

## SUPPLEMENT TO "CURRENT SCIENCE".

Vol. VI]

INDIAN SCIENCE CONGRESS—SILVER JUBILEE SESSION,  
CALCUTTA, 1938

[No. 8

### Summaries of Addresses of Presidents of Sections.

#### MATHEMATICS AND PHYSICS

*President* DR C W B NORMAND, M A D Sc  
F N I

#### SOURCES OF ENERGY OF STORMS

THE general theme of Dr C W B Normand's remarks in his Presidential Address to the Physics and Mathematics Section of the Indian Science Congress at Calcutta may be summed up very briefly as the thermodynamical approach to the study of storms. At the basis of it all, following Margules, there is the simple enough proposition, if the whole air mass around and including a storm can be circumscribed and considered as a closed system, it should be possible from a study of the initial and final conditions alone to decide the main source of the kinetic energy that has been created and displayed during the storm's existence. Before either the gravitational or the internal energies can decrease within a closed system, the stored up energy must be present in a state of instability, actual or potential. The possible diversities of instability are believed to be composites of three main kinds, which for brevity are called the vertical horizontal and latent types, the latter referring particularly to the instability that may arise from the latent heat of water vapour. Horizontal instability arises when two air currents of different temperature meet as for instance polar and tropical air. The horizontal and latent types are the two that can store up energy until favourable conditions allow its release. Latent instability develops behind a veneer of stability. It is analogous to the energy of a hydrogen balloon caught in the corridor of a large hall where it can be fed with more and more hydrogen but cannot escape up to the dome until given a relatively small, yet distinctly appreciable, push.

How are we to estimate quantitatively the relative importance of these main types of instability in originating storms? The standard method of attack is that of Margules, which however can be clarified and extended by graphical methods. The temperature entropy diagram is chosen, with mass as a third co ordinate. Solid

models were shown, of which the volume represents the total energy available from a closed system wherein all the elements rearrange themselves in the most efficient manner thermodynamically while passing from the initial unstable to the final stable configuration. In two simple examples of horizontal instability one with discontinuous and the other with continuous change of temperatures, the volumes take the shapes of a wedge and a pyramid respectively.

The energy of a closed system in which latent instability alone is operative can also be represented by the volume of a solid figure. Imagining a very extreme example and illustrating it by models. Dr Normand stated that the average available energy may give rise to velocities of as much as 80 miles an hour when the effect of rain on the descending air is neglected and to a hurricane of 110 miles an hour throughout the mass, if full advantage is taken of the chance to saturate the descending air by the simultaneously falling rain. The atmospheric engine does not possess this ideal degree of efficiency but these calculations show how important latent instability may be especially in the tropics.

The application of these ideas to dust storms, thunderstorms and cyclones was briefly discussed. More field work is required to settle even the primary thermodynamical questions that should precede any full discussion of the dynamics of storms. The required upper air data must include reliable observations of humidity or of wet bulb temperature as well as of air temperature. The Bay of Bengal with its tropical cyclones, is ever a challenge to meteorologists in India.

#### CHEMISTRY

*President* DR S S BHAINAGAR, O B E, D Sc,  
F N I

#### A SURVEY OF RECENT ADVANCES IN MAGNETISM RELATING TO CHEMISTRY

IN the introduction, Prof Bhatnagar draws attention to the growing importance of magneto chemistry in recent years, which may be judged from the fact that three books on the

subject have appeared during the period 1934-37. The fundamental theoretical relations of diamagnetism and paramagnetism are due to Langevin and all later work has been based upon these. With the development of the quantum theory of the atom and wave mechanics magnetic theory has been further refined so as to fit in better with experimental facts. For instance, Pauling, Slater and others have developed theoretical methods for the calculation of the screening constants of atoms and ions and satisfactory values of diamagnetic susceptibilities have been deduced. Recent improvements in the theory of paramagnetism are largely due to the work of Van Vleck and his collaborators. These theoretical advances have had a great influence on the development of experimental magneto chemistry.

The subject proper of Magneto-chemistry is treated under the following heads—(1) magnetic moments and nuclear chemistry, (2) magnetic properties of free atoms and molecules, (3) magnetic properties of elements, (4) molecular diamagnetism, (5) paramagnetism of molecules, free radicals and biradicals, (6) polymerisation, (7) magnetic properties in relation to phase equilibrium, (8) influence of the magnetic field on homogeneous and heterogeneous equilibria, (9) catalysis and magnetic properties, (10) magneto optical analysis, (11) photo magnetic effect.

Although theory has not advanced far in the study of the magnetic properties of the nuclei of atoms in relation to their structure and constitution a good deal of experimental work has been done to determine nuclear magnetic and mechanical moments and especially the factor  $g'$  which connects them. Chief among the experimental methods mentioned are hyperfine structure determinations due to Goudsmit, polarisation of resonance radiation due to Fillet and Heydenberg and the atomic and molecular beam method of Stern and Gerlach. Recent work on the magnetic moment of the iron atom shows that it has got a finite value of 2.03 Bohr magnetons and not zero as previously reported by Gerlach. It is also interesting that the diatomic molecules of the elements of the sixth group of the Periodic Table possessing a diamagnetic  $^1\Sigma$  and a paramagnetic  $^3\Sigma$  state like  $O_2$ ,  $S_2$  and  $Se_2$  have been found to be paramagnetic experimentally and hence exist in the  $^3\Sigma$  ground states. Gadolinium is found to be highly paramagnetic below  $16^\circ C$ . Chromium though paramagnetic under ordinary conditions shows however no variation of susceptibility with temperature. The magnetic properties of manganese however are sensitive to temperature variations and some samples are found to develop even paramagnetism under suitable conditions. The diamagnetic susceptibility of mercury is different in the liquid and solid states and the explanation offered is that the liquid consists of polyatomic molecules. Bismuth as is well known exhibits many magnetic anomalies. Mention is made of the work on crystalline magnetic anisotropy, which has been shown by Krishnan and others to be a useful method of structural analysis in the case of many aromatic

organic crystals and which in the case of paramagnetic salts has yielded valuable information regarding the nature of the crystalline electric fields and their influence of the paramagnetic ions in the lattice. The structure of rhombic sulphur has been investigated by the method of magnetic anisotropy. The directional magnetic properties of graphite have also been found to possess many interesting features.

