

INDIAN SCIENCE CONGRESS, BENARES, 1941

Summaries of Addresses of Presidents of Sections

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ZOOLOGY

President: PROF. A. SUBBA RAU

SOME ASPECTS OF MAMMALIAN PLACENTATION

HARVEY (1657) regarded the placenta as an organ which elaborated from the maternal blood the food required for the development and growth of the foetus, while Mayow in 1674 considered that it performed the function of a foetal lung. The view that the maternal blood circulated through the placenta was put forward by John and William Hunter. We owe to Jenkinson (1913) the view that the placenta is the organ in which the blood vessels of the embryo are brought into intimate anatomical and physiological relation with the spaces in which maternal blood is circulating. Placentation was defined by Otto Grosser (1910) as the intimate junction of the mucosa of the uterus with the chorion for purpose of exchange of material between the mother and the offspring. Professor Hill emphasised that the placenta was a composite structure partly maternal and partly foetal, the two being either in simple apposition or intimately blended, but in no case with an admixture of foetal and maternal blood streams. Normal mammalian placenta, in the words of Masoman, is an apposition or fusion of the foetal membranes to the uterine mucosa for physiological exchange.

The yolk-sac placenta except in the native bear and the wombat is usually of transitory functional significance. The Eutherian mammals have allantoic placenta. The placenta was formerly distinguished as diffuse, multiplex, zonary, cotyledonary or discoidal according to its external appearance. Weber, Huxley and Strahl based their classification on the presumption that in certain forms there was loss of maternal tissue during parturition. Caducous or non-caducous (Weber), deciduate or non-deciduate (Huxley), Placenta vera or semi placenta (Strahl). Assheton divided the Placenta into placenta cumulate and placenta plicate, based on the activity of the trophoblast. Otto Grosser's classification, however, into four types based on the exact relations of the maternal and foetal tissues has general approval: epithelio-chorialis, e.g., pig; syndesmo-chorialis, e.g., sheep; endothelio-chorialis, e.g., carnivores; haemo-chorialis, e.g., Rodentia, Insectivora, Cheiroptera, Anthropoid Apes and Man. Some maintain that the epithelio-chorialis type is primitive and the haemo-chorialis is highly specialised while others regard the latter as the primitive type. Both views have facts to support, but the former view is more probably the correct one. The number of layers of cells that separate the two blood streams progressively decreases from six in epithelio-chorialis to three in haemo-chorialis.

The endothelium of the maternal capillary, the connective tissue around it, the uterine epithelium, the trophoblastic epithelium, the connective tissue of the allantochorion and the endothelium of the foetal capillary represent the six layers in the epithelio-chorialis type. In the syndesmo type the uterine epithelium is lacking; in the endothelio type the foetal connective tissue is also lost; and in the haemochorialis the maternal capillary endothelium disappears in addition to the above two.

In the fallopian tube the fertilized ovum depends on the secretion of the surrounding tissues for its nourishment. In the uterus, till it attaches to the uterine wall, it is nourished by uterine secretions; with the establishment of the placenta, it depends on direct absorption by the trophoblast of the products of the uterine mucous membrane; and with the vascularisation of the allanto-chorion, on the maternal blood.

The proteins are transferred as amino acids to the foetal blood; the exact nature of the amino-acids has yet to be worked out satisfactorily in the different types of placenta. The glycogen store of the mother is the chief source of carbohydrate for the foetus. The leucocytes of the maternal part of the placenta seem to play a part in the transference of fat, these loaded with fat migrating into the foetus. In the human placenta the fats may either pass across the placental barrier to the foetal blood or may be absorbed by the maternal placenta from its blood stream and passed on to the foetal blood with or without modification. Further work on the function of the placenta as a judicious regulator of fat supply may promise fruitful results, as the fat content of the placenta is stated to decrease with age. Work on placental enzymes is also needed. Our knowledge of the role of vitamins other than that of "E" is meagre, as also of the mineral metabolism.

The foetal haemoglobin differs from that of the mother in the few forms that have been recently examined. The studies of Boor and Hektoen indicate that the carbon monoxide haemoglobin is species specific. Further, the blood of different animals show both qualitative and quantitative differences in their haemoglobin. The metabolic needs of the embryo and accordingly the oxygen requirements vary in different species of mammals. The physico-chemical properties of the placental barrier in different groups of mammals with reference to the rate and intensity of exchange of materials await satisfactory solution.

