Ernest Nagel observes that those.

> "who maintain that our knowledge of matters of fact is "probable" do not thereby maintain that such knowledge is inferior to knowledge of some other kind obtainable by methods different from those the Natural Sciences employ. On the contrary, they maintain the "probable knowledge" is the only kind of knowledge we can find or exhibit, and that the methods and techniques of the sciences are efficacious and dependable precisely because they make available knowledge of that character."[3]

Thus in the whole field of Science, the deductive—mathematical process of absolutely certain inference is being replaced by the probabilistic statistical method of uncertain inference. Ernest Negal has stated the position very clearly.

> "The long history of Science and Philosophy is in large measure the history of the progressive emancipation of men's minds from the theory of self-evident truths and from the postulate of complete certainty as the mark of scientific knowledge."[3]

DETERMINISM AND UNCERTAINTY

If the probabilistic model is accepted as a closer approach to reality, then interesting consequences are likely to follow in the field of human thought and Philosophy. I have no competence to discuss such issues, but one or two observations may not be entirely out of place. All knowledge based on Science, and hence all scientific predictions about the future must be recognized, in principle, as uncertain. It is possible however to admit, in principle, that knowledge about the past may be of a deterministic type. The uncertainty about the future may then be interpreted as supplying an opportunity for fresh creation (at least, as perceived

by the human mind). In fact, the "present moment" on this view is the actual occasion of an ever-continuing stream of creation which is marked in rational thought by the transition from a deductive–mathematical to a probabilistic–statistical model of reality.

STATISTICAL METHODS IN THE CONCRETE

I have so far considered the statistical method in the abstract. A brief survey of the scope and range of the statistical method in the concrete is also of interest. A convenient way of doing this is to construct a kind of mental map of scientific activities. We may start with a geometrical point at the centre to represent Pure Mathematics. On the view which have expounded, Pure Mathematics (being fundamentally deductive in nature) does not itself belong to the field of Science ; and can be, therefore, appropriately represented by a mathematical point which has "position but no dimension".

PHYSICAL SCIENCES

We draw a small circle round the centre to represent Classical Physics in which although the form is still mathematical, actual knowledge is based on measurements subject to errors of observation. Fluctuations are, however, small in magnitude so that predictions can be made with great certainty (but are still, in principle, affected by a margin of statistical uncertainty). A second larger circle may be drawn to represent the area of kinetic theory of gases, statistical mechanics, and thermodynamics. In this region, factors of variation are still amenable to a large degree of control so that the classical method of experimentation (isolating and studying one single factor at a time) is usually available.

BIOMETRY

A third larger circle may be drawn to demarcate an area where the factors of variation are more complex and less liable to control. This broadly represents the field of biological variation. In 1900, Karl Pearson coined a new world "Biometry" to indicate generally the methods particularly appropriate to this area. The fruitful concept of statistical correlation historically had its origin in the field. In 1877 when Sir Francis Galton measured the size of sweet peas in his studies of heredity, he found a "regression" of the size of the daughter seed, compared to the size of the mother seed, towards the general mean. He found the same thing again in connexion with his observations on the height of fathers and sons. These studies led to the development of the theory of regression and correlation by Karl Pearson and others. It is worth noting that Gauss himself had used the product term in his investigations on the theory of errors, but had failed to reach the concept of correlation. The French astronomer Bravais (1811-63) worked on what is in essence the Mathematics of correlation, as early as 1846. The concept of regression and correlation, however, did not emerge until 40 years later ; and this also, only under the stimulus of the study of biological variations. This perhaps is a corroboration of the view that statistics is essentially an Applied Science and not a branch of Mathematics. In the field of biometry, the fluctuations and variations are themselves of great importance, and often supply convenient yard-sticks for purposes of measurements.

During the last 50 years, Biometry has become a very large branch of Statistical science. It covers practically the whole field of Biology and Genetics including agriculture and the study of livestock. Biometric methods are also being increasingly used in psychology, education, and the medical and social sciences including the study of the human factor in industry.

In dealing with living units, it is usually impossible to use the classical method of isolating and studying one single factor at a time. For example, in studying the increase in the yield of crops due to improved seeds or fertilizers or better methods of cultivation, fluctuations in the fertility of the soil from plot to plot, the influence of weather conditions, and many other factors of variation are always present and cannot possibly be isolated. A radical departure had become necessary and took place about a quarter of a century ago, in the development of the design of experiments and the analysis of variance under the leadership of R. A. Fisher[4]. He himself has observed :

> "No aphorism is more frequently repeated in connexion with field trials than that we must ask Nature few questions, or, ideally, one questions at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire, indeed, if we ask her a single question, she will often refuse to answer until some other topic has been discussed."

The central aim of the design of experiments is to make experimental observations in such a way that the different factors of variation would have scope to come into play in a balanced fashion so that it would be possible to study the influence of single factors as well as of various combinations of factors at the same time. In fact, R. A. Fisher has remarked, "The more thorough the design of the experiment, the more meaningful is the question asked". Actual experience has shown abundantly the great advantages (in economy of time and effort, and in adaptability) of using appropriate statistical designs in scientific and technological experiments of all kinds.

The fact of variation is as universal in the field of industrial production as in Biology. Even with machines of the highest precision, no two units are identical in size or other specifications. Usually there is the additional complication of fluctuations in time, but such fluctuations themselves often supply convenient yard-sticks for diagnostic purposes. So long as the fluctuations remain stable, the system may be considered to be under statistical control. W. A. Shewhart[6] used this fundamental concept to develop "control limits" and "control charts" to enable the quality or output of manufactured products being maintained at a desired level. These methods found wide applications during the war. In fact, without the use of such methods, war production in the United States and other allied countries could never have been sufficiently stepped up. After the war, the use of statistical "quality control" is steadily increasing all over the world, and a beginning has been made in a small way in India also.

STATISTICAL SAMPLING

We may add a fourth circle to determinate the region in which the appropriate tool is statistical sampling. Factors of variation are now more complex and are usually not amenable to experimental control. This is the field where the traditional method of the exhaustive census or the attempted complete count has been used for a long time. R. A. Fisher has recently described the present position.

> "The words sample and sampling, like the word random, have always been central in the development of Mathematical, or Theoretical Statistics. With the increased understanding and integration of our Science they have now, as it were, overflowed from the world of abstractions in which they were generated and refined, and have, in fact, supplied the most adaptable, rapid,

economical, and, in the true sense, scientific method of factual ascertainment which we yet posses.

"I have made four claims for the sampling procedure. About the first three, adaptability, speed and economy, I need say nothing further. Too many examples are already available to show how much the new method has to give in these ways. But, why do I say that it is nore scientific than the only procedure with which it may sometimes be in competition, the complete enumeration ? The answer, in my view, lies in the primary process of designing and planning an enquiry by sampling. Rooted as it is in the mathematical theory of the errors of random sampling, the idea of precision is from the first in the forefront. The director of the survey plans from the first for a predetermined and known level of precision ; it is a consideration of which he never loses sight ; and the precision actually attained, subject to well-understood precautions, is manifest from the result of the enquiry".[7]

Rapid developments in this field have taken place during the ten or twelve years in which India has made significant contributions. I shall come back to this subject a little later as it is of great current interest in India.

FREE OBSERVATIONS

We may now add a fifth circle to indicate the area in which factors of variation are neither amenable to control, nor to experimentation, not even, in the usual snese of the term, to sample-surveys or sample-censuses. Here the only feasible approach is the patient collection of observations followed by classification and painstaking investigaton of possible statistical relationships. Experimentation is no longer possble, but it is still feasible to compare predictions with subsequent observations. Statistical methods are particularly appropriate in this field. I shall give one example from my own experience.

In 1926 a catastrophic flood occured in the Brahmani river in Orissa. An expert committee of engineers appointed by the Government of India reached the conclusion that the bed of the river had risen by several feet and consequently the flood level was likely to be higher in future. The Committee naturally recommended raising the height of the embankments by several feet to give protection against higher floods. At the request of the Government of Bihar and Orissa, I made a detailed statistical study, and found a significant correlation between the rainfall in the catchment area and the height of the river flood in the delta. One technical point deserves notice. The Catchment area was divided into two portions, and the rainfall in the two catchments were used as two separate variates for correlation with the height of the river flood. *Report on rainfall and Floods in Orissa Rivers* (submitted in 1930, and printed by the Govermment of Bihar and Orissa). The statistical studies made at this time supplied the basic information for the Hirakud Dam, one of the big river valley project in India. Using the statistical relationship, I found that the abnormal rise of the river in 1926 could be reasonably ascribed to exceptionally heavy rainfall in the catchment areas. On the basis of such statistical evidence, it was possible to advise Government that there was nothing wrong with the river, and it was not necessary to increase the height of the embankments. This advice was given in 1930. The fact that no great change has occurred in the severity or frequency of floods during the last 20 years shows that the statistical findings were correct, Direct experimentation in such cases is out of question ; the statistical method supplies the only valid tool for scientific investigation. Incidentally, in this case, it also saved several crores of rupees.

I should like to include in the mental map the field of operational research in which the information is either too meager, or is not in a suitable form for the calculation of the probability involved in the porblem. In such cases a decision, however, has to be reached be balancing the risks of gain and loss but without the formal use of the probability calculus. Operational research thus comes within the general scope of the statistical method. The work is, no doubt, closely connected with engineering or technological and scientific investigations so that position is somewhat similar to the field of statistical quality control.

STATISTICS IN EVERYDAY LIFE

The importance of Statistics in the field of Science is due to its supplying the general method for inductive inference. The growing importance of Statistics in public estimation, on the other hand, is mainly due to its increasing practical applications in the affairs of everday life. It is necessary to remember that at one time Physical Science itself was held in low esteem in the public eye, and was often a subject of contempt and ridicule. It is interesting to observe that Thomas Sprat made the following observations in 1667, five years after the foundation of the Royal Society of London.

> "It is not to be wonder'd as if men have not been very zealous about those studies, which have been so far removed from present benefit, and from the applasue of men. For what should incite them to bestow their time, and Art, in revealing to mankind, those Mysteries ; for which, it may be, they would be only despis'd at last. How few must there needs be, who will be willing, to be impoverish'd for the common good ? While they shall see, all the rewards, which might give life to their Industry, passing by them, and bestow'd on the deserts of easier studies?[8]

It is only with the great technological achievements of Physical Science that public opinion changed in a remarkable manner and it rose in public esteem. It is this public esteem which enabled the physical scientists to secure sufficient leisure, support, and recognition to pursue their researches free from care and anxiety. This also led to the growth of the belief that scientific research is pure in the degree in which it is removed from practical applications.

"PURE" AND "APPLIED" SCIENCE

I am prepared to admit that a distinction may perhaps be made between "pure" and "applied" Science. A subject like Physics, for example, has a clear responsibility for developing a picture of the universe in terms of physical concepts and elements even if this picture has no practical applications. This is also true of other "Pure" Sciences like Chemistry, Botany, Zoology or Geology; each has the task of supplying a world–picture in its own terms. In an Applied Science like engineering the position is quite different. It has no responsibility (nor any possibility) of giving a general theory of the world in terms of engineering. Its only task is to solve a practical problem. It must, of course, undertake research in its own field. As regards Mathematics, it is simply not possible to have too much help from the subject, but there is no such thing as "mathematical engineering".

STATISTICS—ESSENTIALLY AN APPLIED SCIENCE

In the same way, Statistics is essentially an Applied Science. Its only justification lies in the help it can give in solving a problem. Its aim is to reach a decision, on a probabilistic basis, on available evidence, If the problem is one of a theoretical nature Statistics supplies a valid method

for drawing general conclusions from particular experience. If the problem is a practical one, Statistics supplies the basis for choosing a particular course of action (in preference to other possible courses) by balancing the risks of gain and loss. This is why Clark Maxwell once remarked that "the true logic for the world is the calculus of probability."

On the above view, we cannot contemplate any cleavage between the theory and the practice of Statistics. On one side, Statistics must necessarily be tied closely to practical ends. On the other, it must try at the same time to make its technical apparatus more and more general, and hence more and more abstracted from particular applications. Statistics, like engineering, requires all the help it can receive from Mathematics ; but statistical theory can never become a branch of Mathematics. Individual workers would specialize in particular fields in accordance with their own preference. Some would apply their mind closely to practical applications ; so some to the development of the mathematical technique ; and others to the formulation of logical concepts and abstract theory. The number of persons working in the different fields would be naturally determined, partly by the demand for particular types of work (applications, or mathematical technique, or logical concepts and foundations) and partly by the supply of men of the required aptitude and ability. The integration of practical applications with mathematical and theoretical studies, which is the characteristic feature of Modern Statistics, is perhaps a good model for other sciences also. If technology is divorced from scientific research, it would soon loose its efficiency and adaptability to meet changing requirements. On the other hand, if research is cut off from the stimulus to solve vital problems of human society, it would become lost in sterile intellecutual acrobatics.

THE SOCIAL BACKGROUND OF STATISTICS

In statistical research the greatest stimulus has always come from the need of solving practical problems. R. A. Fisher's work on the design of experiments was due to the urgent need of solving the deadlock in agricultural fields trails. W. A. Shewhart's work on quality control arose from the need of improving the efficiency of inspection in large scale production. On the organizational side also, statistical work is closely determined by the special needs of the country and by the social-economic frame work. Statistics is not only an Applied Science but is also a Public Science. It is becaus of the close connexion with public activities that big developments in Statistics have always occurred only when there has been need of unified policy and coordinated action in times of war or peace. I shall give three examples.

For a long time the volume of statistical work has been greater in the United States than in any other country of the world. But it was only during the New Deal in the 1930's when unified governmental policy became indispensable in the economic field that effective action was first taken for the central coordinaton of the statistical activities of the Federal Government. Other large developments took place because of the need of planning in war production ; and it was only in 1942 that an Act was passed to assign definite statuatory responsibilities to the special division of Statistical Standards in the executive office of the President of the United States.

In the United Kingdom also, under *laissez faire*, Statistics had been developing in a more or less haphazard manner without any focal center within the govermental machinery. All this, however, changed rapidly owing to the need of total planning during the war. A Central Statistical Organization was set up and was entrusted with the duty of

reviewing and making a critical appreciation of all statistical information required by the Cabinet. Although the different Ministries have their own statistical divisions, there is complete coordination at the top. After the war, the importance of the Central Statistical Organization has continued to increase with the growth of social and economic planning in the United Kingdom.

In the U.S.S.R., developments in the statistical field have gone much further. From the beginning a Central Statistical Bureau has been an integral part of the GOSPLAN. No plan can be put into operation until it is cleared by the Statistical Bureau. The Bureau not only helps in preparing the different plans, but also sumbits reports on the progress of such plans on the basis of the information collected directly by the Bureau. In 1947 it had in fact a staff of 22,000 scattered all over Russia paid and controlled directly by the Bureau. Central control by statistical methods is thus complete in the U.S.S.R. It is interesting to note about a year ago, the Central Statistical Bureau was removed from the GOSPLAN and was placed directly under the Council of Ministers (which corresponds to the Cabinet in India). This would seem to indicate that the Bureau now has the further responsibility of submitting reports on the GOSPLAN itself.

In India also there was a great deal of expansion in statistical work during the war without, however, any central coordination. Such lack of coordination was inevitable in the absence of any coherent over-all economic policy. Until the Goverment of the country has an urgent sense of the need of statistical services in shaping policy and programme of action, little progress is possible. In spite of much talk, no action was taken for central coordination in India until very recently. There was indifference and even hostility to new ideas and new devopments. This is typical of the struggle through which scientific innovation must pass in order to establish their worth. I may illustrate these points by briefly recapitulating the story of sample-surverys in India.

SAMPLE-SURVEYS IN BENGAL

For a long time, crop statistics was known to be unreliable in Bengal. In 1934 I discussed with Mr. H. P. V. Townend, I.C.S., (then Development Commissioner, Bengal) the possibility of using random samples for the improvement of the jute forecast. On his initiative, a sample-survey on an area basis was conducted over the whole province in 1935. I believe this was the first area-sample in the world. [As far as I know, Sir John Hubback was the first person to consider random sampling for estimating crop areas ; but he did not use it in practice. His own work was concentrated on statistical sampling for the yield of rice in Bihar and Orissa in the early 1920's. His original report "Sampling for Rice Yield in Bihar and Orissa" published in 1927 as bulletin No. 166 by the Agricultural Research Institute, Pusa, was reprinted in *Sankhyā* ; the Indian Journal of Statistics, Vol. 7, Pt. 3.] The results were not satisfactory ; chiefly, I thought, because of defective field work. A little later, the Indian Central Jute Committee approved a five-year scheme for a sampling method for the jute crop. Work was started, on a very small scale, in 1937, and an efficient sampling plan was developed by the Indian Statistical Institute by a series of annual surveys, on a gradually expanding scale, until the whole province was covered in 1941.

