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Current Topics

A Corrosion Map for India

THE Metals Committee of the Council of Scientific & Industrial Research under the Chairmanship of Sir J. J. Ghandy has started an intensive programme of prevention of corrosion in India. Ten subcommittees have been formed dealing respectively with atmospheric corrosion, underground and subsoil corrosion, corrosion in the chemical industry, corrosion resistant metals and alloys, marine corrosion, cathodic protection and inhibitors, inorganic and organic coatings, testing procedures, industrial corrosion and service failures, and fundamental studies on corrosion. A Corrosion Advisory Bureau has also been formed with a view to helping industries confronted with corrosion problems by rendering assistance and advice, and also for coordinating the work of the different subcommittees. The first issue of Corrosion Bulletin has been published, which is aimed at disseminating information about recent advances in the field of corrosion.

The problems of corrosion, particularly those due to atmospheric conditions, sea water, soil and chemical media, require immediate attention, in view of the rapid industrialization of the country. Extensive data are needed in respect of corrosion under these conditions in different parts of the country and in respect of various materials of construction. This is necessary as corrosion is to a great extent controlled by the environment in addition to the type of materials of construction employed. Field exposure tests in locations or sites representative of these conditions are, therefore, essential in order to provide data which can be readily put to use.

Such extensive data collection has been done in USA, UK, France, Sweden and recently in Japan. Some research workers in USA and UK have collected data all over the world by carrying out typical exposure tests in selected regions. This type of study has helped in solving packaging problems for transport of machinery to other countries as well as in minimizing corrosion of equipments to be used in other countries. Industries like paints, metal finishing, petroleum, chemical, etc., have been helped to a great extent by these data.

Field studies are in progress in a few sites at Jamshedpur, Kanpur, Mandapam, Bombay and Calcutta. The Central Electrochemical Research Institute, Karaikudi, the Defence Research Laboratory, Kanpur, and the National Metallurgical Laboratory, Jamshedpur, are carrying out atmospheric corrosion testing of iron and other metals, and useful data have been collected. To extend this type of data collection on a country-wide basis, a Corrosion Sites Panel has been set up by the Metals Committee and two types of stations, A and B, for field exposure tests have been decided upon.

Major stations will be called 'A' stations, which would carry out tests and provide data for samples supplied by other cooperating organizations. The minor 'B' stations may be established by any organization, and will furnish data to Corrosion Sites Panel for processing and coordinating. The following zones have been demarcated and classified according to the factors like temperature including diurnal variation in temperature, moisture and dust, sand, salt particles and sulphur dioxide in air, etc. The zones chosen are: (1) A coastal strip having both industrial and non-industrial sites; (2) Undifferentiated highlands (Northern Himalayan region); (3) Monsoon rain forest (Terai, Assam and Kerala); (4) Central Indian dry zone; (5) Tropical desert;
(6) Humid subtropical Indo-Gangetic plain; and
(7) Hot and moist industrial areas. At stations located in these zones studies will be carried out on the corrosion of mild steel specimens supplied by the Tata Iron & Steel Co. conforming to ISS 1079 Gr. 1 and zinc specimens conforming to IS: 209-1956, and monthly and yearly corrosion rates of these metals at these stations will be determined. These data will provide the basic information for the drawing up of a 'Corrosion Map of India'. Such a map will provide valuable information in respect of cathodic protection of underground pipelines, water storage tanks, cables, railway lines, ships and structures, etc. The Corrosion Map will enable engineers in charge of planning factories, public utilities, etc., to quickly arrive at a decision regarding the choice of suitable sites and construction materials, paints and other surface coatings and finishes, and to do away with the necessity of carrying out time-consuming and expensive field tests. It is hoped that these stations will be set up as early as possible to enable systematic collection and statistical analysis of the data, and thereby enable the preparation of a Corrosion Map of India at an early date.

Science Reporter

THAT science needs a well-informed public to appreciate its value and benefits and its place in modern society needs no emphasis. Presenting science to the informed layman is an important responsibility of organizations concerned with scientific research and of scientists as well. The Council of Scientific & Industrial Research (CSIR) has been alive to this problem right from the beginning, but it is only with the increasing tempo of research and development in the country in recent years that this need has been more keenly felt. Recognizing the urgency of the need, the CSIR has started the publication of a new popular science monthly, *Science Reporter*, from January 1964. This periodical is "an attempt to provide an interpreter between the

scientist and the rest of our intelligentsia". It also "provides the channel of communication between the laboratory and other market places of thought in the country". The first issue of the journal contains articles on subjects of current interest such as 'Inputs in science', 'How "quiet" is the sun', 'The versatile polymers', 'Long span structures', etc., written by experts in the field. Under the section 'Science news and trends', short items dealing with scientific topics which are very much in the news today, including reports of recent scientific conferences and meetings, are included. A number of processes and products developed indigenously are included in another section 'Science aids industry'. A section entitled 'The bookshelf' contains reviews of some general science books and a list of new books of interest to the general science reader.