The subject of nutrition of the pregnant mother may well form the subject of serious research in the newly established ante-natal clinics in Indian Maternity Hospitals. The attention of the Nutrition Research Laboratories may also be directed to the study of foetal nutrition. Indian zoologists may in future turn more and more to experimental methods in their investigations. A co-operative effort by

zoologists, physiologists, specialist medical men, and biochemists is needed in a well-planned study of foetal nutrition.

S. G. M. R.

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CHEMISTRY

President: PROF. MATA PRASAD

PHYSICO-CHEMICAL STUDIES OF GELS

THE gels may be broadly classified as organic gels, inorganic gels and inorgano-organic gels, the classification being based upon the nature of the gel-forming material. The organic gels are obtained usually by preparing a hot solution of the material in a suitable solvent and cooling it down until it sets. In some cases, mere heating with a suitable solvent is sufficient to bring about the gel formation. Change of solvent is again helpful in the preparation of certain gels. Amongst the inorgano-organic gels, we have the soap gels studied by McBain and co-workers. It has been shown by the work at the *Royal Institute of Science*, that good, transparent, colourless gels of many soaps could be obtained in pinene; these gels showed syneresis and were found to be heat reversible. Inorganic gels have been produced by (a) mixing the constituents of a gel-forming mixture, (b) by the addition of electrolytes to a solution and (c) by the change of solvent.

The composition of the gel-forming mixture has a profound effect on the properties of the gel formed. This aspect has received considerable attention at the laboratories of the *Royal Institute of Science* and has led to the preparation, in a transparent state, of a number of gels which were originally known only in an opaque or translucent condition.

The kinetics of the formation of gels has been the subject of numerous investigations. The methods of (a) Flemming, (b) Fells and Furth, (c) Hurd and Letteron, and (d) Prasad and Hattiangadi, for determining the setting time, are found to yield different values for the same gel-forming mixture. The methods are however, useful for a comparative study. Effect of temperature on the setting time has been investigated by Hurd and co-workers. They are led to consider that the setting of a gel is an activated process. Prasad and co-workers found that heat reversible gels are often associated with a negative heat of activation. The effect of concentrations of reactants, pH, electrolytes and non-electrolytes on the rate of setting has been studied with several gel-forming systems. Prasad and co-workers have contributed considerably to our knowledge in this field. They have followed up the setting process by measurements of viscosity and intensity of transmitted light. The latter technique has now been perfected by Gogate working at the *Royal Institute*. Subbaramiah has followed up the process of gelation by measuring the depolarisation factors, ρ_r , ρ_u and ρ_h . His results are in general agreement with

the accepted ideas regarding the process of gelation.

Gels exhibit many interesting properties. Certain class of gels become solutions on being mechanically agitated and set into gels again on standing. This phenomenon known as thixotropy has been investigated by several workers. Special mention is to be made of the work of Goodeve and co-workers, who have devised a viscometer which permits of a continuous alteration of the rates of shear. Prasad and co-workers have observed "Zonal" changes of viscosity during the gelation of thixotropic gels.

Systematic work on the elastic properties of inorganic gels has been carried out by Prasad and by Yajnik and co-workers. The vibration of the free gels has been studied by Prasad. The vibration of containers containing set gels has been studied by Holmes and co-workers.

The phenomena of syneresis and swelling or inhibition has been investigated by several workers, as also the drying of jellies.

Considerable amount of work has been done on the sorptive properties of the dried gels. Recent work of K. S. Rao on hysteresis in sorption has established the correctness of the cavity concept proposed by McBain for explaining hysteresis. The cavity idea fully explains the phenomena associated with the scanning of the hysteresis loop as well as the drift and the disappearance of the loop.

The structure of jellies has been investigated by a number of workers. "The fibrillar theory is in harmony with most of the characteristic properties and varied phenomena shown by gels. It explains satisfactorily the elasticity, viscosity, syneresis, swelling, dehydration and hysteresis diffusion and optical and ultra-microscopic phenomena. This theory has the adherence of most of the workers on the subject of gels although it cannot be assumed *prima facie* that all gels have the same architecture."