Molecular diamagnetism, which is perhaps the most important section of magneto-chemistry, is considered next. Pioneer work in the field was done by Pascal who discovered the principle of additivity of the diamagnetic properties of non-polar organic compounds. All later work in the field has been based on Pascal's law. Though Pascal's values have been shown to be fairly accurate in general a critical re-examination is sometimes necessary as has been shown by Mitra and Tuli for the susceptibility of the  $CH_3$  group. A new plan for the calculation of diamagnetic susceptibilities has been put forward by Gray and Mukshank and found to be of great help in the elucidation of molecular structure in many doubtful cases. The correct structural formulæ of hydrogen peroxide and urea have been successfully established with the help of the new plan. Investigations of the magnetic properties of complex compounds have yielded much valuable information regarding the linkages in them. Bhatnagar and others have found the ionic magnetic moment of Cu in  $(CuSO_4)(NH_3)_4$  and other complex salts to be 1.89 against a zero magneton value for tetrakisethylene thiocarbamide copper nitrate. Hence in the former the bonds are of the electrovalent type while in the latter true complex salt there is a sharing of the electrons with the central atom. Recent applications of the method by Klemm, Pauling and others to the elucidation of the structure of blood and blood constituents are also mentioned in this connection. The interesting work of Muller, Sugden and Farquharson on the magnetic properties of free radicals and biradicals and the light which such investigations throw on the degree of dissociation of biradicals is referred to in some detail and also the work of Farquharson on polymerisation. Yet another field where the magnetic methods are of great help is the study of phase equilibrium especially in binary systems of metallic alloys. The investigations of Svensson of the Pd-H system of Stephens and Evans of Ag-Si, Ag-Bi and Ag-Pb systems and of Fallot of the alloys of Fe with Al, Si, Cr, V, Au and Sn are of particular interest. Besides alloys of metals solid solutions of  $KMnO_4-KClO_4$ ,  $KCl$ ,  $NaCl$  etc. have also been studied. In the system  $KClO_4-KMnO_4$  the susceptibility-concentration curve is a straight line while the other systems yield curved graphs. Recent work on the influence of magnetic fields on crystallisation, electrolysis, thermal conductivity, the coefficient of viscosity and the course of chemical reactions is then briefly described and the importance of a magnetic study of catalysts and catalysis pointed out. The magneto optical method of analysis of Allison and Murphy is still shown to be of a controversial character. The survey concludes with an account of the work on the photo magnetic effects.

GEOLOGY

President D N WADIA, M.A., F.G.S.,  
F.R.G.S., F.N.I., F.R.S.B.

STRUCTURE OF THE HIMALAYA AND  
OF THE NORTH INDIAN FORELAND

GEOLOGICAL work carried out during the last few years has thrown much light on the structure of Northern India a region of extraordinary geological interest as much on account of the magnitude and intensity of the crustal changes involving the uplift of the Himalayan chain and the formation at its foot, of the deep parallel Indo Gangetic depressions, as on account of the extreme youth of these world transforming events. The region of Northern India resolves itself structurally into two broad zones the crumpled and folded belt of strata constituting the Himalayas and the edge of the Deccan peninsular massif that has resisted the southward advance of the Himalayan earth waves and in the process sagged under the strain. The structure of this foreland is revealed in four principal units (1) The Rajputana plateau prolonged northwards into the Punjab wedge, which has played such an important part in moulding the trend line of N W Himalaya, its main structural axis is transverse to the Himalayan axis (2) The Potwar trough of Northern Punjab, a tertiary basin containing 25,000 ft of river deposits (3) To the south east the Potwar basin widens into the great Gangetic trough 1200 miles long and 200 miles wide and from 10 000 20 000 ft deep mostly filled up by late alluvial deposits of the Gangetic rivers (4) The Assam plateau a tongue of the Gondwana mainland has played the same part as the Punjab wedge in moulding the Himalayan trend at its eastern extremity. The Assam valley is a ramp valley produced by the squeezing

But few parts of the Himalayas have been so far investigated in detail for their structural plan. Areas in which detailed mapping and stratigraphic and tectonic work have been carried out are the Kashmir mountains the Simla area a part of Garhwal and the neighbourhood of Mt Everest in Sikkim. In Kashmir the Himalayan system of earth folds undergoes a deep knee bend round a pivotal point—a narrow promontory of the Punjab foreland hidden under the late Tertiary deposits. The most important feature of this N W Himalaya re-entrant are two concurrent thrust planes at the south foot of the Himalayas, which have been traced for a distance of 250 miles. The inner of these thrusts marks the front of the Kashmir *nappe* or sheet of pre Cambrian and older Palæozoic rocks, which has moved southwards along a low plane of thrust and encroached upon the belt of much younger Palæozoic and Mesozoic rocks obliterating it at places. Four overthrusts have been noted in the Simla mountains, representing flat recumbent folds of great amplitude. The pre Cambrian here is piled up on the Carboniferous and Permian sequence. The Simla rocks are totally unfossiliferous and the evidence of the super position of highly

metamorphosed pre Cambrian building some of the prominent peaks near Simla (*Klippen*) over the less altered younger rocks is obtained by a study of relative metamorphism unconformities thrusts etc. In the Garhwal area recent mapping has proved two superposed *nappes* or fold sheets composed of the older rock formations over riding the autochthonous sequence of newer rocks of the outer Himalayas.

Evidence of the extreme youth of Himalayas has multiplied in recent years. Investigations in the sub Recent glacial and river deposits of the Kashmir valley suggest that between 5,000 8 000 ft of uplift has taken place since the end of the tertiary. A part of the address deals with the recently discovered gravity anomalies both positive and negative in the Himalayan region which cannot be explained on the hypothesis of isostasy. On the whole compensation is in excess in the central Himalayan ranges while the outer Himalaya is an area of overload and undercompensation.

The accurate form of the Himalayas presenting to the south three prominent festoons is best explained as the result of three crustal pegs arresting the free movement of the plastic earth folds pressing against the Deccan under pressures from the north. The central snow clad range built mostly of granite from the Brahmaputra gorge to Nanga Parbat on the Indus thus denotes the Himalayan protaxis the axis of original upward of the ocean floor. At both its ends it has undergone sharp southward deflections to accommodate itself to the shape of the foreland.