The Science Reporter is perhaps the first periodical in the country to be exclusively devoted to the task of presenting lucidly and authoritatively the progress of science and its applications, particularly the developments in India. In this respect, the periodical fulfils a real need. The publication of Science Reporter should be welcomed not only for carrying out this important task but for other reasons also. Popular science writing is much in need of encouragement in the country, and the Science Reporter will provide this much-needed impetus. Remuneration for the articles accepted for publication is one of the incentives which the Science Reporter offers for the prospective contributors. This should induce our scientists to take to popular science writing and to develop the art of clear and lucid exposition of developments in and applications of science, and thereby lay the foundations of popular science journalism in the country.

At the present time, the impact of science on society is becoming more and complex, yet more and more important, and social aspects of science need adequate attention in a popular science periodical. It is hoped that Science Reporter will give adequate coverage to this important facet of science, and bring to the informed public a balanced appreciation of science, and its obligations and benefits to mankind. The efforts of CSIR in bringing science to the informed public should not stop with the publication of the Science Reporter. It should explore other avenues. and carry out research into the peculiar problems. confronting popularization of science in India, including the difficult one of presenting science in the regional languages. It is recognized that special efforts are needed if the intelligent citizen is to be helped to become an informed person in matters of science. Merely increasing the number of media. publishing popular science articles alone will not lead us very far in arousing the interest of the general public in science; this has been the experience elsewhere. It has been observed that a more rewarding response is elicited by demonstration lectures followed up by the printed and spoken word. This is a problem for the establishments concerned with scientific research and science education in the country to tackle with the assistance of learned societies and the public and private sector industries.

Summer School in Molecular Physics

Under the auspices of the Council of Scientific & Industrial Research and the University Grants Commission, a Summer School in Molecular Physics is being organized from 17 May to 6 June 1964 in Ootacamund (Nilgiris). Courses of lectures on the following topics will be delivered by experts in the respective fields: Group theory; Molecular orbital theory and complexes; Electronic spectra; Infrared spectroscopy; Raman spectroscopy; Crystal spectra and luminescence; Structure determination by X-rays; Neutron and electron diffraction; Microwave spectroscopy; and Magnetic resonance. There will also be seminar talks by specialists followed by discussion on subjects connected with molecular physics.

An Organizing Committee has been formed with. Prof. R. S. Krishnan, Head of the Department of Physics, Indian Institute of Science, Bangalore 12, as the Chairman and Convener, who should be contacted for further particulars.

Summer School in Chemistry of Polymers

(Mrs) RAMA BASU

Department of Chemistry, University College of Science & Technology, Calcutta

&

ASISH RANJAN MUKHERJEE

Department of Physical Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta 32

A SUMMER School in Polymer Chemistry, organized by the Ministry of Scientific Research & Cultural Affairs, was held at Dalhousie from 28 May to 11 June 1963 under the directorship of Prof. S. R. Palit. Twenty-eight scientists from different universities and research institutes participated.

The summer school was inaugurated on 29 May by Dr S. H. Zaheer, Director-General, Scientific & Industrial Research, who stressed the importance of polymers in general and the need for acquiring further knowledge in the field. In particular, he drew attention to the shortage of rubber and other high polymeric substances in India, and pleaded for intensification of efforts to produce them in the country.

In his introductory address, Prof. Palit discussed the present and potential uses of polymers in everyday life, agriculture and industry. He referred to certain new fields where polymer research is finding increasing application. Important among these are: (1) development of tough polymers capable of withstanding high temperatures and other extreme conditions for use in space vehicles, and (2) investigations on complex molecules like DNA and the possibility of utilizing the knowledge gained in combating cancer and some other diseases and in understanding the processes of ageing and creation of life.

After inauguration, the school settled down to its normal business according to the programme drawn up and circulated in advance to the participants.

Polymer chemistry being a vast subject, a choice had to be made of the topics for study and discussion. The proceedings of the school were divided into: (1) Group discussion on selected topics, (2) Special and general lectures, and (3) Study session on some advanced topics. The school usually started at 9.30 a.m. with a special lecture of 1 hr duration followed by discussion and a study session up to 12.45 p.m. In the afternoon, the session was resumed for general lectures (each of 1 hr duration) at 2.15 p.m. and continued till 4.30 p.m.