K. S. GURURAJA DOSS.

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GEOLOGY

President: DR. M. R. SAHNI

PALAEOGEOGRAPHICAL REVOLUTIONS
IN THE INDO-BURMESE REGION AND
NEIGHBOURING LANDS

Vindhyan to Devonian

IN his Presidential Address to the Geology Section, Dr. M. R. SAHNI deals with the Palaeogeographical Revolutions in the Indo-Burmese Region and neighbouring lands during the Vindhyan to Devonian period. To use his own words, he has attempted to give us "a panoramic review of the sequence of geological events that have moulded the palaeogeographical history of the Asiatic continent, and more particularly of the Indo-Burmese

region" during this period. Such a review has naturally to be based almost entirely on a comparative study of the rocks and fossils of this period in different areas—the only basis of exact correlation being the occurrence of identical species of animal or plant fossils in strata of marine or continental origin as the case may be. Whenever there is a difference in the character of the marine faunas of a period between two adjacent areas, the usual tendency is to interpolate a land barrier; but as Dr. Sahni has pointed out, this is not always correct since "variation in the physical conditions such as temperature, depth, relative salinity, direction or strength of ocean currents of intercommunicating marine regions may be just as effective barriers to the migration of marine faunas, as land barriers". He also reminds us that "such differences may also be due to the fact that we are not dealing with strictly contemporaneous faunas, but with faunas of varying ages within the same geological system."

After drawing our attention to these aspects of the problem which we have to bear in mind while dealing with palæogeographical studies, Dr. Sahni proceeds to deal with the subject proper of his address and gives an account of the land and water connections which existed between India and the adjacent countries at different periods between the Vindhyan and Devonian times, in the light of the most recent palæontological studies made in these different areas. Some of his main conclusions are (i) "a correlation between the Vindhyan and Cambrian strata seems unjustifiable though one may certainly concede that the physical conditions remained unchanged from the Vindhyan to Cambrian times." (ii) "The Lower Cambrian in Southern and Western Asia was dominantly a continental period. . . . The Middle Cambrian was a period of widespread marine transgression and the Middle Cambrian sea extended from north-west America to western Asia, as far perhaps as the Dead Sea." (iii) "The close of the Ordovician or early Silurian marks a period of profound marine transgression over India, Burma, Indo-China, Yunnan as well as central and southern China. Indeed this transgression which appears to have reached its zenith in Wenlock times, affected the European continent as well as north America; and one common Silurian ocean seems to have spread round the northern hemisphere." (iv) "The commencement of the Devonian witnesses one of the most interesting episodes in the geology of southern Asia, namely, the sudden influx of a fauna which bears no relation to the faunas of immediately surrounding regions, but is a prototype of the far Mediterranean Lower Devonian fauna. . . . The marine transgression which took place in Middle Devonian times has few parallels in the geology of Asia. This resulted not only in the intermingling of the Asiatic fauna of different regions, but also, as emphasised by Reed, in the breaking down of barriers of Asiatic and European life provinces which gave rise to similar faunas in widely separated regions."

L. R. R.

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AGRICULTURE

President: MR. K. RAMIAH

PLANT BREEDING AND GENETICAL WORK IN INDIA

PLANT breeding has formed an important part of the work of agricultural departments in India from the very beginning. The improvement in the plant types aimed at has been in the direction of enhanced yield per acre, rather than in respect of quality, inasmuch as the money return to the grower depends under present conditions upon a bigger yield than on better quality, even though the need for improved quality in a crop like cotton, for instance, is very great. The lack of exact knowledge as to what constitutes quality, the difference between the consumer's estimates of quality and those based upon scientific standards of nutrition, and the fact that a superiority in quality is sometimes offset by a lower yield and a lesser money return have retarded progress in the direction of improvement in quality. The practical results of plant breeding work in the country are very striking although the work has been in progress for a period of hardly thirty years. Taking the four important crops, rice, wheat, sugarcane and cotton, the area under the improved strains evolved by the departments covered in 1937-38 5.2, 19.5, 74.3 and 22.2 per cent. respectively of the total area under these crops. Were it not that in India there are peculiar difficulties in carrying out and financing a large-scale distribution of the seeds of improved types, these varieties would have extended over a much larger area and the work of the plant breeder benefited more growers. The extent of increase in yield is never less than 10 per cent., but is generally a good deal more and even markedly so as in the case of sugarcane. A mere comparison of the average yields of crops in the published statistics for the whole of India, with similar figures of other countries, does not give a true picture of the results achieved by breeders. Compared with the total crop areas in a country as large as India with its wide climatic variations and other conditions, the areas under improved varieties are small, and the increased yields thereon are not only masked, but the potentialities of the variety are reduced materially by lack of adequate manuring, irrigation and the like. The cotton Co. 2 and certain rice strains in Madras have demonstrated possibilities under favourable conditions, and it may be claimed that both in respect of standards of work and of the results achieved plant breeding work in India is quite comparable with the work done in more advanced countries. In this connection attention is drawn to the admittedly unsatisfactory figures of the Indian crop statistics, and recent attempts to rectify matters are referred to.