Three tests had been laid down for the sampling plan which were adequately fulfilled. The method was speedy, inexpensive, and the margin of uncertainty of the provincial estimate was only about 2 per cent.[9] Influential opinion was, however, still strongly opposed to the scheme, and it was terminated at the end of 1941. Since then it has passed through many vicissitudes. The sample-survey was revived in 1942 for only one year.

Since 1939 I had been pressing Government to have the sampling plan extended to rice. In view of the cessation of the supply of rice from Burma, which by this time had fallen to the Japanese, I sent to a high agricultural official in New Delhi in March 1942 a plan for a sample survey of rice in Bengal ; my letter was not acknowledged. In 1943 a famine broke out in Bengal and caused the death of a million-and-a-quarter or a million-and-a-half of men, women, and children. The sample-survey was started afresh in April 1943 ; was stopped after two months, in June ; and was again started in August and extended to the rice crop for the first time, owing chiefly to the urgent need of food statistics.

The adequacy and reliability of the sample-survey was challenged on every occasion. In fact, a sample-survey of crops which had been started in Bihar in 1943-44 was discontinued after one year on the advice of the Agriculture Department of the Government of India, in spite of my earnest pleadings in personal discussions, and in a letter which I sent to New Delhi on the 23rd March 1945. In Bengal also, the position was precarious in 1944. However, after many debates and discussions, the Government of Bengal decided to continue the sample-survey, and also to organize a plot-to-plot enumeration with a view to comparing the two methods.

COMPARISON OF SAMPLE-SURVEY AND PLOT-TO-PLOT ENUMERATION IN BENGAL : 1944-45

In accordance with the above decision, a plot-to-plot enumeration was conducted directly by the Government of Bengal in the winter (aman) rice season of 1944 and the jute season of 1945 ; while the sample-survey was conducted by the Indian Statistical Institute. The sample-survey was, of course, much more economical. The total cost of the plot-to-plot enumeration was about Rs. 82 lakhs (about 61,500 sterling) while the cost of the sample survey was Rs. 8 lakhs only, or just one-tenth. The intensity of sampling was unusually heavy, owing to the desire of Government to have separate figures for 28 smaller geographical units (districts). For a provincial total, or for 3 or 4 regional breakdowns, the cost of the sample survey could have been easily reduced to Rs. 6 lakhs or even Rs. 4 lakhs. From the experience of about 2 years of work in Bengal, we have found that a sample-survey of crops can supply results of sufficient accuracy for most practical purposes at a cost of only a fifteenth or a twentieth of that of a complete count.

It is, however, in the matter of precision that the sample-survey has the greatest advantage. It is possible to make a direct comparison for the jute crop of 1945 in Bengal. Jute being primarily a cash crop, accurate export and trade figures become available about 15 months after the harvesting season. The sample-survery estimate, submitted to Government in September 1945, was 7,540 bales of jute. 1 bale = 400 lbs. of jute. The official forecast in the same month, based on the plot-to-plot enumeration, was 6,304 bales. According to the customs and trade figures which became available in January 1947, the Bengal production was 7,562 bales. The plot-to-plot enumeration gave an under-estimation of 16.6 per cent, while the sample-survery figure differed by only 0.3 per cent from the estimate based on trade figures. The plot-to-plot enumeration was ten times more expensive, and yet gave entirely inaccurate results.

The reason for the greater reliability of the sample-survey is clear. The total staff employed in the plot-to-plot enumeration was about 33,000 against roughly about 600 or 700 in the sample-survey. Sample-survery require a much smaller staff. It is, therefore, always possible to employ better trained people on higher pay, and also to

maintain close supervision on their work. In consequence, the primary material in sample-surveys is usually of much better quality, and furnish final estimates of greater accuracy.

In Bengal, the superiority of the sample-survey was finally acknowledged in January 1948, when the sample-estimates were ordered by the Government of the Province to be accepted in future as official crop-estimates. It had taken eleven years (since 1937) to achieve this result.

A good deal of similar evidence has accumulated in other countries of the world. I shall refer to some very recent work in Japan. At the request of the Occupation Authority, the Japanese Government conducted in 1948 plot-to-plot enumeration of crops (on the basis of old cadastral survey records) of the whole country. Sample-surveys were superposed to assess the accuracy of the plot-to-plot enumeration. The sampling work was done with great care, in fact, with plane table operations with the help of surveying instruments. The combined under-estimation (due to both non-reporting of fields, and under-statement of crop area reported) was about 9.5 per cent for paddy rice, 20 per cent for mixed cereals, more than 26 per cent for sweet-potatoes and fully 35 per cent for upland rice.

RECENT CHANGES IN ATTITUDE

In recent years the sampling method has won increasing recognition all over the world. In 1947 the United Nations established a Sub-Commission on Statistical Sampling which has already met three times in 1947, 1948 and 1949 and has issued three reports covering a very wide field. In India also there has been a distinct change of attitude. The Goverment of India are seriously considering the possibility of using sampling methods in the field of Agricultural Statistics. This has been brought about partly no doubt by the increasing prestige of the method outside India. But it is also symptomatic of a deeper change. The Government of India are giving increasing attention to the all-round improvement of the statistical services of the country. This in its turn is due to a growing awareness of the urgent need of unified economic policy and action on the part of Government. It is the urge of solving vital national problems which is giving real strength to the progress of statistics in India. I shall now turn to some of these problems.

THE FOOD CRISIS IN INDIA

The biggest single problem in India at present is the shortage of food supply. On the 28th November 1949, Jawaharlal Nehru, the Prime Minister of India, is reported to have declared "I desire to make it perfectly clear that whatever happens, whether there is a cyclone or an earthquake, we are determined to stick to the target date of 1951, after which we shall not import food grains for our consumption." He stated that this decision had been forced on the country by the pressure of events, for no country could continue to live beyond its means which of course meant its production in its fields or its factories.

I shall try to give a statistical commentary on the Prime Minister's statement. This will serve two purposes. It will show how Statistics comes into the picture, and how Statistics can help in solving the problem. It will also show how inadequate is the available statistical information, and how much it requires to be improved. The figures quoted by me are, therefore, necessarily illustrative.

INCREASING PRESSURE OF POPULATION

The food position can be judged only in relation to population and other resources of the country. We know the total geographical area of the Indian Union. It is about 1.22 million sq.miles or 780 million acres. [3.159 million sq. km.] As regards the population, the last decennial census was taken

in February 1941. Since then conditions has been abnormal owing to war, the famine in Bengal in 1943, and the partition in August 1947 with subsequent large shifts of population. On the available information, the total population at present would seem to be something between 34 and 35 crores (340 and 350 millions).

The density of population is thus very high, something like 290 per square mile, which is bigger than the density in most countries of the world with the exception of the highly industrialized countries in western Europe, and Japan. If we consider the individual share, in India we have only about 2.25 acres per head. The total area of cultivation in India is not known accurately. It is probably something like 35 or 40 per cent of the whole area. The share of cultivated land is thus well below one acre per head. In comparison, China presumably has about 6 acres, the United States about 13 acres, and the U. S. S. R. nearly 28 acres for each individual. The pressure on land is many times greater in India compared to other countries with a large population.

The population is also increasing at a rapid rate. Between 1931 and 1941 the rate of increase was about 1.4 per cent for the Indian Union.[11] If this rate is being maintained, the population of India is increasing at present by nearly five millions every year. This is more than the total population in each of about 24 or 25 member States of the United Nations. Owing to the adverse conditions created by the war and the partition of India, the rate of growth may have slowed down. If it is only 1 per cent, the increase is still something like 3.5 millions per year. During the 40 years between 1901-1941, the average rate of increase was about 1 per. cent in undivided India and over 0.8 per cent per year in the Indian Union. Even at this lower rate, the increase would be about 3 millions per year.

INADEQUACY OF FOOD STATISTICS

About population we have some information. The position is much worse about food Statistics. In one province, West Bengal (covering only about 2.5 per cent of the total area of India), statistical sampling is being used and can be depended upon to supply estimates of the production of rice with a margin of uncertainty of about 2 per cent. For roughly half the total area of India, reports are available from *patwaries* (village revenue staff) or *chowkidars* (village watchmen) but nothing known about their accuracy as no objective checks have been made. In roughly one-fifth of the whole area, reports are received from the State authorities, but nothing is known about the primary agency. No reports whatsoever are available about the food production for the remaining 30 per cent of Indian Union, and a conventional figure is written down every year in New Delhi. In spite of the Grow More Food campaign conducted for several years, according to official estimates of the Ministry of Agriculture, apparently no appreciable increase has occurred in the production of food. It is best to confess that we do not know the real position.

CRITICAL BALANCE BETWEEN FOOD AND POPULATION

There is some indirect evidence. Actuarial estimates on the basis of the decennial censuses between 1881 and 1931 show that there has not been any appreciable increase in the expectation of life at birth which hovered round or below 25 years during this period. This suggests that, although population increased at a rapid rate, there was no over-all improvement of the vitality of the people. No information is available for the 1941 census, as age-tables were not prepared. These are, however, now being constructed in the Indian Statistical Institute on the basis of the 2 per cent Y-sample.

The famine in Bengal in 1943 was also an ominous indication. From the information collected by the Indian Statistical Institute in the course of a sample survey of famine conditions, I believe the total number of deaths was something between one-and-a quarter and one-and-a half million. The total loss (killed and missing) in the second world war was about 330,000 for the U.S.A., and 300,000 for the United Kingdom.[12] Thus the famine casualty in Bengal was double or more than double of the total war casualty of the U.S.A and the U.K. taken together. It may be noted that in 1943, the area of the undivided province of Bengal was about 78,000 sq. miles, and the estimated population about 63 millions. The density was thus of the order of 800 per sq. mile, which was higher than that in even the most highly industrialized countries of the world. The terrible pressure of population was no doubt a predisposing factor in the famine[13].

INCREASING FOOD IMPORTS

Some further indirect information is available from export and import Statistics. Before the separation in 1937, Burma provided an abundant supply of rice. During the first two or three years of the war, the net import was negligible as the following figures will show.

Net import of cereals per person

Financial Year (1)	Extrapolated population in millions (2)	Net import of cereals in millions tons (3)	Import in lbs per year per person (4)
1941–42	390.3	0.43	+2.5
1942–43	395.4	–0.29	–1.6
1943–44	400.4	0.33	+1.8
1944–45	405.5	0.73	+4.0
1945–46	410.6	0.93	+5.1
1946–47	415.7	2.42	+12.9
1947–48	335.2	2.18	+14.6
1948–49	337.9	2.78	+18.4

1. Population figures for undivided India were calculated by linear extrapolation with the observed growth rate between 1931 and 1941. Figures after partition (15 August 1947) are based on the *Census of India, Paper* No. 2.
2. Up to 1942-43, net imports in col. (3) and taken from the *Food Statistics of India* (1946) published by the Food Departement; from 1943-44, the figures are taken from *Indian Food Statistics* (August 1949) published by the Ministry of Agriculture, Since 1943-44 the figures relate to rice, wheat, maize, millet, barley and wheat flour, with a few minor variations.

In 1943-44, the year of the Bengal famine and the first year of introduction of food rationing, the net import was quite small and only about 1.8 lbs. per head per year. During the last five or six year the position has grown steadily worse. The net import rose to about 18 lbs. per head in 1948-49, and expenditure incurred was something like Rs. 120 or 130 crores (about £100 million sterling). The significance of this figure can be appreciated when it is recalled that the total revenue budget of the Government of India in 1949-50 is of the order of Rs. 320 crores (£ 240 million sterling).

Another aspect of the problem is even more serious. If the food production and the home consumption remain constant, then the surplus coming to the market would also remain constant. In this situation, the total import should increase in proportion to the growth of population. In actual fact the import rose from 0.33 million tons in 1943-44 to 2.78 million tons in 1948-49. This was, no doubt, partly due to the cessation of supplies from Pakistan which was a surplus area. In any case, the supply coming into the market (through procurement or otherwise) has been steadily

decreasing. This is the most alarming feature of the present situation.

STATISTICAL BASIS OF A RATIONAL FOOD POLLICY

What is the solution ? There is obviously no single remedy. The problem has to be attacked on many fronts, and statistics can help on all fronts. I shall briefly try to indicate the magnitude of the task. First, every effort must be made to increase the crop production. Fertilisers, improved seeds, irrigation, and better methods of cultivation are already being used and must be pushed much further. Experimentation at the research level in agricultural field trials must be continued and developed with closer gearing to actual conditions of cultivation. Another possibility is the improvement of varieties through fundamental research in genetics. The spectacular increase in the yield of maize in the U.S.A. is a striking example of the success of such researches. Rice offers a promising field for similar work, and an increase of 25 per cent or 30 per cent in the yield is a definite possibility. Well-equipped centers for the study of rice genetics should be, obviously, established without delay. Here Statistics can render effective help. In fact, in the field of agricultural experimentation and genetics, powerful methods like the design of experiments, the analysis of variance, and the theory of estimation are already available.

INCREASING DIFFICULTIES IN THE FUTURE

It is certainly necessary to attain self-sufficiency in food in 1951. But this is not enough. The production of food must keep pace with the growth of population. But not only food, it is also necessary to produce new houses, clothes, and thousands of other things in increasing quantities. Production must keep pace with population. The future trend of population in India is, therefore, a matter for serious concern. Available evidence indicates that at the existing level of production, the balance has already become adverse. A further and continual growth of population without a commensurate growth in the means of production will be disastrous. The only way is to develop our national resources.

INDUSTRIAL DEVELOPMENT

Rapid industrial development is one possiblity. Government have already started work on a number of big multi-purpose dams for both irrigation and power. A beginning has also been made with machine tools and other basic industries and heavy chemicals. The building of houses, electricals, and other innumerable industries (including production of consumer goods) must be stepped up. All this would require capital goods in the way of plant and equipment, land and buildings, and labour.

It will be useful to obtain even a very rough idea of the capital requirement. The ratio of the gross value of the annual product to the capital investment varies widely from one industry to another. The ratio would be small in the case of iron and steel or basic industries ; the gross value of the annual product may be something like one-third, or one-fourth, or even one-fifth of the invested capital. In electricals and lighter industries the ratio may be unity or even higher. Unfortunately very little information is available. At a rough guess the over-all value of the ratio is likely to be something between half and unity. It may be noted that the over-all ratio of the annual value of the product to the invested capital is about 1.6 in the case of the industries covered by the Industrial Census of 1946 (Ministry of Industry and Supply). It must be remembered, however that most of the capital investment took place long ago, while the annual product was valued at 1946 prices. If the value of the plant, machinery, and building is re-

calculated at 1946 or current prices, the total amount of capital investment would be much higher than that actual shown in the returns. That is, the ratio would certainly fall much below 1.6.

It is also necessary to take into consideration what the economists call the "multiplier" effect. To put it crudely, the multiplier stands for the additional value of products, and business and other activities stimulated by the increase in the primary product. (For example, an increase in the production of steel and cement may be expected to lead to an increase in the building of houses and construction work and other industries in an indirect way). No information is available about the value of the "multiplier" in India. It is sometimes guessed that the multiplier may be some-thing like 1.5 or so. To get a dimensional figure, we may perhaps assume that an investment of, say, one crore of rupees would lead to an increase of an equal amount in the national product (inclusive of the "multiplier" effect). The actual ratio may be some-what higher or somewhat lower, but this would give a rough dimensional picture. It is assumed, of course, that the new capital investments is not in competition with existing investment that is, does not diven any of the factors of production from existing modes of production.