GEOGRAPHY AND GEODESY

President DR A M HERON, D.Sc., F.R.G.S.,  
F.R.S.F., F.N.I., F.R.S.B.

THE PHYSIOGRAPHY OF RAJAPUTANA

IN his Presidential Address to the newly constituted Section of Geography and Geodesy, Dr A M Heron Director Geological Survey of India deals with the Physiography of Rajaputana especially the evolution of its topography in relation to geological formations. Comprising of about 130,460 sq miles Rajaputana is intersected by the well known range of Aravalli Mountains which runs in the country from its north eastern border to the south west extremity for a distance of nearly 130 miles. This natural barrier divides the country into two major physiographic units the north western constituting about three fifths of Rajaputana and the south eastern forming the remaining two fifths.

The north western division is mainly a sandy, poorly watered sterile waste. The extreme western portion of this division constitutes the Thar or the Great Indian Desert wherein long narrow ridges of sand hills are prevalent, the sand being brought by the south westerly gales probably from the Rann of Kachh. Proceeding eastwards towards the Aravalli Mountains, the sand hills become fewer and further eastwards

along the north western foot of the Aravallis, the tracts are somewhat fertile, watered by short streams running off the slopes of the mountains. These streams unite to form the one prominent river of this region the Luni River and excepting for its catchment, the rest of the western Rajaputana forms a land of enclosed drainage. Consequently after the rare and occasional heavy showers, the run off waters accumulate in numerous depressions amongst these sand hills forming saline lakes and giving rise to saline deposits like that of the well known Sambhar Lake of these parts.

Clothed with a thick cover of alluvium, the topography of this region is not very much influenced by its solid geological formations. In the south there are gently folded ancient lavas and their associated granitic rocks lying unconformably on a basement of archaean rocks. By weathering the lavas assume a jagged outline while the granites form domes and tors with perched blocks and boulders. To the north, around Jodhpur these are overlain by horizontal red sandstones and cherty limestones. To the north west, in Jaisalmer and Bikaner, the extensive limestones of later formations (Jurassic and Eocene) form rocky plains.

The south eastern division is morphologically more varied. Essentially it forms an irregular gneissic plain sloping gently eastward from the foot of the Aravallis to the plains of Hindustan. This constitutes the Mewar proper and though the soil is thin and stony the country is well watered with numerous rivers and their tributaries. The extreme south east of this region constitutes the Uparmal or the higher plateau which forms the western lobe of the great Vindhyan Plateau of Central India. It consists of horizontal beds of sandstone and shales faulted against the gneisses of the Mewar plain the sandstones forming as characteristic of Vindhyan formations concentric scarps with intervening valleys formed by softer shales. To the west of this great boundary fault lies the area of archaean rocks, strangely unaltered beyond which on the other side of the boundary fault are the Vindhyan outliers folded and faulted unlike the larger main mass of this formation in Eastern Rajaputana and Central India indicating thereby that in Rajaputana tectonic movements persisted to a geologically much later date than evidenced in the stable block of Peninsular India.

The Vindhyan rocks as found in Western Rajaputana and in the south east are separated by a barrier of rocks of older formations constituting the present Aravalli range. Out of the three alternative suggestions of Sir Lewis Fermor regarding the age at which this *horst* or barrier between the two areas of Vindhyan formations was produced Dr Heron believes that the Aravalli range had been lifted up before the commencement of deposition of the Vindhyan rocks and existed as a barrier throughout the period of deposition of this formation separating it into two unconnected areas of accumulation.

The Aravalli range consists mainly of Quartzites of the Delhi system, of a later age than the

rocks of the Aravalli system exposed only on the flanks of these mountain ranges. The rocks of the Delhi system are developed in a geosyncline and being more deeply folded into the crust than the Aravallis on the flanks, show greater alterations than the older rocks of the Aravalli system. As already stated the Aravalli range is believed to have been upfolded in pre Vindhyan times and to have existed as a barrier at the close of the Vindhyan period separating the two areas of deposition of Vindhyan rocks. The range is believed to have been peneplaned or planed down to the base level of erosion of rivers, during the Mesozoic period probably not earlier than the Cretaceous. Since then, this peneplaned range has again been uplifted and warped, the uplift being about 300-400 feet at its ends, and 3000 feet as a maximum in the centre. It is suggested by Dr Heron that this elevation of the peneplane or the Mesozoic rejuvenation of the Aravalli range and the production of the Great Boundary Fault may be closely connected and contemporaneous. Two other periods of subsequent peneplanations have also been indicated and described.

## ENTOMOLOGY

President MOHAMAD AFZAL HUSAIN, Esq.,  
M A M S C F N I I A S

### ENTOMOLOGY IN INDIA, PAST, PRESENT AND FUTURE

THE knowledge of insects, their economy and their relation to man and higher animals, should not be considered to be new to India. Ancient Sanskrit literature abounds with references to the honey bee the lac insect and the silkworm. The honey bee (and insects in general) known as *Sat pada* in *Amarakosa* (1st century A D) has its modern Latin equivalent in *Hexa Poda* coined by Latreille only hundreds of years later in 1825. The Kauravas with the help of the architect Purochak built a house of lac wherein to destroy their Pandava kinsmen by burning. The propagation of the silkworm and the manufacture of silk cloth were well known as long ago as 6000 years. The medicinal properties of many insects had been discovered. Some insect enemies of man and his food crops have been dealt with in *Atharva Veda*.

Long before Aristotle in Europe (384-320 B C) commenced his scientific studies of insects, many important aspects of the Science of Entomology had already reached an advanced stage in India, unfortunately little, however, is known at present about the Indian contemporaries of Aristotle Pliny and others (23-79 A D).

In modern India the scientific study of insects, started with the intensive collection undertaken by many enthusiastic foreign amateurs like Trabricius Donovan Francillon and Drury, and their identifications by specialists in Europe. Under the auspices of the Asiatic Society of Bengal established in 1785 the collections and knowledge about insects began to accumulate fast. Special mention must be made of the efforts of Lord

Auckland Patron of the Society (about 1836) in encouraging and disseminating scientific knowledge of insects. All through the nineteenth century, the taxonomic study of insects received a good deal of attention and the entomological publications of the period contain a vast amount of valuable information.