Special Lectures

The special lectures were, in general, in the form of up-to-date reviews on some topics of current interest. Dr Sadhan Basu (Calcutta University) gave the first special lecture on 'Spatial conformation of chain polymers'. Using the classical oscillator model, the author showed that a helical structure will interact with the magnetic component of electromagnetic radiation, leading to optical activity. Therefore, change in optical activity of proteins on denaturation is associated with a helix to random coil transition, which is also corroborated by X-ray diffraction studies. The optical activity of a helical structure is also demonstrated by the optical activity of symmetrical dye molecules when absorbed on a protein in a helical conformation.

Dr Hari L. Bhatnagar (Kurukshetra University) in his lecture entitled 'Light scattering studies on polymer films under strain' briefly reviewed the modern theories of the structure of thin polymer films.

The lecture by Dr S. L. Kapur (National Chemical Laboratory, Poona) dealt with studies on the development of an absolute method for the determination of molecular weights from viscosity data without recourse to calibration constants. The validity of this method has been tested for various natural and synthetic polymers.

Dr P. C. Das Gupta (Technological Research Laboratories, Calcutta) discussed the effect of graft copolymerization on polysaccharides, especially cellulose, through addition polymerization mechanism using vinyl monomers. He discussed methods of effecting graft copolymerization under the following heads: (1) by chain transfer mechanism, \neg (2) by ferrous ion and hydrogen peroxide redox system, (3) by ceric ion, (4) by persulphate ion, (5) by radical forming derivatives, and (6) by irradiation.

Dr A. K. Sircar (National Rubber Manufacturers Ltd, Calcutta) discussed in his lecture the applications of differential thermal analysis (DTA) in the field of high polymers — non-elastic and elastic. The future potentialities of DTA were also discussed. The DTA technique has been employed by the author for determining the heat of hard rubber reaction.

Dr M. R. Gopalan (Karnatak University) in his talk on 'Redox systems in polymerization' discussed three types of reactions between oxidizing and reducing agents, viz. reactions involving the formation of one or two radicals, and those in which there is no direct formation of free radicals.

The structure of biopolymers, such as proteins, nucleic acids, viruses, etc., was discussed by Dr D. K. Chattoraj (Jadavpur University, Calcutta). Determination of primary structure (by Sanger's chemical method) has thrown light on the sequence of amino acid residues and the position of active site in the enzyme ribonuclease. Abnormal behaviour of hemoglobin is attributed to slight change in its primary structure. Detailed arrangement in space of polypeptide chains (secondary structure) studied by X-ray analysis has revealed that folding of polypeptide chains in fibrous proteins may be planar, helical or helically helical. Globular proteins may be further folded to give tertiary spherostructure.

In his lecture on the 'Chemical structure and physical properties of polymers', Dr D. Mangaraj (IIT, Kharagpur) referred to the recent suggestion

that a number of static and dynamic properties of polymers can be explained on the basis of two molecular parameters, namely intermolecular forces and chain stiffness. Intermolecular forces are measured in terms of cohesive energy density (c.e.d.) and internal pressure (P_i) ; it has been observed (as also suggested by Gee) that both ΔV^* and E_p/P_i give a fair measure of chain stiffness, where ΔV^* is the activation volume for viscous flow and E_a , the activation energy.

for viscous flow and E_p , the activation energy. Dr M. L. Lakhanpal (Panjab University, Chandigarh) discussed the 'Thermodynamic properties of polyoxyethylene glycols in methanol'. The differential vapour pressures between solvent and solution for fractionated samples have been determined at 25°, 35° and 45°C. by means of a very sensitive technique devised by Puddington (accuracy ± 0.00002 cm. of Hg) for calculating the activities of solutions. The results show an abnormal behaviour below 3 per cent concentration, probably due to association of polymer molecules through terminal hydroxyl groups.

The last special lecture delivered by Dr K. C. Majumder (Central Water & Power Commission, New Delhi) dealt with the 'Role of advanced statistical methods in polymer science'. The problems discussed were: (1) Monte Carlo procedure for the generation of non-intersecting polymer chains, (2) the use of combinational theories in the study of the distribution of chain length of polymer system undergoing random degradation, (3) theory of Markov process — the problem of finding the distribution of segments in crystalline and amorphous region of semicrystalline polymers, and (4) Hosemann and Schvamek's method of accurate determination of molecular weight distribution curve from experimental data.

General Lectures

The session began with a paper entitled 'Modification of natural polymers to improve their utility' by Dr H. R. Chipalkatti (Shri Ram Institute for Industrial Research, Delhi). Problems involved in increasing the tenacity of rayon (for tyre-cord industry) and making it suitable for blending with cotton were discussed. The problems involved in alkali catalysed cross-linking of cotton to make it wash and wear, and finishing of cotton by thermoplastic resins were also discussed.