Consider the implications. To increase the value of the national product by one rupee per head per month or, say, twelve rupees per head per year, it is necessary to invest 420 crores of rupees (= Rs. 12 × 35 crores) or £ 310 million sterling. Compare this figure with the budget of the Government of India which is something like Rs. 320 crores (£ 240 million sterling) in 1949-50. Even if this whole amount is used for industrial development, the value of the national product is not likely to increase by more than, say, twelve annas or a rupee per head per month. It is clear that the Government of India alone can do very little. The industrial development of India depends entirely on the efforts which the people of the country are prepared to make.

THE NATIONAL INCOME

The next question which arises is the extent to which the people can afford to contribute to industrial development. Investing one rupee would bring a return of one rupee in future years; but whether one can afford to invest even one rupee depends on his income. This brings us to the question of the national income of India. Little reliable information is available. [Pioneer work was done by Dr. V. K. R. V. Rao who gave in 1940 an estimate of the national income for 1931-32; and in 1944 gave a tentative estimate for 1942-43. No authoritative estimates for recent years are yet available. Again one can only guess. Perhaps, the monthly income is Rs. 12/- or may be Rs. 15/- per head. We do not know, but this may be the right order. We have also the other guess of "a rupee for a rupee" that is, a future national product of one rupee for a present investment of one rupee. The choice is definitely between jam today and jam tommorrow. We cannot have both. Indeed, unless we save and invest for the future, we may have less and less in future.

THE STATISTICAL POSITION

With meagre material I have constructed a dimensional picture which is admittedly very rough. It will have served its purpose, if it has conveyed to you some idea and the magnitude of the task in front of us. Secondly, if it has made you feel the urgent need of having more and better Statistics. Along with the efforts to increase food production, attempts must be made to improve the Statistics not only of the production of food but of its consumption and distribution. A gap of 10 years between population censuses is no longer tolerable. It is necessary that we should have information

about the growth of population every year. We require information about the distribution of income and expenditure in different sectors of national economy, and in different strata of the population. We must, in fact, set about earnestly to develop a comprehensive system of social accounting for the whole nation.

Of capital requirements I have given a sombre picture. In one sense it is, however, not as dark as it looks at first sight. The capital investment is broadly of three kinds. First machinery and equipment (and technical personnel) which we must import from abroad and must pay for ultimately in hard cash. Secondly, land and water, minerals, forests, livestock and animals, which we have or which we can produce in India. And finally, man-power and labour which we have in abundance. In the beginning, the share of imported equipment from abroad must be necessarily heavy; but as the basic industries develop, this item should become smaller and smaller. The other two items, man-power and material resources, are our own. The imputed value entering into the capital account is, in a real sense, a matter of book-keeping. We can make what we like of these items. It the people and the Government are united in one common endeavour, then the human labour and the material resources in the country are completely at our disposal for national development.

If the statistical picture I have placed before you is not hopelessly wrong, then we are in difficult times and are probably facing greater diffculties than we have ever done in the past. The untied effort of the Government with the people can save us. Such united effort can be brought about only by concerted action. To prevent waste of money, effort resources, and most critical of all, to prevent, any further waste of time planning on a national scale is essential.

NATIONAL PLANNING

National planning has several aspects. First there is the preparation of plans at the technical level requiring the help and cooperation of workers in every branch of Science and technology. Statistics is indispensable at this stage for the supply of basic information. Secondly, the individual plans have to be built into a general plan. Here Statistics is the common denominator, and supplies the common binding medium for the whole. Thirdly, the plan has to be implemented. At this stage also, Statistics can help in two ways. Firstly, by establishing scientific controls to ensure that the programme of action proceeds on efficient lines. Secondly, by conducting continuous assessments of the results by keeping account of the input of money, effort, and resources, and measuring what is obtained in return. The process is never-ending. In the actual working of the plan, defects are revealed, and new possibilities emerge requiring consequential changes. Statistics is again invaluable in diagnosing weaknesses, in guiding controlled experiments, and in suggesting improvements. Statistics is thus pivotal in the dynamics of national planning. I hope you have now received a proper answer to the question : Why statistics ?

RECENT DEVELOPMENTS IN INDIA

As I have already indicated, the progress of Statistics must depend upon and is closely detemined by socio-economic trends. In India, we have seen during the last one year, hopeful signs of advance. A standing Committee of Departmental Statistics with representatives from the different Ministries of the Government of India was established in October 1948. A Central Statistical Unit was created, under the charge of a Statistical Adviser to the Cabinet, on the 28th January 1949. For the first time, a permanent office for the Census and Vital Statistics was estblished under a Registrar-General and ex-officio Census

Commissioner in May 1949. A first comprehensive report on the industrial census of 1946 was published in July 1949. A national Income Committee was set up in August to review the position in this field and to make such estimates as may be possible. And the Central Statistical Unit was converted into a Central Statistical Organization on the 21st December 1949. All this indicates a move towards a more comprehensive review and formulation of the economic policy of the country. We may also hope to reach again, of course, in a more modern form, the state of development in Statistics which was reached in India in the days of the survey of Eastern India in early 19th century, in the days of Akbar at the close of the 16th century, or in the days of Asoka in the third century B. C.

THE CHOICE BEFORE US

Our population is a great asset, but only in a potential form. In India we have every year a vast quantity of water in the form of rainfall. Most of it is wasted. Sometimes, in times of flood, it becomes a menace. But, by building dams and hydrels we can put it to work, and make it a source of power for fruitful production. In the same way, our vast man-power is at present lying mostly stagnant. A great deal remains idle, and a great deal is wasted in inefficient production. Perhaps it is wise to remember that, out of control, it may also become a menace fraught with grave dangers of self-destruction. But, if we can harness this living reservoir of power, there is nothing which we cannot accomplish.

So far attempts have been made to hire this power in a market place. We should think seriously whether we have the means, or the time to continue to do so. Conditions are changing rapidly. It is a matter for serious thought whether or not the wiser policy would be to rally the common man into a great effort for national welfare. We look to our political leaders for guidance, decision, and action.

In a national plan, scientists and technologists also have to make their contributions. They can give the labour of their thought, and by the skill of their research and experimentation, show how to overcome difficultics and open out new possibilities. The statisticians have a humble role, but they also can help in reaching vital decisions. To this great task I call all my friends and colleagues.

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CHROMIUM : ROLE IN DIABETICS

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Diabetes, a widely prevalent disease due to impaired carbohydrate metabolism, is associated also with changes in chromium levels in affected individuals. Organically bound forms of trivalent chromium have an insulin potentiating effect and can ameliorate diabetes. Relevance of chromium complexation of amino acids in the mode of action of chromium is discussed.

INTRODUCTION

Chromium is the seventh most abundant element on earth. Soils contain between 5-3000 μg g^{-1} of chromium. Chromium exists in two major, stable oxidation states. These are trivalent (+3) and hexavalent (+6) chromium. Of the two, hexavalent chromium is extremely toxic. Trivalent chromium is more common in living tissues and in food materials. It is much less toxic. Metabolically also the two forms are different and organisms may handle them differently. For example, chromate is toxic to the mold *Neurospora crassa* and is transported into the cell *via* the sulfate transport system and its toxicity is counteracted, accordingly, by sulfate ; in contrast, trivalent chromium is transported via the iron transport pathway[1]. Some, but not all, organisms can convert one form to the other, *in vivo*.

Although chromium was identified as a nutritionally required element around the late 1950's and there is evidence that it plays an important role in carbohydrate metabolism, many gaps exist in our knowledge regarding the exact chemical nature of the form (s) in which it is active in living organisms and the mechanisms by which it influences metabolism. In certain aspets, chromium remains an enigma. From the human health point of view, the most investigated, though not still fully understood, aspect is the connection between chromium and diabetes.

Chromium is present in small quantities in a wide range of foods. Yeast is unusual in that upto ~80% of its intracellular chromium is present in what is usually referred to as "*organically bound*" form which may consist of a mixture of trivalent chromium complexes. Of these, the best known and the first to be characterized has been the glucose tolerance factor (GTF), a complex containing glutamic acid, glycine, cysteine and nictonic acid, bound to a central chromium atom[2]. In fact, it was the isolation of GTF by Schwarz and Mertz[2] and their demonstration that it is a dietary agent required to maintain normal glucose tolerance in mice, that was instrumental in chromium getting recognition as an essential trace element.

BIOLOGICALLY ACTIVE FORMS OF CHROMIUM

While GTF is active in animal systems, it is believed that the biological role of chromium, in yeast cells, is also mainly connected with carbohydrate metabolism[3]. A chromium-NADP complex has been isolated from yeast subsequently[4] ; it does not, however, account for the biological acitivity of "organically bound" chromium of yeast.

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GTF, though mechanisms not yet defined, is capable of enhancing the biological efficiency of insulin. A time requirement of four hours following GTF administration for a measurable effect on insulin action suggests that GTF triggers a complex series of events that ultimately potentiate insulin action[5].

Yet, there has been some controversy regarding the roles of chromium as well as GTF. A naturally occurring, Low Molecular Weight Chromium binding substance, and hence referred to as LMWCr, has also been isolated from mammals. This contains glutamate, glycine and cysteine bound to chromium. LMWCr has also been found to be active in potentiation of insulin action[6].

CHROMIUM AND DIABETES

There exists, therefore, evidence which implicates chromium as a critical cofactor in the action of insulin. It has been variously suggested that chromium enhances insulin-binding, insulin receptor number, insulin internalization and β-cell sensitivity[7]. Such findings establish a link between chromium and diabetes. The best evidence comes from the studies conducted with a patient receiving Total Parenteral Nutrition (TPN), who developed severe signs of diabetes, including weight loss and hyperglycemia that was refractory to increasing insulin dosage[5]. Thereafter, following chromium supplementation for two weeks, signs and symptoms of diabetes were ameliorated, with markedly improved glycemic status, and greatly reduced insulin requirements. These pronounced effects of chromium in TPN have been confirmed and chromium is now routinely added to TPN solutions[7]. Such studies have led to the belief that chromium is beneficial to persons who are chromium deficient.

It is relevant to note that diabetes is essentially a metabolic disorder. Insulin is required at appropriate levels to transport glucose from blood into cells for growth and as a source of energy.

There are three types of diabetes. In insulin-dependent Diabetes mellitus, known as Type–I Diabetes, production of insulin is nil or severely reduced ; such persons must have daily injection of insulin. In non-insulin dependent or Type–II Diabetes which is a great deal more prevalent in adults over forty years of age, the pancreas does produce some insulin but the body is unable to utilize it effectively. The last type of diabetes is known as "Gestational Diabetes" which develops during pregnancy. Present evidence suggests that chromium greatly affects management of diabetes especially of Type–II[7].

Reduced chromium levels have been reported in the elderly and in patients with diabetes[7]. This study examined serum samples from more than forty thousand patients. It has been suggested that low chromium concentrations and the concomitant impairments in insulin and metabolism could also enhance cardiovascular risk[8].

In view of such findings, the role of chromium in carbohydrate metabolism and as an insulin potentiating factor assumes great importance.

MODE OF ACTION OF CHROMIUM

That chromium is functional in "organically bound" form, rather than free inorganic form, is undisputed. The form(s) in which it is most effective *in vivo*, their biological activities and the underlying mechanisms are aspects which are not as clearly established. GTF and LMWCr are the two forms wherein chromium is complexed to amino acids : of the two, only GTF has nicotinic acid also. However, the number and nature of ligands that are needed to generate biologically active form(s) of chromium is unknown. Nicotinic acid is a part of GTF, but chromium complexes of nicotinic acid alone, which have been synthesized, are found to be unstable near neutral pH and without any GTF–like activity[9]. On the other hand, chromium picolinate (CrP) benefits diabetics (Type–II) significantly on long term administration[10] and is a

popular dietary supplement. Picolinic acid is an isomer of nicotinic acid. However, while CrP ameliorates diabetes, fears exist that it may be mutagenic.

Recently, a $Cr(pa)_3$ complex (Pa = D-phenylalanine) has been synthesized and found to enhance insulin stimulated glucose uptake in mouse 3T3 adipocytes[11]. Therefore chromium picolinate as well as $Cr(Pa)_3$ have biological effects similar to those of the structurally more complex GTF and LMWCr, which have a multiple number of amino acid ligands complexed to trivalent chromium ; in neither case, however, are the exact structural features of the complex known. Despite the obvious diversity two features stand out. Firstly, whatever the exact mechanism, the end result is stimulation of glucose transort at the cellular level ; in animal systems this is insulin dependent.

Secondly, it is remarkable, in this scenario, that the major role of GTF in yeast, is also enhancement of glucose utilization, by stimulating transport of glucose, at least in part. Yeast is a simpler system, therefore, wherein it would be possible to examine the metabolic effects of amino acid–chromium complexes which could be considered as structural components, or even, in one sense, models of GTF. Such studies could provide answers to unresolved questions like the minimal number and nature of amino acids that would need to be complexed to trivalent chromium to yield metabolically active molecules.

Recent work from this laboratory has shown that, indeed, simple binary (1 : 1) Amino acid–Cr(III) complexes have very remarkable biological activities. A binary complex *l*-phenylalanine–Cr(III), (PHCr), has been synthesized and found to be capable of being utilized as a sole carbon source far more efficiently than free, uncomplexed phenylalanie by *Saccharomyces cerevisiae*[12] ; the effect of complexation with trivalent chromium is a stimulation of metabolism of the carbon skeleton of the amino acid. Also, when exogenously added to yeast growing on glucose medium, PHCr was found to enhance glucose utilization–a GTF like activity.

Another striking effect also observed for the first time in this laboratory, has been the ability of lysine–Cr (synthesized by reacting lysine with chromium sulfate in equimolar proportions) to function as a very good nitrogen source for *S. cerevisiae*[13] ; this, again, is in sharp contrast with free lysine, which (when provided exogenously) cannot support growth of yeast as a sole nitrogen source[14]. In this case, complexation of an amino acid with chromium has a profound effect on nitrogen metabolism. The only other comparable example, todate, is stimulation of uric acid uptake, and enhanced growth due to chromiumuric acid complexes in *Nrurospora crassa*[15].

Such phenomena serve to show that chromium complexation with some bimolecules like amino acids (and purines) has marked effects on transport and metabolism of liganded molecules, the nature of which depends on the complexed molecules. Trivalent chromium taken up by cells apparently can form complexes with intracellular molecules and then modify metabolic patterns. Understanding the intricacies of chromium metabolism may well lead to better management of diabetes and to health benefits.

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DO YOU KNOW ?

Q1. How do we know that Himalayas have risen from the sea ?

Q2. Did planet Earth began as a hot or a cold body ?

AN OVERVIEW TO EARTHQUAKE TECHNOLOGY AND COUNTER MEASURES

Harish Chandra Arora*

The devastating earthquakes during the past decade have generated a lot of concern in the common man about seismic safety of their houses in rural and urban areas. This fear has led to serious debate about construction practices in the country. There is an urgent need to encourage earthquake resistant construction in order to reduce the devastating consequence in the event of an earthquake. The present paper summarizes some general features of earthquake resistant constructions.

INTRODUCTION

Urban seismic risk is steadily increasing worldwide, especially in developing countries. Among the reasons for this increase are urbanization, lack of planning and resources to accommodate rapid urban growth, lack of appropriate building and land-use codes or lack of mechanisms to enforce them, and most importantly, lack of awareness by the community and its leaders. This lack of awareness has kept communities, institutions and citizens from supporting risk management initiatives. The World Bank estimates that frequency of earthquakes, volcanic eruptions etc has increased in recent years due to the Greenhouse Effect caused by increased CO_2 emission.

Almost half of the world population lives in cities, where all kinds of human activities are concentrated. Thus, cities are more and more vulnerable to disasters, particularly to earthquakes, which can strike any city suddenly without warning. Once an earthquake takes place in a large city, the damage can be tremendous both in human and economic terms. Even an intermediate earthquake can cause devastation of a city as happened in the cases of the 1995 earthquake in Kobe, Japan and the 2001 earthquake in Bhuj.

CONSTRUCTION TECHNOLOGY PREVALENT IN INDIA

In India, load-bearing masonry is the most (>75%) prevalent material of construction for houses and other buildings in semi-urban and rural areas. Even in urban area many (≅ 50%) buildings are also of load bearing masonry type. It is well known that masonry has poor resistance against earthquakes unless provided with some strengthening arrangements. In India building stock is a mixture of various building technologies. Building categories may roughly be categorized as follows.

- Reinforced concrete frame building with partition walls.