With the establishment of the Indian Museum, Calcutta, in 1875 scientific work in Entomology began to be carried out in India itself by pioneers like Cotes and Anderson in Agricultural Entomology and Ross in Medical Entomology. The post of Entomologist to the Government of India was first created in 1901 and was attached to the Indian Museum although the post was later transferred to the Agricultural Department mainly taxonomic work was continued to be carried out in the Museum which now contains over 17 000 named species.

The Indian Museum and the Bombay Natural History Society (established in 1883) have a large share in the early development of entomology in India. The *Fauna of British India* and other publications gradually added to the knowledge of Indian insects. At the present moment a host of workers both Indian and foreign are engaged in exhaustive studies of various groups. Some 40 000 species of Indian insects are now clearly known, the most recent estimate of the insect species of India being  $2\frac{1}{2}$  millions. Of Indian insects, therefore, we know only one for every 60. This will give an idea of how vast is the field for investigation. To the enthusiastic band of British Entomologists who have already made the fauna of British India, the monumental record that it now is India owes a deep debt. The number of Indian Entomologists now working in Taxonomy has appreciably increased and in the course of a few years a wide range of important groups is certain to be covered. Other aspects of pure Entomology such as insect cytology, are also receiving the attention of several able young men in the different University Centres.

Applied Entomology, the aspect of the science that is of the greatest economic value in India, was first taken up by Mason and Coats of the Indian Museum. The enormity and magnitude of work involved very soon impressed on the central and the provincial governments the need for the appointment of specialists and duly qualified hands all over the country. An Imperial Entomologist was appointed in 1901 with headquarters at the Indian Museum. After the reorganization of the Central Agricultural Department by Lord Curzon in 1905 Maxwell Lefroy was made the Imperial Entomologist at the Central Agricultural Research Institute at Pusa. Lefroy's *Indian Insect Life* has long been the classical work on Indian insects and is a monument to the extraordinary energy and knowledge and experience of Lefroy and his co-workers in India of that period. Lefroy left India in 1912 and was followed by Howlett, as Imperial Pathological Entomologist and later by T. Bainbriggs Fletcher whose devoted and energetic work in the cause of Indian Entomology has left the Pusa Entomological Department (now at Delhi)

what it is now. In the early part of the present century the central institute at Pusa was of considerable help to most of the provinces, besides training a large number of qualified hands in various branches of Entomology, the Entomological Department of the Institute acted as a much needed advisory agent.

Gradually the British Provinces began to have their own entomologists and entomological research mainly on economic problems soon forged ahead.

Of the Indian States, Mysore was the first to appoint an Entomologist in 1908, before any of the provinces created a similar post. A lot of valuable and pioneering work was carried out by Dr J. C. Coleman and the late Dr Kunhi Kannan and thus they laid the foundation for Entomological research not only in Mysore but in the whole of South India.

Research in Economic Entomology is also receiving due attention by an ever-increasing band of workers, financed by the Indian Central Cotton Committee, the Imperial Council of Agricultural Research, the Planters Associations and the Indian Lac Research Institute.

In the spheres of forest, medical and veterinary Entomology as well there has been an amount of excellent work of great economic value carried out by a large number of scientists. Stebbing and Imms no longer in India were responsible for much and the early development of forest entomology. Beeson and Cardner have now added enormously to the knowledge on forest insects and their relation to forest products. The most spectacular efforts in applied entomology efforts indeed of a far reaching importance to human existence, have been witnessed, in the field of medical entomology. Ever since the discovery of the role of the mosquito in the development and dissemination of malaria, rapid strides have been taken in the matter of knowledge of insect transmission of human diseases. Ronald Ross, Daniel Austin and other stalwarts in the line have made contributions whose value it is hardly possible to assess. House flies, sand flies, fleas, lice and bed bug are all being studied by medical entomologists as probable and possible vectors of several diseases peculiar to India and the tropics. But work on insects in relation to domestic animals and their diseases has not progressed far, with the appointment of Sen as Entomologist at the Imperial Veterinary Institute it is hoped that the much needed relief to the live stock from the unpleasant and dangerous attentions of several insect species will soon be made possible. In view of the fact that the live stock form the main stay in Indian agriculture no more time should be lost in vigorously investigating their insect borne diseases.

Although Entomology has long been recognised as one of the major Biological sciences and afforded equal importance with other subjects in the educational institutions of the West, in India, it is still a Cinderella of the prevailing educational system. It is high time that Entomology is included, as an independent major subject in the

Secondary and University curricula in view of the vast importance of insects in relation to human welfare. Especially should the subject be given the status it deserves in the biological sections of the technical and professional course while the study of Entomology in the agricultural Colleges in India is insisted on as a necessary part of the general course in medical and veterinary colleges it is scarcely touched upon.

It is impossible to deny the importance of Entomology to India. Citing the case of a single insect borne disease of man in India namely malaria Sir Mirza Ismail as leader of the Indian Delegation at the Inter Government Conference on Rural Hygiene in 1937 has well stressed on the national importance of the mosquito. And yet mosquito is only one of several important insects concerned in human diseases in India. The losses caused to India by insects that destroy valuable crops timber and animal products are estimated at 200 crores of rupees. The loss caused from insect pests to domesticated animals exceeds 3½ crores. The Ox Warble fly alone is responsible for loss to the extent of 1½ crores of rupees to the hides produced in the country. There cannot be the least doubt that among sciences of economic value in India Entomology must take the very first place in importance.

There is growing need for a proper training for Entomological research workers in the country. The Universities can play a very great part in this training by affording a distinct place to and improving the status of Entomology in their Zoology Course for the degree examinations and in post graduate courses. The Zoology Departments of the Universities can also by means of healthy co-operation with the Entomological Departments of the Agricultural services in the country turn out a tremendous lot of valuable work in pure and applied Entomology. A perennial source of vital subjects for serious studies is awaiting the research workers in the Universities in the field of Entomology.

For the rapid advancement of Entomology in India the organisation of an Entomological Society is of immediate importance and a Periodical devoted entirely to the publication of research work in this science is very essential. It is hoped that the workers will soon mobilize and lay the foundation for both.

#### ANTHROPOLOGY

President DR B S GUHA M.A. PH.D. F.N.I.

#### THE RACIAL COMPOSITION OF THE HINDUKUSH TRIBES

THE region south of the Hindukush and Karakorum mountains occupied a strategic position in the racial geography of India, for in these difficult high mountainous valleys were still sheltered some of the remnants of the northern steppe folks who invaded India in the second millennium B.C.