In India as elsewhere plant improvement has been sought to be effected by the three familiar methods of introduction, selection and hybridisation. The first is very limited in scope, in

view of the variety of local conditions of environment which have already brought about the most suitable adaptations. In respect of selection among the self-fertilised crops, wheat, jowar, rice and other cereals, the aim has practically been an isolation of pure lines and subsequent testing to find out the best among them. The picking out of the primary selections in the mixture of types which is mostly the case has to be largely left to individual skill and the practised eye, and success depends on the large number of selections handled in the test. The practical difficulty of testing accurately, the very large number of types involved is now materially reduced by recent advances in statistical methods, notably, the incomplete randomised blocks method and modifications thereof; thanks also to the statistician, it is possible even to carry on simultaneously with the tests on the breeders' plots, tests in the cultivators' fields, and thereby to secure a speeding up of the process. Secondary or further selection after this stage, taking only the yield character, the scope for improvement is little, and in any case there are no records of systematic secondary selection in the cereals. Even in the case of cotton, as far as yield is concerned, secondary selection is of small importance, and the secondary selection, which nevertheless is generally practised, has been in respect of ginning percentage and length of fibre in which heterozygosity persists even after several generations of selfing. Genetic variability, which is the starting point for selection, is often masked by the effect of environmental variation, but a method has been evolved to study them freed from such interaction. By this method improvement in cotton has been effected in Indore in characters for which the type was considered to have been fixed; it has furthermore been applied to the evolving of wilt resistant types, whereby from material showing 60 per cent. wilt mortality types showing less than 10 per cent. mortality have been selected. Even in cereals the method showed that, though there was no progressive improvement in yield by secondary selection, genetic variability could still be demonstrated, such as, the lodging of straw.

In regard to the third method of plant breeding, *viz.*, hybridisation, the production of genetic variation by crossing gained the scientific foundation necessitated by the rediscovery of Mendel's laws, which also gave rise to great hopes that many valuable attributes coming from different parents could be combined in a single new plant. These hopes have not been realised, if we take increased yield as a criterion of plant improvement. Greater success has, however, been attained in other directions like disease resistance; Prof. Biffen's, rust resistant wheats and Prof. Nilsson-Ehle's winter resistant wheats and barleys, in Europe and the wilt resistant *arhar* of Pusa, wilt resistant cotton of Bombay and the blast resistant rice of Madras are notable examples.

On the subject of mixture *versus* pure types the address is reminiscent of the heated controversy on this subject of thirty years ago, and the views expressed are not only different from orthodox ideas, but have important bearing on

the course of future practical work. Experimental evidence is brought forward to show that mixtures have given a higher yield than their components, and it is explained that the undoubted superiority of pure types over mixtures in the case of rice, cotton, jowar, etc., applies only within a limited range of conditions existing in the tracts where they were evolved, and that mixtures would prove more useful over a wider range of conditions. It is also stated that some crops like the Upland cotton of Central India do better in competition with others than when grown pure. The former suffers less from leaf roll and red leaf when grown in association than when grown pure. The resulting mixed cotton has also been found to possess a higher spinning value than the average of the two constituents, giving thus a higher money value to the mixed cotton. Notwithstanding well-established ideas to the contrary on this all-important matter these opinions of such a great authority merit serious consideration.