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- Brick masonry buildings with reinforced concrete roofs and using cement mortar.
- Informal brick masonry buildings (which may or may not use brick mortar).
- Buildings of other materials such as tin sheets, thatch and other lightweight materials.

The first two come under engineered constructions in which qualified engineers provide suggestions at every stage of their construction and these constructions are expected to comply with the appropriate codes and standards. The other two are non-engineered constructions in which services of engineers and skilled labors are not utilized. Most of these types of buildings are designed without any detailed analysis and may also be of very poor quality. These are expercted to behave very poorly in the event of an earthquake. Among these, lightweight buildings are expected to trap fewer people, leading to lower casualty.

In India, however, a number of reinforced and brick masonry constructions exist and are also presently designed and constructed without the assistance of qualified engineers. These may perform worse than expected during earthquake and as a result these buildings also come under the category of non-engineered constructions. More over, many engineered constructions which are very old and may have exceeded their useful service life and may have deteriorated very badly.

HISTORY OF EARTHQUAKES IN INDIA

A number of significant earthquakes occurred in and around India over the past century. Some of these occurred in populated and urbanized areas and hence caused great damage. Some of the damaging and recent earthquakes are listed in **Table–1**.

Table–1 : Earthquakes in India during 1991–2001

Place	Year	Magnitude	Deaths (Approx.)
Uttarkashi	1991	6.6	1500
Latur	1973	6.4	9000
Jabalpur	1997	6.0	40
Chamoli	1999	6.8	100
Bhuj	2001	6.9	20000

**This is a quantitative measure of the actual size of the earthquake.*

In the past considerable destruction was caused by earthquakes in Delhi (1670), Calcutta (1737), Eastern Bengal (1862), Kutch (M8.0, 1819, Toll 1500), Kashmir (M8.0, 1885), Shillong (M8.7, 1897, Toll 1500), Kangra (M8.5, 1905, Toll 20000). Dhubri (M7.1, 1930), Bihar-Nepal (M8.3, 1934, Toll 11000), Assam (M8.6, 1950, Toll 1530), Koyna (M6.3, 1967, Toll 200), Bihar-Nepal(M 6.6, 1988, Toll 1004). More than 700 earthquakes in excess of magnitude 5.0 have been recorded since 1890. There were more than 110 earthquakes of magnitude 7.0 or intensity VII on Modified Merclli (MM) scale, i.e. which have caused collapse of houses. There were more than four great earthquakes in a span of 53 years from 1897 to 1950. It is estimated that over 50% of the Indian landmass is subjected to varying degrees of earthquake shocks.

India was the first country to prepare a standard code of practice for non-engineered buildings protection in 1967 but the implementation outside the government sector has not taken place. India loses more than a million housing units (about half percent of 195 million existing units) each year due to earthquakes which put a severe strain on the development efforts due to the cost of relief, rehabilitation and reconstruction.

Fifty to sixty developing countries are extremely susceptible to natural disasters. Obviously, citizens

of poor nations run the highest risk of death during natural disasters. In addition to inadequate design criteria, deficiencies in the structures are also caused by lack of quality assurance both in the construction stages as well as in the evaluation process for issuance of building construction permit. Majority of masonry and some of the RCC houses are not designed and constructed properly and may be subjected to heavy damage during an earthquake. According to vulnerability Atlas of the country, more than 80% houses are non-engineered construction, which are mainly load bearing buildings and many R. C. framed buildings also are constructed ignoring the codal provisions with reference to earthquake resistance criteria.

DISASTER PREVENTION

The most important theme in disaster counter measures is its prevention. Being careful can sometimes prevent major fires ; however just being careful will not prevent major earthquakes from occurring. A disaster prevention countermeasure for earthquakes would be to build an earthquake resistant structure based on a hypothetical earthquake and to implement countermeasures and drills predicting the coming of an earthquake as early as possible.

Although it is not possible to prevent earthquakes, it is possible to avoid or eliminate some of their dangerous effects. Structures can be built to reduce the possibility of collapse and resulting injury or death to occupants. Fire damage can be reduced by proper precautions, such as automatic shutoffs on gas lines. These are just two examples of the efforts of government agencies towards reducing loss from earthquakes. Similarly individuals can also do to increase personal safety and reduce financial loss during earthquakes.

ROLE OF DESIGN

A carefully designed building is the best survival insurance available in earthquake prone areas and, thus, the role of a knowledgeable architect is invaluable. A good deal can be learned about the behavior of foundations, walls, floors, and ornamental elements during earthquakes from damage, incurred in the past tremors. The general principles to be observed in the construction of earthquake resistant buildings as specified in standards include lightness, continuity of construction, avoiding projecting and suspended proper parts, building configuration, strength in various directions, stable foundations, ductility of structure, connection to non-structural parts and finally, fire safety of structures.

IMPORTANT FACTORS FOR RISK REDUCTION

Many aspects of a building construction, which have influence over its performance during earthquakes, should be taken into consideration prior to construction. These factors are listed.

- *Structural form*— shape of plan, shape in elevation, number of stories, stiffness, percentage of openings, location of openings, foundations (depth, adequacy), design faults, type of roof. All elements of a building should be well connected. This includes the foundations to the rest of the building, as well as the floor and roof to walls. The walls should be adequately strengthened to resist rotation and consequent collapse of the structure.
- *Site planning*–pounding effect, slope effects, mutual stiffening effects, and local ground failure. Site selection will determine the type of foundation needed as well as the likely survival of a structure in a tremor.
- *Construction quality*–quality of building material, quality of workmanship, neglect of design specifications.

- *History*–age, pre-existing damage weakening structure, repair and maintenance of structure, modification to structure.

FUTURE CONSTRUCTION PRACTICES

For the future one can recommead the following.

- Construction of multi-storey buildings with open space, meant for parking vehicles need reconsideration.
- Buildings are to be designed/checked according to the latest code and there has to be awareness about earthquake engineering practices for future constructions.
- Quality of original construction as per various codal provisions and proper maintenance of building during passage of time are to be ensured.
- Training of building professionals on subject of disaster management should be encouraged.
- Involvement of qualified structural engineers for desinging/construction must be there.

Bureau of Indian Standards (BIS) in case of India is mainly responsible for documentation and publication of such magazine in the interest of citizens. BIS also have linkages with various research organizations like Council of Scientific and Industrial Research (CSIR) etc., academic institutions like IIT's and Universities etc. and other bodies like Ministry of Consumer Affairs and Public Distribution, Associated Chambers of Commerce & Industries of India. Various government agencies such as the MHRD, DST, UGC, CSIR, DAE, ISRO and others are spending, directly or indirectly, billions of rupees every year for research and development of disaster resistant construction. Indian Society of Earthquake Technology published a manual for earthquake resistant construction for non-engineered buildings in 1981 for wide distribution (ISET : 1991). BIS has brought out IS : 1893-1984, IS : 4326-1993, IS : 13827-1993, IS : 13828-1993, IS : 13920-1993, and IS : 13935-1993 as guidelines for improving the earthquake resistance for different types of constructions. Ministry of urban affairs and employment, Government of India has prepared the Vulnerability Atlas of India, covering floods, cyclones and earthquakes giving state wise maps and risk tables for all the districts of the country.

CONCLUSION

There is a need to realize the consequences of inappropriate choice of construction materials and technology. Similarly structural systems that comply with the appropriate codal provisions are found to behave much well during earthquake than deficient structural system. There is an immediate need to train engineers, builders, masons about the earthquake resistant design and construction practice so as to undertake the massive work of reconstruction, retrofitting and new construction. Public can be educated and encouraged to build their houses and buildings to be earthquake resistant. Similarly if the community buildings such as schools, dispensaries and lifeline structures as well as commercial buildings are made earthquake resistant in the first instance, it will help a great deal in providing timely help to the needy and the region affected will come back to normal activities very fast. Two-fold strategy should be used to mitigate the disaster due to earthquake. First should be preparedness to face such an event and second should be to make earthquake resistant buildings learning from our past experiences.

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DO YOU KNOW ?

Q3. What is Triskaidekaphobia ?

Q4. Can the Nobel prize be given posthumously ?

FACE RECOGNITION SYSTEM–A BIOMETRIC APPROACH

Kinshuk Majumder*

Information Technology has become an indispensable part of the e-sophisticated civilization in this millenium. As we become increasingly reliant upon the internet technologies like e-commerce, e-banking, e-finance, e-education, etc., the exploitation of these facilities by cyber criminals poses threat to the e-civilization. Identity validation for social welfare, crime detection, ATM access and computer security are the prime issues of this era. Face recognition has been evolving as a convenient biometric mode for human authentication over last two decades.

INTRODUCTION

Biometrics refers to the automatic identification or identity verification of living persons using their enduring physical or behavioral characteristics. Many body parts, personal characteristics and imaging methods have been suggested and used for biometric system : fingers, hands, feet, faces, eyes, ears, teeth, veins, voices, signatures, typing styles, gaits and odors. All of these biometric techniques are differentiated by speed, durability, reliability, and cost effectiveness.

Biometric technologies are becoming the foundation of an extensive array of highly secured identification and personal verification solutions.

IDENTIFICATION AND AUTHENTICATION BIOMETRIC SYSTEM

Identification is also called one-to-many (1 : n) comparison. It compares the current biometric data set against all other reference data of persons previously recorded in the system. The system identifies the end user from his/her biometric sample by associating it with his/her particular reference template based on a database search among the reference templates of the entire enrolled population.

Authentication (or verification) is also known as one-at-one (1 : 1) comparison. The verification procedure confirms whether the person in question is actually the person they claim to be. The system verifies the claimed identity of the user by comparing his/her biometric sample with one specific reference template, which is either physically presented by the user or pointed to in the database.[2]

ATTRIBUTES OF A BIOMETRIC SYSTEM

Components : Date collection, Transmission, Signal processing and Decision cum data storage are the major components of a biometric system.

Features : The important features of a biometric system are robustness, distinctiveness, accessibility, acceptability and availability.

Standards : ISO/IEC JTCI (world) DIN NI-AHGB & NI-37 (Germany) are the two organiszations who make standardization of biometric systems. At the moment, biometric standards are still in progress or have been submitted for standardization to ISO. Among the

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topics treated are–Biometric vocabulary and definitions, Biometric technical interfaces, Biometric data interchange formats and Profiles for biometric applications.[3]

Measuring factors : Some important factors necessary for efficient biometric system are accuracy, speed, uniqueness, reliability and data storage requirements.

- False Reject Rate (FRR)–It measures how frequently registered users are rejected by the system. The FRR of BioCert devices is currently about .01%
- False Accept Rate (FAR)–It measures how frequently unauthorized persons are accepted by the system due to erroneous matching. The FAR of BioCert devices is currently about .001%.
- Failure to Enroll Rate (FTE or FER)–It is the proportion of people who fail to be enrolled successfully.
- False Identification Rate (FIR)–It is the probability in an identification that the biometric features is falsely assigned to a reference.
- False Match Rate (FMR)–It is the rate at which non-authorized people are falsely recognized during the feature comparison.
- False Non-Match Rate (FNMR)–It is the rate at which authorized people are falsely not recognized during features comparison.[4]

BIOMETRIC : A FACE RECOGNITION SYSTEM

Working details : Face recognition technique is widely used to distinguish different features of human face by capturing the photo of a face by a camera from a specific distance. Three dimensional data of facial geometry can be obtained from stereo vision, structured light systems and scanning laser range finders. The resulting image is then reduced to a digital code.[5]

In facial recognition, an image of a person's face is stored digitally when the person opens an account. At each transaction, a tiny camera feeds a live image of the person to a database, which compares the image to the one stored and to the account number. It also depends on some factors like weather conditions, clenliness, etc. So, this system will allow identification (by comparing a face with the stored database), verification (by comparing the declared attributes with that of memorized area in the database), supervision (which allows to follow the image of the person in a video sequence), and surveillance (which allows to find, in real time, a person in a video sequence from a list of faces). Generally the system will locate individual's face very quickly and perform checking against the claimed identity.

Different methods of facial recognition are based on Eigenface, Local Feature Analysis (LFA), neural Network, Partitioned Iterated Function System (PIFS), Hidden Markov Model (HMM), Profile images, Elastic graph matching, template matching, etc. Eigenface is a real time recognition method and too sensitive also. LFA is based on location of different component of face i.e. eye, nose, mouth, etc. and generating their inter relationships. PIFS generates a region wise compact encoding of face. Templete matching process is based on the matching between reference template and the query image.[6]

Special features : Overall appearance of face may vary depending upon variability in scale, location, orientation, pose, facial expression, occlusion, lighting conditions, etc.

The following criteria should be taken into account while taking photo of a person for face recognition purpose.[7]

- Photo should be a colourful and natural one. Front view photo is only accepted, side

view or other type of views are not accepted (Fig. 1).

Fig. 1. Side view

- Eyes should be open and visible. Eyes should not be closed (Fig. 2) or partially covered by hair (Fig. 3). No flash reflection off the spectacle glasses (Fig. 4) and no tinted

Fig. 2. Eyes closed

Fig. 3. Eyes covered

Fig. 4. Flash reflection

lenses. If possible, person should avoid heavy frames and wear lighter framed glasses when the photo is taken. It is also noticed that the frame does not cover any part of the eyes.

- Face should be square on to the camera. Head should not be tilted (Fig. 5). Face is also not be partially covered (Fig. 6)
- Photo should be taken with a plain light coloured background. Dark clumsy background is not accepted (Fig. 7)
- Photo should be taken under uniform light. Shadow (Fig. 8) or flash reflection should not be encountered.

Fig. 5. Tilted head

Fig. 6. Face covered by hand

Fig. 7. Clumsy dark background

Fig. 8. Shadow photo

- Photos should be up-to-date, photos, which are older than 6 months are not to be accepted for verification.

- Normally photos are 35-40 mm in width.
- Face is neither too close (Fig. 9) not too far away, it should takes 70-80% portion of the photograph.
- Focus should be sharp and clear. Hazy photo is not accepted (Fig. 10).
- Person should be looking directly at the camera, Angular vision is not accepted (Fig. 11).
- Skin should tone naturally.
- Appropriate brightness and contrast are needed.

Fig. 9. Face too close

Fig. 10. Hazy photo

Fig. 11. Angular vision

- Photos should be printed on high quality photo paper with high resolution.
- Head should not be covered (Fig. 12) except for religious reasons. Face from bottom of chin to top of forehead and both edges of the face must be clearly shown.
- Mouth should be closed (Fig. 13)
- Photo must contain the person alone. No other person should be visible partly/fully in the photograph (Fig. 14).

Fig. 12. Head covered by hat

Fig. 13. Open mouth

Fig. 14. Not alone

- It is recomnended that the person should look at the camera with natural expression.

Advantages and Disadvantages :

Advantages :

(i) High speed of operation.

(ii) Does not bother the user during recognition process.

(iii) It provides a good performance even against disguises, weight changes, aging, or changes in haistyle or facial hair[1].

Disadvantages :

(i) Use of mask may result in the phenomena of "False Accept" which cannot be concentrated by video sequences.

(ii) Any kind of serious accident on face or undergoing a plastic surgery would definitely require system administration level updating of the database to avoid subsequent 'False Rejections'.

(iii) Negligible practical changes in face pattern may deceive the computer.

(iv) Whenever a network gets involved, compression and decompression have to be applied during transmission and reception of video signals also.

(v) Facial expression may change from time to time based on some environmental variables, human appearances, style, etc[1].

ERROR INCIDENCE AND SECURITY LEVEL

A perfect system would recognize a person 100 per cent of the time, and reject an imposter equally well. But, biometric samples are gathered from human beings in some uncontrollable environmental conditions. Biometric systems' accuracy is impossible to assess before deployment. Biometric systems fail in two ways : false match FAR (incorrectly matching a subject with someone else's reference sample) and false non-match FRR (failing to match a subject with her own reference sample). There's a trade-off between these two types of error[4].

CONCLUSION

Biometrics make the new security initiatives. Already various government and private sectors have taken such measures to tackle the problem of identification and authorization. Also they are implementing different biometric schemes and there are a number of commercial vendors who have been engaged in generating different biometric tools. A biometric system, when implemented with quality software, can be unique, accurate and speedy. It requires multimedia technologies for efficient image manipulation appliction for easy recognition purpose and data warehouse for storing large amounts of data. Modern compression and decompression techniques for transmission and storage of audio and video data are essential in this respect, to save bandwidth and memory usage.