Linguistically the tribes living in this area could be classified under two heads, namely,

Dardic and Burushaski with Kaffiri occupying an intermediate position between Iranian and Indian. Burushaski was unrelated to any known language but Moregenstierne's investigations had shown the essentially Indian character of the Dardic and even the Kaffiri languages.

The earliest investigations on the somatic characters of these interesting tribes were those of Ujfalvy followed by Stein, Dainelli and the author himself who as a member of the scientific expedition sent by the Government of India, visited Kaffiristan and Chitral in 1929.

From a careful consideration of physical characters, it appeared that the basic racial type in the entire region was a short, dark dolichocephalic strain with prominent long nose, often aquiline which might be regarded as a variant of Eugen Fischer's *Oriental race* and the most characteristic type of the region.

Besides this principal type they had the southern extension of a broad headed race closely allied to what was known as the *Dinaric race* of eastern Europe. In its strongest form it was found among the Khos of the Chitral valley and the Burushos of Hunza Nagir though it occurred throughout the Dardic tribes in varying degrees. The skin colour in this race was prevalingly of a rosy white tint but the eyes were more often hazel and green, and the colour of the hair was brown.

The third main racial strain was a tall dolichocephalic type with long and straight nose. It formed a very important layer among the Kaffirs and the upper stratum of the Burusho and the Dardic tribes. The distribution of the cephalic index in this type followed the same trend as found by Ariens Kappers in the races of the Aral-Caspian regions and very similar to that which formed the dominant element in the North European population, from whom its chief distinction lay in the integumentary colours.

Whereas in Sweden the blond type represented 49% of the population among the Kaffirs it did not exceed 15%. Blondness, as was well known was due to a deficiency mutation which suppressed the appearance of pigment. It is certain that this deficiency mutation had occurred in this and at least in another namely, the *East Baltic race* at some time or other. It was probable that the mutations for skin, eye and eye colours had taken place separately.

In the Baltic tribes the high rate of the deficiency mutation might probably account for the larger percentage of the blond as compared to the Hindukush tribes among whom the activators were perhaps dominant over suppression causing the general persistence of the more pigmented people.

Lastly an intruding Mongoloid element must also be responsible for the yellowish tint in the skin colour and broad flat nose found among many individuals.

The proportions of these strains varied in different parts. The Dinaric and the Proto Nordic elements were stronger in the western valleys, whereas the basic Oriental and the Mongoloid elements were more conspicuous in the eastern valleys of the Upper Indus.

## AGRICULTURE

President RAO BAHADUR T S VENKATRAMAN,  
C I E , B A , I A S , F N I

### HYBRIDIZATION IN AND WITH THE GENUS *SACCHARUM* ITS SCIENTIFIC AND ECONOMIC ASPECTS

THE discovery of fertile seeds in sugarcane has been fully utilised in the breeding of improved types of sugarcanes for commercial purposes. At Coimbatore work on hybridization of sugarcanes is in progress for over 25 years employing several hundred parents belonging to at least six different species of *Saccharum* and four genera—two of them widely separated from *Saccharum* in taxonomic position. This work represents the first attempt in the sugarcane world at improving the subtropical canes specially for the Indian sugarcane area utilising a wider range of parents than in other countries for hybridization.

Recent classifications of grasses based on morphological and ecological characters place *Saccharum* which is included in the tribe *Andropogoneae* among the more evolved forms as compared to primitive *Bambuseae* and *Festuceae*. The tribe *Andropogoneae* includes sugarcanes, sorghums, Lemmon grass and Khus Khus. The genus *Saccharum* is of economic importance as it includes all the sugarcanes *S. officinarum*. The wild *Saccharums* appear to have two races both of which are confined to South East Asia and New Guinea. *S. spontaneum* has a much wider range spreading from Turkestan to Malaya and *S. robustum* is confined to New Guinea. In breeding work it has been observed that *S. robustum* has a closer affinity to the 'thick class of canes' than the *S. spontaneum*. Certain Indian canes bear a close affinity to the group of *S. spontaneum* and in the hybrids though the high juice quality is maintained, marked juice impurities are inherited. There is a wide range of forms in this group which differ in morphological, physiological and field characters.

The sugarcanes in cultivation are divisible into two main groups, perhaps, originally derived from *S. spontaneum* and *S. robustum*. They show in cultivation markedly different agricultural characters. The Indian indigenous canes related to *S. spontaneum* are on the whole, hardier than the thick class of canes. They are confined mostly to subtropical India and are subject to severe summer in the early stages and frosts in the cold weather. They have only a short period of growth of six months. The severe growth conditions have established types which are hardy and resistant to diseases though poor in tonnage. Java utilized one of these canes 'Chunnee' of U P to breed canes resistant to

'sereh'. The sugar industries of the tropical world have been built upon the 'Noble' or tropical canes. They are thick stemmed and need a longer period for full growth. The best yields are obtained under tropical conditions and they respond to good cultivation and manuring. Record yields have been obtained with these canes but they are less hardy and more liable to diseases.

There is a wide range of forms in *S. spontaneum* ranging from inconspicuous plants to those growing from 10 to 15 ft high. In a cursory collection made in Bihar about eight different types were secured. Their sugar content varied from 0.5 per cent to 17.0 per cent which latter figure is somewhat higher than some of the Indian canes in cultivation. A well organised survey will yield very interesting results. The common types of Java and Coimbatore differ and both the places are using types of them in breeding most of the recent popular canes. Most of the canes grown in upper India come under *S. barberi* or *S. sinense*. Some like Mungo Nargoni and Sunnabelle groups cannot be placed under the above classifications. The short Mungo group held a dominant position on account of its excellent habit, high juice quality and uniformity of canes at harvest time. Nargoni group is resistant to water logging and is erect in habit. These two groups have not been useful in breeding as they do not generally flower. The Sunnabelle group also does not generally flower. This group of canes is often liked for its satisfactory juice qualities and the erect habit of growth. These with *S. robustum* varieties of *S. officinarum* and *S. arundinaceum* afford all the material required in sugarcane breeding work at the present time.