The address then traces the progress of genetical science through its several phases, the study of the chromosomes as the carriers of the hereditary units, the genes, research in cytology, attempts at wide interspecific crosses, the use of X-rays, colchicine and other agents for the alteration of chromosome numbers and the production of mutations quickly and more abundantly—all of which have helped to afford to the plant breeder greater control over his material, although as far as practical results are concerned much has not followed this progress in the new science. A notable exception, however, is provided by the work on maize in America. In India genetics comprised largely a study of the inheritance of simple characters which were all found to obey simple Mendelian ratios. Yield, ginning percentage, staple length and similar characters which, as the resultant of several single unit characters, are controlled by numerous genes have not received much attention on account of the great difficulties in following their complex inheritance. The actual contribution has been by way of selections, many of which however were found of limited adaptation necessitating the opening of breeding stations on an extended scale for evolving strains suited to different environmental conditions. In hybridisation a knowledge of the inheritance of the characters which are sought to be combined was lacking in India and advance was due to a hit or miss method and success was the result of accident. The estimation of genetical variance as an aid to selection is then illustrated by some recent work on certain cotton crosses by a highly complicated statistical technique. The extent to which heterosis can be profitably made use of in breeding is next discussed and *bajra* is suggested as a suitable crop for the utilisation of this method, which in the U.S.A. has produced the famous hybrid corn of that country. The question of correlations is then taken up, and the poor chances of combining characters where the correlation is physiological is stressed by the examples of failures of work in combining high yield with short duration in rice in Madras. There is a greater chance in respect of genetically

correlated characters though even here there are limits to such combination. The use of the 'discriminant function', by which the component factor which shows the least variation due to environment is determined and utilised, is referred to in the case of the components of the yield character in rice and cotton. Dealing with the subject of wide crosses, the advantage in respect of hardiness and resistance to diseases secured by crossing with wild types is pointed out, which has also been availed of an Indian work. Some outstanding work on wide crosses are already to India's credit, and the bamboo sugarcane cross and the sorghum sugarcane cross of Venkataraman, and crosses effected between Asiatic and American cottons are all referred to. It is, however, pointed out that there is a limit to the amount of combination of characters expected in wide crosses owing to the tendencies of certain parental species characters to stay together, these being borne but by the failure of certain rice crosses in Madras and the U.P. to come up to expectations.

The address next deals with the need for maintaining strains pure and combating the

tendency to deteriorate, keeping up a nucleus in the breeding stations and again for the carrying out of basic research in genetics. Though a certain amount of such research has been in progress at various centres in India it is claimed that with greater co-ordination more valuable results can be expected, as has been achieved in the study of the chromosomes of maize in America. A plea is also put in for the formation of a Bureau of Plant Introduction for India on the American model and for the introduction of genetics as a subject of study in the Veterinary Colleges of India. The address concludes by emphasising the desirability of a change of outlook in the botanical teaching of our Universities, firstly by the introduction of genetical studies of agricultural crops in the syllabus and secondly by establishing greater contact between the Universities and the agricultural departments, such contact having already proved fruitful, as exemplified in the case of the work on the rusts of wheat and that on statistical methods applied to agriculture.

A. K. Y.

THE MAGNETIC ACTIVITY OF THE YEARS 1939 AND 1940

BY

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THE magnetic activity for the years 1939 and 1940 was larger than that for the year 1938, as seen from the magnetograms of the Alibag Magnetic Observatory. The method adopted by the Bombay Observatory for determining the magnetic characters of individual days is that recommended by the International Commission of Terr. Mag. and Atm. Elec.¹ The mode of classification of days into *quiet* and *disturbed* days has been described in an earlier note.²

During the year 1939 there were 95 quiet days, 229 days of slight disturbance, 32 of moderate disturbance and 9 of great disturbance. In 1940, there were 101 quiet days, 222 days of slight disturbance, 36 of moderate disturbance, 5 of great disturbance and 2 of very great disturbance. During 1939, according to both Bombay and International classifications, April was the most disturbed month and November the least disturbed one. For 1940 International Character figures are not available but according to Bombay classification only, April was the quietest month. March can be considered to be the most disturbed month although the monthly mean character for March was slightly lower than that for January. The mean monthly characters for the year 1939 according to Bombay and International³ classifications based on data from 62 observatories are given in Table I.

TABLE I
(Magnetic Characters, 1939)

| Month | Classifications | |
|-----------|-----------------|---------------|
| | Bombay | International |
| January | 0.71 | 0.51 |
| February | 0.89 | 0.86 |
| March | 0.97 | 0.96 |
| April | 1.03 | 1.01 |
| May | 0.94 | 0.93 |
| June | 0.83 | 0.78 |
| July | 0.97 | 0.83 |
| August | 0.77 | 0.66 |
| September | 0.70 | 0.66 |
| October | 0.97 | 0.87 |
| November | 0.70 | 0.47 |
| December | 0.77 | 0.63 |
| Year | 0.854 | 0.763 |

¹ Vide their Circular letter of March 1924.

² *Current Science*, 1940, 9, 90.

³ Van Dijk, G., *Terr. Mag.*, 1940, 45, 351.