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NON-CALORIC SUGAR FROM STEVIA PLANT BRINGING NEW HOPE TO THE DIABETICS

Deb Prasad Ray*

India is the largest consumer of sugar in the world and the country has a fairly high population of diabetic people (about 15%) in the age group of 25-45 which is increasing at an alarming pace. Due to sedentary life styles that we all tend to lead these days, the incidence of obesity and diabetic conditions is constantly increasing dramatically. This single factor we have come to understand would greatly contribute to increasing the number of diabetic people and related problems. Stevia extracts are considered to be free of calories, carbohydrates, sugars, fats and cholesterol. So, it can safely be used by the diabetic patients. Therefore, the cultivation of Stevia with modern agro-techniques is gaining importance in India and it has been selected as an alternative crop in many states of India including West Bengal with high return support to the farmers.

INTRODUCTION

Have you ever thought if there is no sugar in your kitchen in a very beautiful morning ? Your tea will be meaningless, your butter toast will be as non-sense as white bread and you will find your curry tasteless. So, a sweet-less day is unimaginable. Again, if you are diabetic patient, you have the idea of no sugar then no sweet life. But here is Stevia. Have you ever heard the name of a plant which yields sugar much sweeter than ordinary sugar ? It is Stevia. The botanical name of the plant is *Stevia rebaudiana.* It is relatively a new crop in the Indian Sub-continent and gaining very high popularity amongst all types of sweetener users as the most ideal substitute for sugar. In this age of changing life styles and people becoming more conscious of their health, the world wide sugar consumption is going down and is getting replaced by low calorie sweeteners. Many of these sweeteners are complex chemicals or many a time naturals as well.

BOTANY AND CHEMISTRY OF STEVIA PLANTS

Stevia is a member of the *Asteraceae* family. It is native to the valley of the Rio Monday in highlands of Paraguay, between 25 and 26 degrees south latitude, where it grows in sandy soils near streams[1]. It is a small shrubby perennial growing up to 65 cm tall, with sessile, oppositely arranged lance lanceolate to oblanceolate leaves, serrated above the middle. The flowers are small (7-15 mm), white and arranged in an irregular cyme. The seed is an achene with a feathery pappus[2].

CHEMISTRY AND COMPOSITION OF STEVIA SWEETENERS

Although interest in the chemistry of the sweetening principles dates from very early in the century, significant progress towards chemical characterization was not made until 1931. With the isolation of stevioside, secrecy of stevia was established[3]. From the extensive research it was

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revealed that the sweetening principle in stevia is due to natural sweet active components present in the leaves of *Stevia rebaudiana* that is Stevioside and rebaudiosides A, B, C, D, and E ; dulcoside A; and steviolbioside. Stevioside has a slight bitter aftertaste and provides 250 to 300 times the sweetness of sugar. It is at 200° (392°F), but it is not fermentable and does not act in browning reactions.

Treatment of stevioside with the digestive juice of a snail yielded three moles of glucose and one mole of steviol, while acid hydrolysis gave isosteviol[4]. Isosteviol was also obtained when steviol was heated in dilute sulfuric acid. Subsequent studies have led to the isolation of seven other sweet glycosides of steviol. Typical proportions, on a dry weight basis for the four major glycosides found in the leaves of wild stevia plants are 0.3% dulcoside, 0.6% rebaudioside C, 3.8% rebaudioside A and 9.1% stevioside.

Structure of Steviol, Isosteviol and Stevioside

The structure, stereochemistry and absolute configuration of steviol and isosteviol were established, through a series of chemical reactions and correlations over 20 years after the pioneering work of Bridel and Lavieille. Chemically, Stevioside is 10–O–glucopyranousyl–13–O–glucopyransyl (1, 2)-glucopyranosyl stevia (Molecular weight 804.2).

Structures of these and other diterpenes and diterpene glucosides are presented in Fig. 1. Concurrent studies on the parent glycoside indicated that on D-glucopyranose residue, hydrolyzed under alkaline conditions yielding steviolbioside, was attached to a carboxyl group while the other two were components of sophorosyl group bound to the aglycone through a α–glycosidic linkage.

Support for the proposed stereochemistry was achieved by the synthetic transformation of steviol into stevioside[5]. In 1993, spectroscopic data concerning stevioside and steviolbioside were published[6].

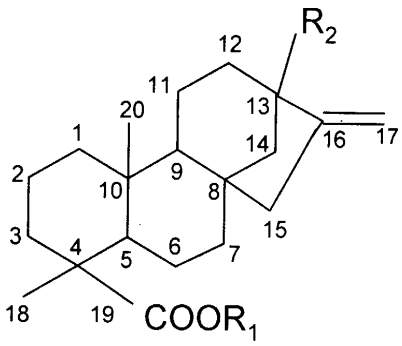

Fig. 1. Molecular Structure of Stevioside

Sweet components Contained in Stevia Extract:

COMPOUNDS	R1	R2
Stevioside	β – glc	$\beta - glc^{2}_{\beta}{}^{1} glc$
Rebaudioside A	β – glc	$\beta - glc^{2}_{3}\begin{matrix}\beta_1 glc \\ \beta_1 glc\end{matrix}$
Rebaudioside C	β – glc	$\beta - glc^{2}_{3}\begin{matrix}\alpha_1 rham \\ \beta_1 glc\end{matrix}$
Rebaudioside D	$\beta - glc^{2}_{\beta}{}^{1} glc$	$\beta - glc^{2}_{3}\begin{matrix}\beta_1 glc \\ \beta_1 glc\end{matrix}$

HISTORY OF USE

The Guarani Indians had known for centuries about the unique advantages of *kaa-he-he* (a native term which translates as "sweet herd")-long before the invaders from Old World were lured by the treasures of the New. These native people knew the leaves of the wild stevia shrub (a perennial indigenous to the Amambay Mountain region) to have a sweetening power unlike anything else ; they commonly used the leaves to enhance the taste of bitter mate (a tea-like beverage) and medicinal potions, or simply chewed them for their sweet taste. The widespread native use of stevia was chronicled by the Spaniards in historical documents preserved in the Paraguayan National Archives in Asuncion. Historians noted that

indigenous people had been sweetening herbal teas with stevia leaves "since ancient times." In due course, it was introduced to settlers. By the 1800s, daily stevia consumption had become well entrenched throughout the region–not just in Paraguay, but also neighboring Brazil and Argentina.

Like the discovery of America itself, however, credit for stevia's "discovery" goes to an Italian. In this case, the explorer was a botanist whose initial unfamiliarity with the region caused him to believe that he had stumbled onto a "little-known" plant.

Dr. Moises Santiago Bertoni, Director of the College of Agriculture in Asuncion, first learned of what he described as "this very strange plant" from Indian guides while exploring Paraguay's eastern forests in 1887. This area was not the herb's native 'growing ground.' Consequently, Bertoni, by his own account, was initially "unable to find it." It was 12 years before he was presented with tangible evidence—a packet of stevia fragments and broken leaves received from a friend who had received them from the mate plantations in the northeast. He subsequently announced discovery of the "new species" in a botanical journal published in Asuncion.

In 1970, the stevioside and other stevia products were introduced in Japan and the products quickly caught on. By 1988, they reportedly represented approximately 41% of the market share of potently sweet substances consumed in Japan. In addition to widespread use as a tabletop sweetener, like the packets of saccharin ("Sweet-n-Low") and aspartame ("Equal") commonly found in the United States, stevia was also used by the Japanese to sweeten a variety of food products, including ice cream, bread, candies, pickles, seafood, vegetables, and soft drinks.

AWARENESS AROUND THE WORLD

Stevia has a long history of safe usage with more than 150 safety studies and Government approvals in many countries across the world. For centuries, the native Guarani Indians of South America have been safely using Stevia. They have been using Stevia leaves to sweeten and enhance the taste of their food and beverages. For over 30 years, Stevia has been extensively used in countries like Japan, China and Korea as a Cane sugar substitute and also to replace low calorie artificial sweeteners. Stevia has been used in a wide variety of food products including sweets, confectioneries, ice creams, soft drinks etc. In so many years of its use, no harmful effects have ever been reported by the Stevia users. Today, Stevia is commercially grown and used in countries including Japan, China USA, Canada and Australia. Ministry of Health & Welfare, Japan, National Health Inspection Authority, China, Ministry of Health, Korea, US Food & Drug Administration (USFDA), Australian Register of Therapeutic Goods (ARTG), Australia and other fifteen countries across the world (including India) approve it which support the safety of stevia.

In India, it was simultaneously introduced in Pune as well as Banglore and the demand for high quality Stevia leaves is increasing dramatically day by day. The cultivation of stevia with modern agro-techniques is gaining importance in India and it has been selected as an alternative crop in many states of India with high return support to the farmers. Looking at the nature and agroclimatic conditions like climate, soil moisture and pH, the Government of India has proposed to build one each processing units in Western and Southern States. At the same time, its potential uses in contemporary Ayurvedic formulations is under active consideration by Indian Ayurvedic medicine

majors. This new crop would give Indian farmers a choice of a profitable and healthy crop to satisfy palates of eternally sweet toothed Indians.

COMMERCIAL EXTRACTION OF STEVIOL GLYCOSIDES

Most of commercial processing of stevia leaves occurs In Japan and there are dozens of patents describing method for the extraction of steviol glycosides. The extraction is based on solvent[7], solvent plus a decolorizing agent[8], adsorption chromatography[9] or ion exchange[10] and selective precipitation of individual glycosides[11]. The most favoured extraction process[12] involve four steps : aqueous or solvent extraction, ion exchange, precipitation or coagulation with filtration, then crystallization and drying. Recently, new method based on ultra-filtration have been developed[13].

DIFFERENT USES OF STEVIA

1. Stevia extract are considered to have few calories, carbohydrates, sugars, fats and cholesterol. So, it can be safely used by diabetic patients.
2. Stevia also acts as flavouring agent. It brings out true flavours in cereals, breads, icecreams, tooth paste and mouth-wash.
3. Stevia has also the potential of alleviating bleeding gums, sore throats and cold sores due to its mild antibacterial function.
4. It is used to aid digestion, losing weight and stimulating appetite.
5. The sweetening effect of these compounds is purely by taste, they are undigested and the body absorbs no part of the chemicals. They are, therefore of, no nutritional value.

One-fourth teaspoonful of dried leaves (finely ground) is claimed to have a sweetening value equal to one cup of sugar (Table 1.)

Table : 1. Comparison of Sugar , Stevia Concentrate Powder and the Liquid Stevia.

Sugar	Stevia Concentrate Power	Liquid Stevia
1 teaspoon	tip of toothpick	3 drops
1 tablespoon	1/2 pinch	7 drops
1 cup	1/4 tsp	48 drops

MEDICINAL PROPERTIES OF STEVIA

Stevia is a completely safe specific herb for diabetes and hypoglycaemia, a flavour enhancer, it contains a variety of constituents, besides the steviosides and rebaudiosides the nutrients and good deal of sterols, triterpenses, flavonoids, tannins. Stevia also contains an extremely rich volatile oil comprising rich proportions of aromatics aldehyde, monterpenes and sesquiterpenes. So far these constituents probably have some impact on human physiology and may help explain some of the reported beneficial therapeutic uses of stevia.

Blood-Sugar Normalizer

It is probably the presence of the steviosides themselves that has produced dozens of empirical and semi-controlled reports of antihypoglycemic action. In different places of the world, it is believed that stevia is helpful for hypoglycemia and diabetes because it nourishes the pancreas and thereby helps to restore normal pancreatic function. In semi-controlled clinical reports, one also encounters this action. Similar trends have been reported in humans and experimental animals by other workers. In Brazil, stevia tea and stevia capsules are officially approved for sale for the treatment of diabetes. Stevia shows a normalizing tendency to blood sugar i.e., it brings high blood sugar down, and raises low blood sugar, and has no effect on persons with normal blood sugar levels.

Cardiovascular Action

A good deal of experimental work has been done on the effects of stevia and stevioside on cardiovascular functioning in man and animals. Some of this work was simply looking for possible toxicity, while some was investigating possible therapeutic action. In neither case significant changes have been found, only thing observed was a slight lowering of arterial blood pressure at low and normal doses, changing to a slight rise in arterial pressure at very high doses. The most curious finding is a dose dependent action on heart beat, with a slight increase appearing at lower doses, changing to a mild decrease at higher doses. In neither instance is the result remarkable, and it is extremely doubtful that humans would experience any effect at normal doses. The long term use of stevia would probably have a cardiotonic action, that is, would produce a mild, beneficial, strengthening of the heart and vascular system.

Antimicrobial Action

The ability of stevia to inhibit the growth and reproduction of bacteria and other infectious organisms is important in at least two respects. First, it may help explain why users of stevia enhanced products report a lower incidence of colds and flu, and second, it has fostered the invention of a number of mouthwash and tooth paste products. Research clearly shows that *Streptococcus mutans, Pseudomonas aeruginos, Proteus vulgaris* and other microbes do not thrive in the presence of the non-nutritive stevia constituents. This fact, combined with the naturally sweet flavor of the herb, makes it a suitable ingredient for mouth washes.

Digestive Action

In the literature of Brazil, stevia ranks high among the list of plants used for centuries by the "gauchos" of the southern plains to flavor the bitter medicinal preparations used by that nomadic culture. For example, it was widely used in their "mate tea" (*Ilex paraguayensis).* Through much experimentation, these people learned that stevia made a significant contribution to improved digestion, and that it improved overall gastrointestinal function. Likewise, since its introduction in China, stevia tea, made from either hot or cold water, is used as a low calorie, sweet-tasting tea, as an appetite stimulant, as a digestive aid, as an aid to losing weight and even for staying young.

Effects on the Skin

One of the properties of a liquid extract of stevia, that has not yet been investigated experimentally, is its apparent ability to help clear up skin problems. The Guarani and other people who have become familiar with stevia report that it is effective when applied to acne, seborrhea, dermatitis, eczema, etc. Placed directly in cuts and wounds, more rapid healing, without scaring, is observed. (This treatment may sting for a few seconds, but this is followed by a significant lowering of pain.) Smooth skin, softer to the touch is claimed to result from the frequent application of stevia poultices and extracts.

Effect on Reproduction

One effect on reproductive physiology, which must await further research, is a healing effect on the processes underlying prostate disease.

OTHER NATURAL SWEETENERS

In addition to stevia, quite a few other natural products known for long as sweeteners with far better properties for our bodies than refined sugars or artificial sweeteners, listed in Table 2.

Table 2. Other Natural Sweeteners

Sl. No.	Natural Sweeteners	Details of the Sweetness
1.	**Agave**	Agave nectar is sweet syrup, like honey, but a little thinner in consistency. It is a great honey replacement for diabetics and low-glycemic dieters due to its low glycemic index and thus blood sugar in not elevated. Agave nectar is made from the juice of *Agave teuquilana.*
2.	**Barley malt syrup and powder**	A liquid sweetener that is reminiscent of molasses. Can be substituted for molasses in baking. Barley malt syrup metabolizes slowly in the body but does have calories and carbohydrates. Diabetics and low-carb dieters should use it with caution. Otherwise, it is fine for anyone who wants a whole-food natural sweetener.
3.	**Brown rice syrup**	Brown rice syrup is a liquid sweetener with the consistency of honey. It can be substituted for honey in baking. It has a unique caramel-like flavor that can be used to enhance a recipe, but it will disappear if used sparingly in a recipe, Brown rice syrup metabolizes slowly but does have calories and carbohydrates. Diabetics and low-carb dieters should use it with caution. Otherwise, it is fine for anyone who wants a whole-food natural sweetener.
4.	**Date Sugar**	Date sugar is made by simply dehydrating dates and grinding them up into a rather coarse, granulated-type sugar. It contains fiber and nutrients, just as fresh dates do, Although it will not dissolve very well in your cup of coffee it works very well, substituted cup-for-cup, in any baked-goods recipe that calls for brown sugar. Dates are 50 to 70 percent sugar by weight. The supersweet Deglet Noor variety contains the same sucrose as sugar cane. The Halawy, Zahidi and Khadrawy varieties contain invert sugar composed of dextrose and levulose, similar to that in honey. Though fresh dates score low on the glycemic index, dried fruits always score higher, and dehydration would make it score higher still, as the sugar becomes more and more concentrated. So it's not recommended for diabetics or those on a low- glycemic diet, but it's great for anyone else who wants a very unrefined close-to-sweetener.
5.	**Evaporated Cane Juice**	"Evaporated organic cane juice" is just that-the juice of the same sugar cane used to make refined white sugar, but in it's whole, natural state. Only the water is removed. As a whole food it still retains its vitamins and minerals. It also retains its natural balance of sucrose, glucose, and fructose instead of being straight sucrose. This is a dark brown sugar that contains molasses and has a slight caramel flavor.
6.	**Fruit Spreads**	Fruit spreads are like jam or preserves, but sweetened with concentrated fruit juice syrup instead of sugar. Usually these syrups are made from grape, apple, pear, or pineapple juice, or some combination of these. These are all natural, unrefined fructose. They are delicious and taste even better than the sugar-sweetened variety because the sweetener is more harmonious in character with the natural fruit.