After the discovery of the viability of sugarcane seed, when large numbers of seedlings were raised a wide range of forms was noticed even in selfed flower heads. This was due to the heterozygous nature of the parents. The need of the sugar industry was so urgent that attention was paid only to the economic results by the breeding stations. Work of fundamental nature should be taken up sooner or later by the universities or the breeding stations in studying the inheritance in *Saccharum*. Such a work is needed to place sugarcane breeding in a line with that of other crops. Sugarcanes in cultivation are mostly polyploids and *S. officinarum* is octoploid. There is a wide range of variation in the seedlings and a kind of family resemblance is found though their nature is veiled and modified by other factors.

As compared with other crops there has been very little 'breeding' in sugarcane. It is worth attempting either to eliminate undesirable characters in sugarcanes or to obtain reliable data in the interests of science. There have been rather interesting examples of inbreeding at Coimbatore. *S. spontaneum* was selfed for two generations without obtaining canes superior to the  $F_1$  hybrid in field characters but there was a distinct improvement in sugar content when the selection was made on this basis.  $F_1$  of a cross between a Mauritius cane, *S. barberi*

and *S. spontaneum* was inferior to the original parent in vigour continuous selection in breeding resulted in a type distinctly superior to the original parent both in early maturity and high juice quality. It is likely that one accentuates certain characters in the new productions. The loss of vigour would probably necessitate further hybridization with suitable types to improve vigour. The experiments are indicative of the possibilities of breeding in sugarcane.

The results from breeding proving so limited, breeders all over the world have turned their attention to hybridization between varieties, species and even genera for obtaining economic results. Hybrids of a fairly complicated ancestry have been built up often involving three different species of *Saccharum*.

In sugarcane the flowers are small floral structures are delicate and bagging inhibits seed setting. Emasculation and selfing have been but little practised in the breeding of commercial types. In the present methods adopted mother parent is known and the pollinating parent is often not so certain as there often exists possibilities of other pollen reaching the stigmas of the treated flowers. Selection of seedlings is for commercial types and all the seedlings are not studied and bred further for the study of inheritance. The bulk of the seedlings are from the parents employed and the  $F_1$  seedlings yield very useful indications in the matter of inheritance.

In Java Mauritius Hawaii West Indies and other places hybridization between varieties in *S. officinarum* have resulted in seedlings having useful field characters which render them superior to existing types. Inter-varietal hybridization in *S. barberi* have produced poor class of seedlings when selfed. The *S. sinense* group have defective floral organs. Other Indian canes do not flower or have defective floral organs. At Coimbatore a fair amount of work in inter-varietal crossing in *S. spontaneum* is in progress with the main object of understanding the cytogenetic composition of the genus *Saccharum*.

Java produced disease resistant canes through interspecific hybridization in the genus *Saccharum*. As breeding inside the species of *S. officinarum* or *S. barberi* do not yield types suitable for upper India interspecific hybrids between them were attempted but they did not yield desirable results. Under these difficulties early in 1912, Coimbatore turned its attention to the raising of interspecific hybrids between *S. officinarum* and *S. spontaneum*. The success of Co 205 obtained in such a manner was a definite and clear indication of the line of work to be adopted for evolving canes for Northern India. Coimbatore has freely used *S. spontaneum* in its breeding programme and most of the popular seedlings now in cultivation have in their ancestry *S. spontaneum* suitably blended with *S. officinarum* or *S. barberi*. In such hybrids the wild parent introduces marked impurity in the juice and they require further crossing with *S. officinarum* to ultimately secure economic types. *S. robustum* has been known to introduce greater vigour of growth when crossed with

*S. officinarum*. Crosses with *S. arundinaceum* and *S. officinarum* seem to inherit the perennial character of the wild parent.

The intergeneric hybrids obtained by crossing *Saccharum* with other genera are very interesting. The distance in their taxonomic positions is greater than in any other intergeneric hybrids recorded hitherto. *Saccharum* has not only been successfully crossed with other genera like *Narenga Erianthus* and four species of sorghum but also with a genus belonging to a different subfamily *Bambusa* and two other genera at Coimbatore.

The two intergeneric hybrids with sorghums and *Bambusa* were effected with the definite object of securing a wide range of variation in the  $F_1$  and introducing if possible new characters that might be useful in the further evolution of economic sugarcane seedlings. Sorghum cross was made to introduce a shorter life cycle. Types maturing in about seven months having a high quality juice and showing ability to stand in the field without appreciable deterioration up to four months have been secured. The economic types have been disappointing in their growth vigour. Bamboo hybridization was successfully done in December 1936. This attempt was made to introduce greater vigour if possible into *Saccharum* hybrids and also into the comparatively early maturing sugarcane  $\times$  sorghum hybrids. It is too early to predict the possible economic results.

In both the sorghum and bamboo hybrids with sugarcane there is a general dominance of *Saccharum* characters in  $F_1$  and this is of great practical value to the sugarcane breeder who multiplies his improved canes by vegetative means. In the case of sugarcane  $\times$  sorghum hybrids the general dominance of *Saccharum* characters was found to persist even after twice back crossing the hybrids with their sorghum parent. Certain of the sorghum hybrids exhibited characters not found in either parent. The leaves were thicker than either parent and it got emphasized in further back crosses with sorghum. The intergeneric hybrids have also shown a very large number of abnormalities in stem, bud leaf and floral organs such as flattened stem double or multiple buds multiple ovaries and stigmas partial suppression of lamina and forked leaves.

In the intergeneric hybrids between sugarcane and bamboo there is a wide range of variation in the  $F_1$  plants. The bamboo characters of early branching, central cavity in the stem, ascending root eyes and hardness are found distributed in the various plants thus affording scope for making the required selection for further vegetative propagation.

In sugarcane breeding there is a large amount of chance or hit and miss in securing required results. It is difficult to resynthesize or rebuild an improved cane that has been once obtained. There is a general absence of well defined segregation of characters in *Saccharum* hybrids. Even after carrying the process to more than three generations, types resembling the original



parents have not been obtained. This is attributed to the peculiar mode of division and pairing of chromosomes yielding amphidiploids or constant hybrids. In the interspecific and intergeneric hybrids, there is no sterility in  $F_1$  plants. Even if they show sterility in the first year they produce fertile pollen after further vegetative propagation from cuttings and set seed freely.

Intensive work on the cytology of *Saccharum* is in progress at Coimbatore for the last three years. Properly controlled crosses have been made for critical study. This work is throwing light on the origin and distribution of *S. spontaneum* types and the probable origin of certain Indian canes.

The sugar industry has derived immense material benefits from hybridization in the genus *Saccharum*. The wide variations found in the seedlings supplied the sugarcane breeder with a large number of new types. The possibility of vegetative propagation of the improved types and the continuance in the subsequent crops of such characters, has been a great asset in securing quick results. The introduction of the wild species into the parentage has been useful in keeping down pests and diseases. They have been also of great value in introducing into the new productions hardiness and power to withstand adverse conditions.

The wide disparities that have been bridged by the intergeneric hybrids with *Saccharum* leads to a new orientation in the concept of genus and species at least in the genera and families allied to *Saccharum*.

#### MEDICAL RESEARCH

President SIR U N BRAHMACHAR, M A M D  
PH D F N I F R A S B

### THE CONQUEST OF KALA AZAR AND CERTAIN OBSERVATIONS ON THE CHEMOTHERAPY OF MALARIA

#### I THE CONQUEST OF KALA AZAR

THE earliest epidemic of kala azar in Bengal (Burdwan fever) occurred in the seventies of the last century when it was probably compli-

cated with malaria. In this epidemic the fell disease had mocked every human effort and absorbed in its powerful grasp day by day and inch by inch, every blessed spot which once used to be prized for its salubrity. In more recent times the epidemic of the disease in Nowgong district of Assam produced such an appalling mortality that there was a decrease of 31.5 per cent in population of the place in the decade 1891-1900.

The mortality from the disease has now been reduced from 90 per cent or more to 1 or 2 per cent. Including complicated cases it has been reduced from 99 to less than 10 per cent.

The conquest of kala azar may be said to have begun when Cistina and Caronia obtained remarkable results in infantile kala azar of the Mediterranean basin by the use of tartar emetic. It has been observed (Brahmachari and co-worker) that when metallic antimony is injected intravenously in an leishmania infected experimental animal in a state of fine subdivision the particles are picked up by the same cells in the spleen as those that harbour the parasites of kala azar and that in the struggle that ensues the fight ends most remarkably in the complete destruction of the parasites in the speediest way. It is one of the most powerful leishmanocides.

It has been found that in the campaign against kala azar, treatment with tartar emetic or sodium antimonyl tartrate had the disadvantage of being long and tedious. In Assam which was once the hot bed of the disease mass treatment with these drugs was therefore found difficult to enforce as patients discontinued treatment altogether or attended very irregularly after a few injections. It was felt that the difficulties in reducing the number of Stopped Treatment cases would be overcome more effectively if some drug could be introduced which would be more efficacious than tartar emetic and take a much shorter time to effect a cure. Such a drug was found in urea stibamine. Its value in the campaign against kala-azar in Assam is demonstrated from statistics from the annual Public Health Reports of the Government of Assam quoted below.

Statistics of number of Kala-azar Cases Treated by the Government of Assam and the number of Deaths from the Disease.

#### PROVINCE OF ASSAM AS A WHOLE

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	60,940	49,385	33,415	23,576	21,804	16,430	12,592	11,958	12,650	13,398	11,100
No of deaths	6,365	4,176	2,859	1,660	1,405	953	1,017	987	749	770	845

## DISTRICTS

*Sylhet*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	10 934	16 335	10 527	8 988	9,162	6 726	5 512	4 719	4 210	4 612	3 869
No of deaths	2 109	1 320	798	482	429	274	246	296	146	227	260

*Goalpara*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	6,003	5 671	3 495	2,316	2,389	1,439	992	1,089	1 159	1 107	1,245
No of deaths	453	297	226	166	135	112	121	122	92	61	100

*Kamrup*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	8 753	7 301	6 445	3 577	2 598	1,814	1,690	2 061	2 223	2 197	1 465
No of deaths	1 120	714	475	241	180	102	160	152	129	151	176

*Darrang*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	5,262	4 414	4,053	2,228	1 399	1 106	942	665	757	876	738
No of deaths	478	474	318	258	241	185	222	155	167	136	91

*Nowgong*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	13,895	9 586	5 008	2 614	2,433	1,440	1 057	1 075	1 663	1 726	1 651
No of deaths	1 445	839	528	260	178	132	129	132	110	78	52

*Garro Hills*

Year	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
No of cases treated	1 952	2,812	1 828	1,690	2,905	1,905	882	605	850	927	690
No of deaths	435	346	350	154	149	84	64	43	34	23	58

The figures for Cachar which are not exhibited in the above tables are very interesting. Out of 5,188 cases treated from 1925 to 1936 the number of deaths was 56 showing a percentage of less than 1.08. Out of 574 cases treated in 1936 the number of deaths was 2 showing a percentage of less than 0.3. The incidence of the disease in Assam has been reduced from 60,940 in 1925 to 10,587 in 1936 and the mortality from 6,365 to 753 during the same period. The disease has lost all its terrors in the Province and people who suffer from it are less afraid than those who suffer from malaria.

The Kala-azar Commission, India, used, throughout the seven years of their existence urea stibamine only, in the routine treatment of kala azar. According to them the acute fulminating type characteristic of the peak period of an epidemic responded to treatment with urea stibamine extraordinarily promptly and with an almost dramatic cessation of fever, diminution in size

therapy of quinoline and acridine compounds in malaria may one day play an important part in the campaign against the disease and its conquest. While some quinoline and acridine compounds have marked destructive action on paramoecia most of them have been observed to have no action on the parasites of malaria when used clinically in patients suffering from the disease.

Recently a compound having a similar composition to that of quinacrine or atabrin has been synthesized in the speaker's laboratory. It has been used as hydrochloride or hydrobromide. Its action in benign tertian and malignant tertian infections in man is identical with that of atabrin. Shortt and Menon have observed that in a series of experiments carried out with this compound and atabrin on monkeys infected with *Plasmodium knowlesi* the effect of the two drugs in sterilizing the peripheral blood, the cure rate and relapse rate were identical. Its effect on paramoecia is noted below.