Sl. No.	Natural Sweeteners	Details of the Sweetness
7.	**Honey**	Honey is "the nectar and floral exudations of plants gathered and stored in the comb of honeybees." It is a thick, sticky syrup that is 40% sweeter than sugar. It has a high glycemic index, so it is not recommended for diabetics or low-glycemic dieters. Honey comes in a wide range of colors and flavours-darker honeys having stronger flavours and lighter honeys more mild flavours. Honey is in perfect edible form in its natural state, requiring no processing. It was one of our first sweetener and highly prized around the world for centuries. It was our primary sweetener until the industrialization of sugar cane in the mid-1800s. Honey has many health benefits, particularly when eaten raw.
8.	**Maple syrup and sugar**	Maple syrup is a very sweet liquid sweetener, made by harvesting the sap from maples trees and boiling it down to a syrup. As continued boiling removes even more water, it turns into that nice, creamy maple sugar candy, and eventually into granules. It has it's own unique flavor that is well-known and well-loved. Maple syrup and sugar has a very high glycemic index and will make your blood sugar jump. So if you are diabetic or on a low-glycemic diet, stay away from maple syrup. Its fine for anyone else who wants a very low-processed natural sweetener.
9.	**Vegetable Glycerin**	Vegetable glycerin is derived from palm (coconut) oil. it is colorless, odorless, calorie-free, does not make blood sugar rise and is about half again sweeter than sugar. It is a liquid used in many cosmetic preparations and in commercial food preparations, but is not yet widely sold as a sweetener.
10.	**Xylitol**	Xylitol is a naturally-occurring sugar alcohol, not a sugar. The sweetener is found in many foods, including fruits, berries, mushrooms and lettuce. It is not a strange or artificial substance to our bodies, but is a normal part of everyday metabolism. Our bodies produce up to 15 grams of xylitol from regular food sources.

ADVANTAGES OF USING STEVIA

The advantages of using Stevia over conventional sweeteners are :

- Stevia leaves are 20-30 times sweeter than sugar.
- Stevia leaves can be dried and stored.
- Stevia can be used in raw form.
- Stevia is short duration crop. Similarly Stivia can be harvested 3 to 4 times a year for five years.
- Initial cost of establishment is high, 40000 plants per Acre and Rs. 5 per Plant.
- The yearly yields can be in the range of 4-5 tons stevia which an be sold @ 60-120 Rs per kilo of dried leaves.

CONCLUSION

India is not only one of the largest producer of sugar, but also one of the largest consumer of sugar. Sugarcane cultivation and processing requires

a huge amount of land and human resource. Moreover, sugarcane cultivation involves higher amount of energy and inputs. In comparison, one ace of *Stevia rebaudiana* cultivation would produce sweetener equivalent to 36 Acres of Sugar Cane. India being the largest consumer of cane sugar along with largest diabetic population in the world, Stevia is ideally poised to make significant contribution in satisfying the Indian demand of natural low calorie sweetener. As per WHO findings, this wonderful herb has other medicinal virtues e.g. it regulates blood pressure, fights cavities, induces pancreas to produce more insulin, skin care, flavor enhancer and bactericidal agent[14]. Therefore, cultivation of this miraculous plant may be encouraged around India.

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DO YOU KNOW ?

Q5. Which famous Educational Institution of India was started in Jail Building ?

Q6. What is an Odometer ?

ALZHEIMER : A DISEASE DISCOVERED 100 YEARS BACK

Abhijit Mitra*

Reviewed here are certain main causes, effects and preventions of this deadly disease within our scope of general observation. To start with the interesting story of describing this disease first in 1906 and subsequently, discussed are the main causes, risk factors involved and different early warning signs of Alzheimer. A few simple methods to keep the brain healthy will be reviewed next, followed by a brief 100-year timeline summary of this disease. The article is concluded with a simple social-care treatment proposal to combat Alzheimer.

INTRODUCTION

Let us think about an unfortunate scenario where the a-to-z storehouse of a system is malfunctioning, leaving the system totally disordered. The same happens when the storehouse of immense knowledge of mankind, *brain*, which is the source of all logical, rational and creative attributes, starts deteriorating. As a result, the entire living system of an individual becomes handicapped. Among many reasons, one of the major culprit who is involved in the deterioration of brain is Alzheimer's disease ; in short, Alzheimer. First described in 1906 and named after its discover, German physician Dr. Alois Alzheimer (Fig. 1), it is a devastating disease of brain that robs the afflicted individual of intelligence, memory and eventually life. Many famous personalities including Ronald Reagan, Winston Churchill have fallen victims of this disease at their old age.

Alzheimer, indeed, is the most widespread of a large category of disorders known clinically as *dementias*. The main features of dementia are a progressive deterioration of thinking (cognitive impairment) and of memory. Common symptoms include a gradual loss of memory, problems with reasoning or judgment, disorientation, difficulty in learning, loss of language skills, etc. People with dementia also experience changes in their personalities and behavioral problems. It has recently been shown that Alzheimer is the leading cause of dementia–in fact 70% of dementias are due to Alzheimer. Apart from deterioration of thinking, in Alzheimer there can also be behavioral changes such as agitation, aggression, and an inability to find the way even in familiar surroundings. The cumulative effect of all these changes becomes distressing both to the individual and their families. According to statistics, as many as 2-4% of global population of 65 years of age and older have Alzheimer. As many as 20% (or more) of population over 85 years age have the disease. It should be stressed that Alzheimer's disease knows no social, economic, ethnic or geographical boundaries ; eventually those affected are unable to care for themselves and need help with all aspects of daily life. The magnitude of this disease is so huge that it is estimated to be 18 million people affected worldwide with Alzheimer.

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DR. ALOIS ALZHEIMER AND HIS DISCOVERY

Dr. Alois Alzheimer (b. June 14, 1864 in Bavaria, d. Dec. 19, 1915 in Breslau) was of German origin who initially excelled as a professor of Psychology in Breslau. Later in Munich, his interest in histopathology eventually created him a giant in this area. Together with Dr. Franz Nissl, they established the pathological anatomy of mental illness. Dr. Alzheimer published several treatises on cerebro arteriosclerosis in 1904 and on Huntingtons chorea early in 1911. However, he presented the most celebrated paper of his life to the meeting of the South West German Society of Alienists on the 3rd November 1906. It was the first paper describing a clinical case of dementia and was an examination of the behavior of Frau Auguste D.

Frau Auguste had been admitted to the Municipal Mental Asylum in Frankfurt-am-main, Germany on 25th November 1901 at the age of 51 years when she started experiencing symptoms with increasing inability to care for herself. The senior physician at the hospital at that time was Dr. Alois Alzheimer. By the time she died in April 1906, only 5 years later, Dr. Alzheimer had moved to the Anatomical Laboratory of the Royal Psychiatric Clinic, Munich University as a co-worker to Dr. Emil Kraepelin, who is treated as the father of modern psychiatry. After the death of Frau Auguste D, her brain was immediately sent to Dr. Alzheimer as per his wish. His autopsy of her brain tissues identified the *plaques* and *tangles* that today characterize Alzheimer's disease and are treated as hallmark traits of the disease.

In the 3-page monumental paper he presented on 3rd November, 1906, Dr. Alzheimer described a "particular disease of the cerebral cortex" of Frau Auguste, which caused disorientation, impaired memory, trouble with reading and writing, hallucinations, and ultimately, her death. The following year, Dr. Alzheimer published further findings on the disease, and in 1910 an Italian researcher, Dr. Gaetano Perusini, published findings from four similar cases. Researchers then proposed that Dr. Alzheimer's name be attached to the condition. Alhough Italian writers preferred the term "Alzheimer-Perusini disease", but the single moniker, Alzheimer's disease, is now in general use.

MAIN CAUSE AND RISK FACTORS INVOLVED

Alzheimer's disease is mainly characterized by progressive death of brain cells. This results from two abnormal structures in the brain : Amyloid plaques, which are clumps of protein fragments that accumulate outside of cells and Neurofibrillary tangles, which are clumps of altered proteins inside cells. This is shown in Fig. 2. We show the outline of brains of a healthy person and a person with Alzheimer, respectively. In Figs. 3 and 4 a detailed research shows that four important changes occur in the brains of people with Alzheimer disease : (i) Here and there many of the

nerve cells start to shrink, eventually disappearing (they degenerate) ;

(ii) Amyloid plaques develop all over the brain ;

(iii) Neurofibrillary tangles of a fine thread-like protein called "tau" develop inside brain cells ; and,

(iv) Inflammation of the brain develops.

Research about these structures has provided clues about why nerve cells die, but till date scientists have not been able to determine exactly why these changes develop. In short, no one yet knows exactly what causes Alzheimer's disease. Most researchers agree that the cause may be a complex set of factors. A few such risk factors involved are discussed below.

The first identified risk factor is increasing age. Though Alzheimer's disease affects individuals in 40s and 50s, studies have shown that the greatest known risk for developing Alzheimer is increasing age. However, this does not mean that everyone living to a certain age or beyond will get the disease.

The next identified risk factor is a genetic predisposition, i.e., family history. Having a parent or sibling with the disease increases an individual's chances of developing Alzheimer. However, since Alzheimers disease is nearly a common factor among older people, even if many elderly members in a family are affected by the disease, it does not necessarily mean that the disease is being transmitted within the family on a purely genetic basis.

Many mysterious diseases have also provided interesting clues through genetic studies. Scientists have identified certain genes, which are very strongly related to Alzheimer. To date, three such genetic defects considered as "causative genes" have been identified in patients of Alzheimers diseases. In other words, people inheriting these genes from their parents may get the disease. One defect each is situated on chromosome 14, chromosome 19 and on chromosome 21. There may be other possible genetic defects, as yet

unidentified, in patients of Alzheimers disease. These genetic defects manifest themselves by aggregation of multiple cases of the disease within families affecting multiple generations. However, it must be emphasized that the proportion of all cases of Alzheimer which are inherited on a genetic basis is less than 1-2% of all known cases of the disease.

Another mechanism of genetic effect is the inheritance of a "susceptibility gene". The best known susceptibility gene identified by medical research is the Apolipoprotein E 14 (ApoE) gene. However, inheriting this gene does not necessarily mean that the person will get Alzheimers disease ; there are numerous patients, who have these genes and still do not get Alzheimer, while there are numerous patients, who do not have these genes and yet get the disease. Researchers believe that external factors must interact with this susceptibility gene to precipitate Alzheimer. This interaction is referred to as "gene environment interaction" by medical researchers. The external factors are still unknown. However, since ApoE is known to affect cholesterol metabolism, research in India and Nigeria has suggested that high-fat diet, as is typical in western countries, may be one of the factors which interacts with ApoE gene to increase the risk of Alzheimers disease in the West. This is a subject of intense research and remains to be proved.

Millions of dollars have already been spent worldwide in trying to determine why certain people get Alzheimers disease. At the current stage of knowledge, it is still not possible to predict who will get the disease. It can strike anyone irrespective of gender, caste, creed, culture or socioeconomic status. However, based on some characteristics, prevention can be taken at the early stage of the disease. We discuss these in the following, followed by a few simple method to keep the brain healthy.

10 EARLY WARNING SIGNS FOR ALZHEIMER

The disease is a progressive, degenerative disease with many symptoms including loss of memory, difficulty with day-to-day tasks, changes in mood and behaviour etc. People may think these symptoms are part of normal aging but they aren't. Below, some warning signs are given, provided by alzheimer society, to help those people with less idea about this disease. It is important to consult a doctor or "Alzheimer's & Related Disorders Society of India"[6] if any of these symptoms is noticed as they may be due to other conditions such as depression, drug interactions or an infection also.

● ***Memory loss affecting day-to-day function :***

It's quite normal for a human being to occasionally forget appointments, colleagues' names or a friend's phone number and remember them later. But, a person with Alzheimer may forget things more often and not remember them later, especially things that have happened more recently.

● ***Difficult performing familiar tasks :***

Busy people can be so distracted from time that they may leave the carrots on the stove and only remember to serve them at the end of meal. However, a person with Alzheimer may have trouble with tasks that have been familiar to them all their lives, such as preparing a meal or knotting a tie.

● ***Problems with language expression :***

Everyone has trouble finding the right word sometimes, but a person with the disease may forget simple words or substitute words, making her sentences difficult to understand.

● ***Disorientation to time and place :***

A person with Alzheimer can become lost on their own street, not knowing how they got there or how to get home as well as cannot remember frequently the day or date.

● ***Poor or decreased judgment :***

People may sometimes put off going to doctor if they have an infection, but eventually seek medical attention. A person with Alzheimer may have noticable decreased judgment, for example, not recognizing a medical problem that needs attention or wearing heavy clothing on a hot day.

● ***Problems with abstract thinking :***

From time to time, people may have difficulty with tasks that require abstract thinking, such as balancing a cheque book. Someone, however, with the disease may have significant difficulties with such tasks, for example, not recognizing what the numbers in the cheque book mean.

● ***Misplacing things :***

Anyone can temporarily misplace a wallet or keys. A person with Alzheimer may regularly put things in inappropriate places : an iron in the freezer or a wristwatch in the sugar bowl.

● ***Changes in mood and behaviour :***

Everyone becomes sad or moody from time to time. Someone with Alzheimer can exhibit varied mood swings very fast from calm to tears to anger–for no apparent reason.

● ***Changes in personality :***

People's personalities can change somewhat with age. However, an old person with the disease can become confused, suspicious or withdrawn. Changes may also include apathy, fearfulness or acting out of character.

● ***Loss of initiative :***

It's normal to tire of housework, business activities or social obligations, but people usually regain their initiative on the next day. A person with Alzheimer's disease may become very passive for a long time and require cues and prompting to become involved.

REGULARLY KEEPING THE BRAIN HEALTHY

Although a person with the said early warnings should immediately consult a specialist doctor as there are nowadays some advanced treatments to slow down the progress of alzheimer[2], it is however recommended to keep the brain healthy in various ways as preventive methods as discussed below. Note that practising these simple methods always leads to good results even for any normal human being.

● ***Performing exercise :***

It is better to have it regular, in varied and enjoyable ways. Exercise can help to keep the extra weight and blood pressure down—both are risk factors for Alzhemier's disease and related dementias. Variety of physical activity can be as important as the specific type of exercise.

● ***Eating sensibly :***

A healthy diet that is good for heart and blood circulation is also good for brain. High cholesterol is thought to lead to stroke and brain-cell damage. Diabetes is also thought to significantly increase the risk of developing dementia. According to a study involving genetically engineered mice, it was suggested that "curcumin", which is an active ingredient of the Indian curry spice turmeric and has been a part of Indian traditional medicine for thousands of years, could inhibit the accumulation of destructive beta amyloids–a component of the neurofibrillary tangles and plaques attributed to Alzheimer's disease–in the brains of Alzheimer patients, as well as break up existing plaques.

● ***Stimulating brain :***

It is always suggested to be mentally active. To find things that challenge the human memory and thought processes usually helps to strengthen the connections between brain cells. There are always new experiences to try, so it is advised to become proactive and find something enjoyable.

● ***Being socially active :***

The social connections should not be loosened with increasing age. Social activity always helps to stave off depression and stress, which are not good for brain. Joining certain organizations to think logically or interact with others also help adequately.

1960-2006 : A 100-YEARS OVERVIEW ENCIRCLING ALZHEIMER

As time passes on, mankind become more and more aware, leading towards many fruitful discovery with detailed understanding of a system, which might have been unknown even sometimes back. In a similar way after 1906 sequential discoveries about Alzheimer's disease have made it possible today, a hundred years after its first inception, to understand the disease with clarity, thereby equipping us with modern treatment to combat this deadly disease. Although we are still not in a position to eradicate Alzheimer totally from our society–rather it is proliferating its number of victims day by day, we can now think about decelerating its progress by vaccines and other possible ways. A brief sequential timeline of the 100 years below states how it has been made possible.

● **Alzhemier's Disease Discovered (1906) :**

Dr. Alois Alzheimer, a German neurologist and psychiatrist, describes for the first time a dementia what later becomes known as Alzheimer's disease : a progressive, degenerative brain disease with no known cause or cure. Through an autopsy of a patient's brain, he identifies "Plaques and tangles"—the hallmarks traits of Alzheimer's disease.

● **A "Normal" Part of Aging Concept (next 50 years) :**

For the next 50 years of its discovery, most of the scientific community regarded Alzeimer's disease symptoms simply as "normal " brain decline due to old age and "senility".

● **Alzheimer's Disease Recognized as a Disease (1960s) :**

The discovery of the link between cognitive decline and the numbers of plaques and tangles in the brain leads medical scientists to finally recognize Alzheimer's as a "disease", not a normal part of aging.

● **Scientific Interest in Alzheimer's Disease (1970s) :**

Scientific advances bring new tools, techniques and knowledge to the exploration and understanding of the human body. The disease emerges as an area of research interest.

● **Alzheimer Society of Canada Founded (1978) :**

The Alzheimer Society is formed to help families caring for someone with the disease and to promote research into treatments, prevention and a cure worldwide. Note that it was the first organization of its kind in the world.

● **Research Focuses on Plaques and Tangles (1980s) :**

Researchers examine the complex interactions that are harming nerve cells in the Alzheimer-diseased brain. They focus on the chemistry of the toxic proteins identified as "amyloid" in plaques and "tau" in tangles. This research assists in the genetic breakthroughs in the 1990s.

● **Giant Leaps Forward (1990s) :**

Teams of scientists discover genetic links to Alzheimer's disease. In turn, this leads to the creation of mice models of the disease, allowing research testing that had not been possible previously.

● **An Essential Piece of the Alzheimer Puzzle (1992) :**

The first real genetic link to the disease is discovered—a mutated gene in the majority of

familial Alzhemier cases that influences a person's risk of getting the disease. Although this form is rare, roughly seven per cent of the Alzheimer population, this is still a crucial discovery.

● **Major Risk Factor Identified (1993) :**

A few Canadian scientists make major advances– this time identifying the role of the ApoE gene in the brain.

● **First Drug Treatment Approved (1997) :**

The first drug, a cholinesterase inhibitor known as "Aricept" becomes available that lessens the symptoms of mild to moderate Alzhemier in some individuals. Two new cholinesterase inhibitors, "Exelon" and "Reminyl" are developed over the next five years, offering treatment alternatives.

● **First Vaccine is Tested (1999) :**

The first Alzheimer's disease vaccine is developed and tested using mouse models with a significant achievement. The work on vaccines continues to show great promise.

● **Sophisticated Imaging of the Living Brain (2000) :**

Technological advances in imaging provide a new window into the living brain. Images indicate that changes may exist in the brain long before a person develops symptoms of Alzheimer's disease.

● **New Drug Therapy Approved (2004) :**

A new drug, A "NMDA receptor blocker", intended to treat symptoms in people with moderate to advanced Alzhemier's disease, is available. In trails it stabilized or slowed the decline of cognitive function.

● **New Tailor-Made Vaccine (2005) :**

If one wants to combat Alzheimer immunologically, it is essential to generate antibodies which are targeted against the beta-amyloids, but which leave the normal constituent of the cerebral cells unharmed, since the latter would induce an autoimmune disease. In keeping with this, a new vaccine approach has been shown to be highly specific for beta amyloids and not to react with the normal constituent of cerebral cells.

● **A Drug to 'Halt' the Progress of Alzheimer (2006) :**

An experimental drug that for the first time appears to block the devastating progression of the disease has been unveiled in March. Although it has been applied to animals only, scientists are constantly making efforts to extend the effects to human being also.

CONCLUSION :

THE ULTIMATE HEALING TOUCH– 'CAREGIVING'

In 2006, a year-long campaign in Canada is focusing on research and 100 years of discovery of Alzheimer's disease. People are also hopeful about the recent discovery in 2006 that demands to halt the progress of Alzheimer in brain. However, all the efforts are still confined within genetically engineered mice and the exact cause of the disease is still known to us.

It is estimated that there are currently about 18 million people worldwide with alzheimers disease. This figure is projected to nearly double by 2025 to 34 million, if the disease can't be stopped. It is also said that much of this increase will be in the developing countries alone, and will be due to the ageing population. With increasing population, Indian community is also ageing, meaning, in turn, that the number of people with Alzheimer and related dementias is also on the rise. Currently we have an estimated 4 million affected victims. It is also shocking to note that West Bengal has about 40 lakh elderly people over 65 years with 80,000 of them suffering from Dementia. Kolkata itself has about 46,000 dementia patients. A recent research in India and Africa suggests that the risk of Alzheimers disease is possibly higher for urban

as compared to rural areas. This has again raised several important issues for research : What is then the deciding factor ? Is it increased life expectancy ? Is it lifestyle ? Is it diet ?

A new branch of upcoming social/psychological research idea regarding Alzheimer is now stressing on caregiving and quality of life in order to protect people from it and the notion mainly comes from nerve sprouting. It is well accepted by researcher that nerve sprouting from surviving nerve cells is a key feature of repair in the diseased or damaged nervous system. Nerve sprouting is induced by the bodys own "growth factors". However, it is now also well established that there is another important way to induce nerve sprouting ; this is by initiating impulses in the nerve cells, or, in other words, by "driving" them. Experimentally this is done by electrically stimulating them. In life it is done especially well for brain cells by increasing the "sensory input", i.e., by providing sensory stimulation such as light, touch, sound, and so on. Now in the parts of the brain that control feeling and thinking, the input that matters most is that from the social environment – from people talking and touching or caressing and generally interacting with the individual. This means that the more of this "social stimulation" persons with Alzheimer get, the more likely it is that their surviving brain cells will be induced to sprout and restore lost connections with other nerve cells. The caregiver, family member, anyone involved with the person, clearly has a critical role here. We should never be put off by absence of response. The emotional benefits of maintaining contact between people with Alzheimer and their caregivers and family members can only be guessed at, but the bottom line is–if we keep trying to communicate, keep talking, and keep on showing affection without overdoing it, it will definitely act as a positive catalyst to those elderly people for regaining their normalcy. After all, we only have the control over today, not tomorrow, to keep our older generation with mental peace and solace.

OBITUARY

While preparing this manuscript, it was learnt that Prof. Raymond Davis Jr. (1915-2006) has passed away at his home in New York. Nobel laureate Prof. Davis won the laurel in 2002 in physics for capturing evanescent particles known as 'neutrinos'. The cause of his death was complications of Alzheimer's disease, according to his wife, Ms. Anna Davis. With this incident, let us take the resolution once again to do as far as we can for eradicating this disease from our society.

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SOMETHING TO THINK ABOUT

DO FISHES OF DARK OCEAN DEPTHS HAVE EYES ?

Hem Shanker Ray

It should be common sense that if there is no light, then there is no need of eyes either. In fact, in many dark caves, which receive no sunlight at all, small creatures such as salamangers have no eyes. However, in case of the dark depths of the ocean, this is not so. And the explanation is not that the fishes may occasionally come up to depths closer to the surface where there is light. The fishes that live in the deepest regions have evolved to be suited to a dark habitat only–they never come up.

As sunlight falls on sea water, the first to be absorbed is the long wave length red light. The upper most layers of the sea quickly extinguish the red fraction. The rest of the spectrum penetrates deeper and by 200 metres or so there is a twilight situation. At lower depths there is increasing darkness, the human eye cannot detect any sunlight below 500 metres. Some animals with more sensitive eyes may detect sunlight in these depths perhaps, but certainly every trace of sunlight is extinguished by 1000 metres. At these depths and even much below, however, innumerable fishes thrive and, surprisingly many have eyes. These eyes often unusually large, are not meant for sunlight but for bioluminiscence.

Recently, the leading Science journal Nature (22nd. November, 2007, p. 472) has described some experiments carried out in Bahamas by Erika Raymand, a doctoral student of Oceanography of John Hopkins University in Maryland, U.S.A. He took videos at a depth of 600 metres using a camera system stationed on the sea floor where there was practically no sunlight. At these depths artificial lights may attract or scare away any animals that can sense the light and this will ruin experimentation. Therfore, images of sea creatures were taken using red light that is invisible to most deep sea creatures. The camera rig was, however, equipped with an LED here, a cluster of tiny lights that were designed to flash or flicker in specific patterns.

When flashes were made by the camera rig, several species such as some giant sharks nearly gave matching responses. Repetitive flashes were answered by similar repetitive flashes and often received responses from long distances also. This observation proved that not only the creatures could sense the luminiscense but by their own bioluminiscense flashes, they were actually communicating with the camera rig. The actual message being sent by the response, of course, was not obvious. The response could imply a simple affirmation of signal received, a threat delivered, an invitation to mate or something else.

Actually at these depths where darkness prevails bioluminiscence is every-where and it plays a key role in everything. Search for food, search for a mate, warning signals to potential attackers and many other vital factors for life style depend on bioluminiscence. Flashes can be sent to long distances and specific fishes may have characteristic patterns as different birds have different signature tunes. The bioluminiscence organs known as

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phosphors and distributed in the body in different species may have some special functions too. For example, near the twilight zone some fishes will appear as shadows to pretators at lower depths when they look up. These fishes may have the organs in the underside so that they blend with the background light. Quite often, bioluminiscent organs provide search lights.

Most deep sea animals seem to be able to see light only in the blue-green range with shorter wave lengths, but there can be exceptions. Some animals have red bioluminiscent 'search lights' which may be an evolutionary trick to attract mates using a light others cannot see in the neighbourhood.

DO YOU KNOW ?

Q7. What is the colour of the pigment in the blood of Octopus ?

Q8. For how long a crocodile stay under water without breathing ?

KNOW THY INSTITUTIONS

INSTITUTE OF PHYSICS, BHUBANESWAR

Institute of Physics, Bhubaneswar (IOP), is an autonomous research institution funded by the Department of Atomic Energy, Govt. of India and the Department of Higher Education, Government of Orissa. The Institute was officially established in 1972 by the Government of Orissa, and registered in 1972 as a registered society under societies Registration Act 1860. The Institute started functioning under the directorship of Prof. T. Pradhan on September 4, 1974 in two rented rooms of the Utkal University Guest House. After a few months, the Institute moved to a rented house in Sahid Nagar, Bhudaneswar where its academic activities got started in January 1975 with two faculty besides the then Director, Prof. T. Pradhan. From 1974 to 1981, the Institute functioned in rented buildings and moved to its present campus in 1981. On March 25, 1985, the Institute was taken up by the Department of Atomic Energy. It is a premier research institute carrying out research in the frontier areas of physics and other allied areas. The Institute also acts as a nodal centre for scientific manpower development with participation from universities and educational institutions from all parts of the country. It has active research programmes in theoretical and experimental areas of High Energy, Nuclear, Atomic, Molecular and Condensed Matter Physics, and accelerator based basic and applied sciences.

The management of affairs of the Institute is vested in a Governing Council consisting of an eminent Scientist nominated as its Chairman, the Director of the Institute and members nominated by the Department of Atomic Energy (DAE) and the Government of Orissa. The Registrar of the Institute functions as its Secretary. The Institute receives major part of its financial support from the Department of Atomic Energy, Government of India, and a token support from the Government of Orissa. The Institute also receives funds from other government agencies (like CSIR and U.G.C.) to finance specific reserach projects.

The experimental research activities in Institute of Physics are centered mainly around a 3 MV Pelletron Accelerator located in the Ion Beam Laboratory (IBL). The accelerator provides low energy ion beams starting from protons and alphas to heavy ions. The types of experiments that are being carried out in the ion beam laboratory are ion implantation, channeling, Rutherford backscattering, micro-beam analysis and radiocarbon dating. Some low energy nuclear physics experiments are also performed. The experimental facilities of Accelerator Mass Spectrometry and micro-beam at the IBL are unique and first of its kind in the country.

The Institute has developed a very good laboratory for surface physics research. The facilities for research in surface sciences include an ultra-high vacuum chamber on the beam line, a thin film preparation unit, a molecular beam epitaxy setup, a transmission electron microscope and a X-ray photo-electron spectrometer. There is also an active programme in cluster and nanomaterial science to produce and investigate the properties of metallic and semiconductor cluster materials.

The Institute is actively collaborating in ultra-relativistic heavy ion collision experiments. The Institute, in collaboration with a number of centres in India, has developed a highly granular photon multiplicity detector. The detectors are being installed in BNL, USA and CERN, Geneva and experiments are carried out in these laboratories to investigate quark gluon plasma formation in heavy ion collisions.

The main components of **theoretical physics research** at Institute of Physics are in the fields of high energy, unclear and condensed matter physics. The areas in which extensive work is carried out are : (1) String theory and Quantum Gravity, (ii) Particle physics phenomenology, (iii) Quantum mechanics, (iv) Relativistic heavy ion collisions, (v) neutron/quark stars, (vi) exotic nuclei and their properties, (vii) nonequilibrium statistical mechanics, (viii) superconductivity and magnetism, (ix) mesoscopic systems and clusters. The Institute has active national and international collaborative research programs within these and other theoretical areas.

Campus and Facilities

Institute of Physics campus is located at about six kms. from the centre of Bhubaneswar city. The Instiute is spread over an area of over fifty acres, and has a scenic environment with a large number of trees and decorative plants. The main building houses the offices of the faculty, research scholars, administrative staff and has a lecture theatre and seminar room where seminars and colloquia are held on regular basis. Other buildings in the campus are the ion beam laboratory, workshop, hot laboratory, cluster and nanostructure laboratory, auditorium, library and computer centre. The Institute has a guest house for visitors and on-campus housing for faculty and staff. The Institute also has facilities for a number of indoor and outdoor games. There is a bank and medical facility with a dispensary inside the campus of the Institute.

The Library and Computer Centre of the Institute are open for 24 hours. The library subscribes to all important physics journals and has books on advanced topics in physics and related areas. Being a member of the DAE Consortium, the Institute members have electronic access to a large number of online journals. The computing facilities include advanced computer systems, campus-wide network, internet access, numerical, algebraic and graphics packages and document preparation systems.

Hostel Facilities

The Institute has sufficiently large hostel space to accommodate all predoctoral, doctoral and post-doctoral scholars. Efforts are also being made to construct studio apartments for married scholars and long term visitors. The mess attached to the hostel is run by the scholars themselves so that they can have the food of their choice. There are a number of recreational facilities, including indoor and outdoor games for the scholars.

Pre-Doctoral (Post M. Sc.) Programme

Institute of Physics runs a one year Predoctoral Program which is mandatory for doing Ph. D. at the Institute. During the year, the scholars undergo course work in all branches of physics such as quantum mechanics, statistical mechanics, field theory, numerical methods, mathematical methods, many body theory, particle physics, nuclear physics, condensed matter physics, experimental physics etc. The prime objective of the program is to train the scholars in the advanced methodologies of experimental and theoretical physics. On completion, the scholars are awarded a predoctoral diploma which is considered to be equivalent to the M. Phil degree of the Universities of Orissa. The candidates for the Predoctoral course are selected on the basis of their performance in the JEST written test and a viva-voce test conducted at IOP.

Doctoral Programme

On successful completion of the Predoctoral program the scholars work towards their Ph. D. degree with one of the faculty members. On completion of their work, the scholars may submit their thesis to any of the universities of Orissa.

Contact : Director

Institute of Physics

Sachivalaya Marg, Bhubaneswar 751 005

Tel : (0674) 2301058, 2301205

Fax : (0674) 2300142

Email : iop_jest@iopb.res.in

Conferences / Meetings / Symposia / Seminars

17th APSI Scientists Meet 2008 and National Conference on Perspectives and Present Scenario in Plant Science Research, November 20-21, 2008, Mumbai, India

This session of Academy of Plant Sciences is organized at Department of Botany, Institute of Sciences, Mumbai. Scientific sessions will include invited lectures/research papers/Posters presentations. The following topics will be included.