	Experiment No I	Experiment No II	Experiment No III
Strength	Effect on Paramoecia	Effect on Paramoecia	Effect on Paramoecia
1 1,000	Death in 2 to 4 minutes	Death in 3 minutes	Death in 2 to 5 minutes
1 5,000	Death in 4 to 6 minutes	Death in 3 to 5 minutes	Death in 4 to 6 minutes
1 10,000	Death in 8 to 10 minutes	Death in 7 to 10 minutes	Death in 6 to 9 minutes
1 40,000	Death in 12 to 15 minutes	Death in 10 to 14 minutes	Death in 10 to 15 minutes
1 80,000	Majority died in $\frac{3}{4}$ of an hour	Majority died in $1\frac{1}{2}$ hours	Majority died in 62 minutes
1 100,000	Majority died in $1\frac{1}{4}$ hours	Majority died in $1\frac{1}{2}$ hours	Majority died in $1\frac{1}{2}$ hours (few survived)
1 120,000	Few deaths in $1\frac{1}{2}$ hours	Few deaths in 2 hours	Few deaths in 2 hours
1 160,000	No death in 2 hours	No death in $2\frac{1}{2}$ hours	No death in $2\frac{1}{2}$ hours

of the spleen and return to normal condition of health.

In 1933, the Director of Public Health, Assam, noted that 'It is no exaggeration to say that approximately 3.25 lacs of valuable lives have been saved to the Province.'

In 1932, in studying the treatment of kala-azar, the speaker observed certain remarkable skin eruptions caused by *Leishmania donovani* developing in kala-azar patients two or three years after completion of antimonial treatment and apparent cure though under ordinary conditions in kala-azar the skin shows very little involvement or none (*Dermal Leishmanoid*). Viable leishmania have been cultured from these skin lesions in test-tubes and sandflies. They are therefore a source of infection and the conquest of kala azar cannot be regarded complete unless these lesions are either averted or quickly cured. In the campaign against kala-azar and its conquest, proper handling of cases of dermal leishmanoid is an important point to be taken into consideration.

## II CERTAIN OBSERVATIONS ON THE CHEMOTHERAPY OF MALARIA

Research in malaria-therapy has been intense in recent times. In certain parts of India it is of greater interest than kala-azar. The chemo-

The discoveries of effective antimalarials and leishmanocides rank among the highest triumphs of synthetic chemistry in its application to tropical medicine.

The author concludes by saying that if along with the conquest of malaria and kala azar there is in India a proper balance between labour-saving devices and industry increasing discoveries, and if her people will but decide to put in play the methods which science to day has provided for sufficient supply of food and clothing and shelter then the health and economic problems of India, with her endless natural resources will be solved to a great extent and much of her unrest and unemployment will cease and she will have the opportunity of being richer, happier, healthier and freer than ever before.

## PSYCHOLOGY

President DR. G. BOSE M.B. D.Sc. F.N.I.

## AMBIVALENCE

DR. G. BOSE, D.Sc. M.B., F.N.I., has devoted his Presidential Address to the phenomenon of Ambivalence. Observing that no satisfactory explanation has as yet been advanced of negativism Dr. Bose refers to

Dr Bleuler's "Concept of Ambivalence (ie to ambivalence and to ambivalency) and restricts the term ambivalence to include both ambivalence and ambivalency. After reference to the view of Freud according to which Oral libido as a causative factor in ambivalence is the most important contribution (p 3) occurs the statement that in true ambivalence opposite tendencies are supposed to be present but one of the contending elements at any particular moment must necessarily be unconscious (p 4) Analysing ambivalence in 'Feeling, Emotion and Judgment' Dr Bose asserts that 'The problem of ambivalence is therefore restricted to the domain of wish only (p 6) Thus WISH has got to be separated from emotional and feeling attachments if analytical grasp of ambivalence is to be firm. The question is next considered whether ambivalence is a characteristic of a "single wish" or a pair of opposite wishes. The distinction between an active wish and a 'passive wish' is then emphasized and reference is made by way of illustration to the desire to kiss and the desire to be kissed (p 9) Dr Bose finds that neither the antithesis between love and hate nor the one between activity and passivity would give the clue to the solution of ambivalence. He then dissects the antithesis between subject and object and wants the Ego to be split into (split is his term not mine) 'subjective half' and 'objective half' (p 11) After reference to their vicissitudes, and identification of the subjective half with the objective in certain characteristic situations such as the giver and the receiver of a gift occurs the illustration of RADHA bitterly feeling the absence of KRISHNA 'imagines herself to be KRISHNA seeking RADHA' (p 11) The experience of paraphrenia is referred to. There is according to Dr Bose, an inherent opposition between the subjective and the objective halves of the ego, and ambivalence develops when transference of the objective half to an external object is not perfect (p 13) Thus one reads 'repressed masochism makes sadism ambivalent and vice versa'. In reference to this unresolvable and inevitable halving of the Ego into subjective and objective 'Paired wishes' 'Identification' and 'The Wish Circuit' are explained. Then Dr Bose sums up conclusions. Ambi-

valence is not a fundamental trait of mental life. Ambivalence is removable showing it is a repression product. There is no wish without its opposite counterpart. It is the opposite wish that provides the motive force for all repression (p 18)

From the fore stated summary of the Presidential Address of Dr Bose it must be evident that he has endeavoured to account for the phenomenon of ambivalence mainly on the basis of the existence of every wish having its opposite counterpart a repression, and the existence of FOUR values secured by a process of simple elementary arithmetic indicated by subjective and objective halves of the Ego and primary and secondary. While the permutations and combinations among the four primary subjective, primary objective, secondary-subjective and secondary objective may be taken to delight a particular species of modern experimental psychologists I am unable to see what may be the net psychological gain to the credit of the psychological world in the matter of an intelligent understanding of ambivalence without recourse to mystification of data and terminology. There is the epic story of an ambivalent wife with whom the husband seems to have got on, indeed splendidly well by carefully demanding of her the opposite of what he normally wanted. If he was hungry he would just say 'No, I do not want to eat today'. No preparations need be made. Immediately, the ambivalent wife got everything gastronomical ready. I do not wish to continue the story.

So long as Dr Bose freely uses the concept and terminology of repression, Ego, etc, he is quite content to rest in the company of the so called experimental psychologists. I have an open mind in the matter but whether ambivalence always and universally means one of the opposite tendencies should remain below the threshold of awareness is more than I can see today. International behaviourism is adroitly ambivalent. All talk is of disarmament. But the military budget mounts unconscionably high!

N NAGA RAJA SARMA