- Genetic Improvement of Plant Resources
- Bio-diversity
- In-Vitro Studies in Medicinal Plants
- Phytochemical Analysis
- Stress Physiology
- Sustainability, Conservation and Bioremediation

Papers are invited for presentation at conference and for the publication of abstract in the pre proceeding volume. Two copies of abstract of the paper should be sent through post by *10th October, 2008*.

APSI will award seven Gold medals and citations to selected scientists for outstanding contributions and one Gold Medal for each of best paper presentation in oral and poster categories.

Contact : Dr. S. K. Gupta, Secretary, APSI, 657/6 (770), South Civil Lines, Muzaffarnagar-251001, U. P., Ph. No. (0131) 2621276

78th Annual Session of the National Academy of Sciences (NASI) and Symposium on 'Novel Approaches for Bio-medical Research', November 21-23, Chandigarh, India

The Scientific Sessions will be held in two sections : Section of Physical Sciences and Section of Biological Sciences. The Physical Sciences Section will be presided over by Dr. S. R. Shetye, Director, National Institute of Oceanography, Dona Paula, Goa and the Biological Sciences section will be presided over by Prof. Nikhil Tandon, Department of Endocrinology & Metabolism, All India Institute of Medical Sciences, Delhi.

The National Academy of Sciences India-Swarna Jayanti Puraskars each comprising Rs. 5000/- and citation will be awarded to the young scientists (below the age of 35 years on 1.1.2008) presenting the best research paper in the Sections of Physical and Biological Sciences. A National Symposium on 'Novel Approaches for Bio-medical Research' will be held during the session. Presentation of papers in the Symposium would only be through invitation

Contact : Dr. V. K. Anand, University Librarian, A. C. Joshi Library, Panjab University, Chandigarh-160014, Ph. No. 0172-2548159 E-mail : anandvk@pu.ac.in

XXXV th Annual National Conference of Association of Clinical Biochemists of India organized by Ramkrishna Mission Seva Pratisthan and Vivkananda Institute of Medical Sciences, December 19-21, 2008, ACBI (Vedic) Village, Kolkata, India.

The Conference will address the following issues :

1. Recent Diagnostic Trends in Hepatic disorders
2. Biochemistry of Renal Disorders
3. Biochemical Diagnosis in Industrial Hazards
4. Role of Biochemistry in the Diagnosis and Management of Environmental Pollution
5. Biochemical Functional Tests in Pulmonary Dysfunction
6. Re-evaluation of role of Dietary Lipids on plasma Lipids
7. Clinical Biochemistry in the Diagnosis and Management of Cardiovascular Disorder
8. Utilisation of Nanotechnology in Clinical Biochemistry

For other topics consult www.acbicon.208.

Contact : Prof. Krishnajyoti Goswami, Dept. of Biochemistry, Ramkrishna Mission Seva Pratishthan, Vivkananda Institute of Medical Sciences, 99 Sarat Bose Road, Kolkata-700026 Ph. No. 9831134908, E-mail : acbicon2008@gmail.com

FORM IV

Rule 8

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I, S.P. Mukherjee, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date : 21. 07. 08

S.P. Mukherjee
Publisher
Everyman's Science

S & T ACROSS THE WORLD

UTILIZING WASTE GYPSUM

Rashtriya Chemicals and Fertilizers Ltd. (RCF) plans to earn carbon credits from phosphogypsum, a by-product of its manufacturing process. The company intends to manufacture prefabricated wall panels-construction materials-with the waste generated for which it has tied up with Rapid Building Systems of Australia.

A Rs 75 crore panel making unit would be set up in Trombay for the project which is expected to earn 1.1 lakh credits per year worth 1.65 million Euros. A methodology is being formulated for claiming the credits and the World Bank has shown interest in buying upto 10 lakh such credits.

The Australian company has developed a process to turn the waste gypsum into high quality plaster which can be used to make 'Rapidwall'. The patented load bearing walling system is approved in Australia, China and India for construction of upto 10-storey building.

According to the Finance Director of RFC, the use of the wall panel could help save on bricks and mortar. A 36-sq.m phosphogypsum wall panel could replace 3960 bricks and would save 10,000 liters of water, and 2.9 tons of carbon emissions, which relates to brick manufacturing and would make the unit eligible for carbon credits.

(Chemical Weekly, Mar 25, 2008)

COOLEST SOLAR BUILDING ?

Sanyo in Japan has constructed an amazing solar collecting building that embodies both clean energy ideals and awesome architectural design strategies.

The so-called Solar Ark has over 5000 active solar panels generating over 500,000k Wh of environmentally friendly energy. Nearly 500 multi-coloured lighting units placed between the various solar panels can be activated to create a variety of shapes and letters on the sides of this enormous structure.

As a working example of the potential of solar energy, the structure contains a solar museum with interactive exhibits as well as a solar laboratory and various meeting rooms for global environmental programmers. The curved form of the building is designed to take maximum benefit from as well as graphically reflect the path of the sun and its energy. An elaborate truss system allows dizzying cantilevers to span out from the centre of the structure and rise towards the sky.

(ecoble.com, Jan 7, 2008)

BIOMSS FUEL

With all fossil fuels increasing sharply in price at almost the same time, demand is growing for eco-friendly energy alternatives. More and more manufacturers and producers are relalising that their waste has the potential to become valuable biofuels. However, one of the disadvantages of using these biofuels is their moisture content.

Now, a company named Thermal Energy has development a DRY-REX test facility to handle funded research projects on drying different sources of biomass for use as biofuels. The laboratory located in Chilliwack, British Columbia, Canada, is under the supervision of Thermal Energy's chief scientist. The test facility has already received its first on grape pressings, and orange pressings. This is one of the several requests from potential customers in Europe's bioenergy sector, seeking to determine viability of the DRY-REX (TM) low temperature biomass dryer at these sites.

The new lab also acts as a catalyst for selling DRY-REX technology to help customers achieve the goals. The low operating temperatures of the DRY-REX technology minimizes the amount of

volatile organic compounds generated from biomass and the risk of fires and explosions which can with them.

(Thermal Energy. Mar 6, 2008)

NANOPARTICALS FOR FOOD SAFETY

Researchers are studying the potential of using silver nanoparticles to improve the safety of the world's food supply. Although the particles cannot be added directly to food, the ultimate goal of the study is to develop food-related applications, such as microbe resistant fabrics or non-biofoulding surfaces. The research could have a massive impact on the safety of foods.

Silver nanoparticles are already being used in food packaging to soak up the plant-ripening hormone ethylene so that the shelf life of fruits can be extended. The science is at a basic point right now but the researchers expect that it will translate into something more tangible in the near future.

The researchers hope to learn more about how silver nanoparticles exert their microbial activities by testing QSI-nano (R) Silver for its ability to interact with microbia cells. QSI-Nano (R) Silver is prepared from pure metallic silver that is vaporized in the presence of an inert gas, and then condensed under controlled conditions.

(PHYSORG.com. Apr 10, 2008)

ANSWERS TO "DO YOU KNOW ?"

A1. One can find fossil remains of marine animals

A2. Perhaps it was a cold planet to start with. The inside later heated up and melted from intense heat produced by radioactivity and gravitational queezey.

A3. Fear of the number 13

A4. No.

A5. I.I.T., Kharagpur in Hijli Jail.

A6. Device to measure distance.

A7. Blue.

A8. Two Hours.

भारतीय विज्ञान कांग्रेस संस्था

14, डा० विरेश गुह स्ट्रीट, कोलकाता 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

Telegram	:	SCICONG : CALCUTTA	Fax	:	91-33-2287-2551
Telephone	:	(033) 2287-4530, 2281-5323	E-mail	:	iscacal@vsnl.net
Website	:	http://sciencecongress.nic.in			iscacal_2004@yahoo.com

Terms of Membership and Privileges of Members :

Membership of the Association is open to persons with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

1. **Member :** A person willing to be enrolled as new Member has to pay an annual subscription of Rs. 200/- **along with an admission fee of Rs. 50/-** (for foreign* U.S. $70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subscription on or before the *15th July* in any year shall lose the right of voting and / or holding any office of the Association for that year. A Member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member.

   Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprint of the Proceedings to Session of any one section of their interest and also the bi-monthly journal of the Association "Everyman's Science".

2. **Sessional Member :** Sessional members are those who join the Association for the Session only. A Sessional Member has to pay a subscription of Rs. 250/- (for foreign U.S. $60) only.

3. **Student Member :** A person studying at the under-graduate level may be enrolled as a Student Member provided his/her application be duly certified by the Principal/Head of the Department. A Student Member shall have the right to submit papers for presentation at the Session of the Congress of which he/she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/she shall not have the right to vote or to hold any office. A Student Member shall not be eligible to participate in the Business meetings of the Sections and the General Body. Subscription Rs. 100/-

4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of Rs. 2000/- (for foreign U.S. $ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of Rs. 50/- for every year of such membership, provided that the compounding fee shall not be less than Rs. 1,200/- (for foreign U.S. $ 12.50 and U.S $ 300 respectively). A Life Member shall have all the privileges of a member during his/her lifetime.

**Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.*

5. **Institutional Member :** An Institution paying a subscription of Rs. 5,000/- (for foreign U.S. $ 2,500) only, can become an Institutional Member of the Association. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy of the Association's journal "Everyman's Science".

6. **Donor :** Any person paying a lump sum of Rs. 10,000/- (for foreign U.S. $5000) only, can become a Donor of the Assocaiation. An ***INDIVIDUAL DONOR*** shall have all the rights and privileges of a member during his/her lifetime. An Institution paying a lump of Rs. 50,000/- (for foreign U.S. $25,000) only, can become ***INSTITUTIONAL DONOR*** of the Association, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional / Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress as also the Association's journal "Everyman's Science".

A) **Presentation of Papers :** A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President General Secretary (Hqrs) Latest by *September 15*, each year.

B) Members of all categories are entitled to railway Concession of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation.

C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.

D) Members of all categories may use Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

Note : All Money Orders, Bank Drafts etc. should be drawn in favour of "*Treasurer, The Indian Science Congress Association*". Members are requested to mention their Card No. while making any correspondence to ISCA office.

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* (A Foreign Member means one who is normally resident outside India.)

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E-mail : iscacal@vsnl.net
iscacal_2004@yahoo.com

APPLICATION FORM FOR MEMBERSHIP

To
The General Secretary
The Indian Science Congress Association
14, Dr. Biresh Guha Street,
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Stamp Size Photograph

Dear Sir,

I like to be enrolled as a Member / Life Member / Donor / Sessional Member / Student Member / of The Indian Science Congress Association.

I am sending herewith an amount of Rs. ..... in payment of my subscription by Bank Draft / Money Order / Cash for Membership / Life Membership Subscription / from the year 1st April 200 ..... to 31st March 200 .....

I am interested in the following section (Please tick any one).

SECTIONS

1. Agriculture and Forestry Sciences
2. Animal, Veterinary and Fishery Sciences
3. Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences)
4. Chemical Sciences
5. Earth System Sciences
6. Engineering Sciences
7. Environmental Sciences
8. Information and Communication Science & Technology (including Computer Sciences)
9. Materials Science.
10. Mathematical Sciences (including Statistics)
11. Medical Sciences (including Physiology)
12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. Physical Sciences
14. Plant Sciences

(Please type or fillup in Block Letters)

Name (in block letters) : _____ _____ _____
SURNAME FIRST NAME MIDDLE NAME

Academic Qualifications :
(Evidence to be submitted)

Designation :

Address for Communication :
(including State, City/Town and Pin code)

Phone No. & e-mail

Permanent Address :

Yours faithfully

Date : Signature

- *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application form "care of" address is given then there should be also signature of the person in whose name "care of" is given.*
- *Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.*

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1. Everymans's Science intends to Propagate the *latest message of science* in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. *Research articles* usually meant for publication in periodicals devoted to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman's Science. Instead, popular or easily intelligible expositions of new or recent developments in different branches of Science & Technology are welcome.

2. Manuscripts should be typewritten on one side of the paper with double spacing. Articles should be written generally in non-technical language and should not ordinarily *exceed 2000 words.* Articles must be understandable by the average enthusiastic readers with some modest scientific background but outside the field. It should not be a review article in a specialised area. Without being too technical, it must also reflect state of the art situation in the field. *A summary* in 50 words should be submitted along with the paper highlighting the importance of the work. *Two copies* of the manuscript complete in all respects should be submitted. The title should be written in capital letters and name(s) of the author(s) should be given along with the Department, Institution, City and Country of each author.

3. Illustration & Tables : The size of illustrations should be such as to permit reduction to about one-third. Legends and captions should be typed on a separate sheet of paper. Photographs should be on glossy paper with strong contrast in black and white. Typed tables should be in separate pages and provided with titles and their serial numbers. The exact position for the placement of the tables should be marked in the script. Authors are specially requested to reduce the number of tables, illustrations and diagrams to a minimum (maximum of 3)

4. References : References to be given on a selective basis, (maximum of 10) and the order of placement should be numerically with (a) name(s) of the author(s) (surname last), (b) name of the journal in abbreviated form according to the 'World list of Scientific Periodicals' and in italics, (c) volume number (in bold) (d) page number and (e) year of publication.

For citations of books the author's name should be followed by the (a) title of the book, (b) year of publication or edition or both, (c) page number, (d) name of publishers, and (e) place of publication.

5. The Indian Science Congress Association and the Editors of Everyman's Science assume no responsibility for statements and opinions advanced by the contributors to the journal.

Reprints : The communicating author with receive 1 copy of the journal and 10 reprints free of cost.

All manuscripts and correspondences should be addressed to the *Hony, Editor, Everyman's Science, The Indian Science Congress Association 14, Dr. Biresh Guha Street, Kolkata-700 017.* Email : iscacal@vsnl.net. iscacal_2004@yahoo.com, Fax : 91-33-2287-2551

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KOLKATA–700 017

A. PAPER PRESENTATION (ORAL/POSTER)

1. All papers to be submitted for presentation at the 96th Indian Science Congress must be sent to the **Concerned Sectional Presidents**. Each paper must be accompanied by *three copies* of abstracts (within 100 words, without any sketches, tables, etc.) and a copy of the full paper. The name of the section where the paper is to be presented should be indicated. The model format for abstract is given below. The addresses of Sectional Presidents are given in the website : *http:www.sciencecongress.nic.in*
2. Each author is entitled to submit only two papers.
3. All authors must be **members** of ISCA. Corresponding author must give a declaration that authors/co-authors are members of ISCA.
4. Papers should reach on or before **September 15, 2008**. The abstracts of these papers if approved will be printed in Part II of the Proceedings of the 96th Indian Science Congress. Papers (along with abstracts) received after **September 15, 2008** will not be considered.
5. Contributed papers would be presented primarily by way of posters. Authors of the accepted papers will be advised by the concerned Sectional Presidents about preparation of posters. Size of each poster should be **1 meter × 1 meter** and should be neatly prepared which can be read from a distance of 3 feet.
6. To encourage scientists, the Indian Science Congress Association has introduced a number of prizes for **Best Poster** presentation since January, 1999. A maximum of **Two** prizes of Rs. 5000/- each in cash along with a certificate will be awarded to the best presentations in each Section during the valedictory function of the 96th Indian Science Congress.

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A. PAPER PRESENTATION (ORAL/POSTER)

1. All papers to be submitted for presentation at the 96th Indian Science Congress must be sent to the **Concerned Sectional Presidents**. Each paper must be accompanied by *three copies* of abstracts (within 100 words, without any sketches, tables, etc.) and a copy of the full paper. The name of the section where the paper is to be presented should be indicated. The model format for abstract is given below. The addresses of Sectional Presidents are given in the website : *http:www.sciencecongress.nic.in*
2. Each author is entitled to submit only two papers.
3. All authors must be **members** of ISCA. Corresponding author must give a declaration that authors/co-authors are members of ISCA.
4. Papers should reach on or before **September 15, 2008**. The abstracts of these papers if approved will be printed in Part II of the Proceedings of the 96th Indian Science Congress. Papers (along with abstracts) received after **September 15, 2008** will not be considered.
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