Dr. P. K. Chowdhury (Calcutta University) reported the results of his detailed studies on viscose, covering the following aspects: (1) change in DP of cellulose during viscose formation, (2) chemical nature of viscose solution, and (3) polyelectrolytic behaviour of viscose solution. Maximum degradation in cellulose molecule has been found to take place during the first 24 hr of the ageing process (oxidative degradation). Light scattering studies have revealed that concentrated viscose solution is colloidal (miscellar) in nature, but dilute solutions (< 1per cent concentration) might be molecular solutions. Cellulose xanthate in aqueous or 6 per cent sodium hydroxide solution and green or ripened viscose in 6 per cent sodium hydroxide solution showed typical polyelectrolytic behaviour.

¹ Dr R. T. Thampy (Shri Ram Institute for Industrial Research, Delhi) presented the results of his studies on polyesterification and cross-linking of unsaturated polyesters, containing maleic anhydride, phthalic anhydride and propylene glycol with methyl ethyl ketone peroxide as initiator and cobalt accelerator. Styrene was used in cross-linking studies instead of diallyl phthalate. No such studies have been reported so far. From infrared spectra of cured and uncured polyester resin, it has been found that complete cure is effected in 48 hr.

Dr (Miss) V. Kalpagam (Indian Institute of Science, Bangalore) presented a paper on 'Depolarization measurements of polymer solutions at high dilutions '. To have a clear understanding of the geometry and structure of polymer molecules, the author has carried out depolarization studies on light scattered from polymer solutions in different solvents containing particles which were either small (< 1/20th of the wavelength of light used) or big (colloidal particles having dimensions comparable with wavelength of light used) over the concentration range 0-01-0-25 per cent.

[^] Miss M. Atreyi (University of Delhi) discussed the 'Titration curves of proteins '. The dissociation curve of protein represents the variation of proton binding capacity of the protein (h) with pH, keeping the isoionic point as the point of reference at which h is zero. A quantitative as well as qualitative analysis of the amphoteric character of proteins can be obtained from a study of the dissociation curve. Potentiometric and conductometric titrations of egg albumin with hydrochloric acid and with potassium and barium hydroxides have been carried out in salt-free medium and titration curves for pH or specific conductance against the amount of added acid or base were obtained. The total number of prototropic groups calculated from the values of acid or base added at the final inflexions agrees fairly well with the total number obtained from analytical data.

A paper presented by Dr G. S. Misra (Lucknow University) was concerned with the 'Determination of molecular weight of some addition polymers by endgroup analysis'. Styrene, methyl methacryl-ate and vinyl acetate were polymerized in bulk or solution at 90-100°C. using γ,γ' -azo- γ -cyano-*n*-valeric acid as initiator and the molecular weights of both fractionated and unfractionated samples were determined by viscosity and endgroup titration. The two sets of results have been compared using different viscosity equations in order to find out which one of them gave the best correspondence.

Dr J. S. Shukla (Lucknow University) reported the results of studies on the 'Use of N-nitrosoacylarylamines as catalysts in addition polymerization of styrene, methyl methacrylate and acrylonitrile'. According to Hey and Misra, both aryl and acyloxy groups are incorporated in polymers during this initiation. The present author has shown that when the initiator contains aromatic acyl group, both aryl and acyloxy groups take part in initiation, but when the initiator contains aliphatic acyl group, only aryl radicals take part in initiation.

Lectures by Mr Asish Ranjan Mukherjee and Mr M. K. Saha (Department of Physical Chemistry, Indian Association for the Cultivation of Science, Calcutta) were on endgroup analysis of polymers by

the application of dve technique, recently developed in their laboratory. The former discussed the characterization of sulphoxy endgroups in polymers and the technique developed for the separate estimation of sulphate ($\sim OSO_3$) and sulphonate ($\sim SO_3H$) types of endgroups in polymers. The latter discussed the characterization of halogen endgroups in polymers. Polymethyl methacrylate samples were prepared by Mr Mukherjee using different sulphoxy compounds (both oxidizing and reducing) as initiators in aqueous medium under different conditions and the sulphoxy endgroup content of the polymers was estimated quantitatively by the dye technique. Mr Saha incorporated halogen endgroups (F, Cl, Br and I) in vinyl polymers prepared in bulk, solution or heterogeneous aqueous phase and quantitatively estimated the halogen content by the dye technique.

Dr Premamoy Ghosh (Department of Applied Chemistry, Calcutta University) reviewed in his paper the work done so far on the 'Role of salts of metals of variable valency in vinyl polymerization'. The discussion covered the following aspects of the problems: (1) oxidation or reduction of organic (macro) radicals by these salts, (2) dependence of rate of polymerization on the nature of metal salt, and (3) the probability of determining the rate of initiation and termination, initiator efficiency and number average DP by studying the reaction in a solvent of very low transfer constant. The metal ions covered were Fe^{2+} , Fe^{3+} , Cu^{2+} and Ag^+ with various associated anions.

Mr A. B. Deshpande (National Chemical Laboratory, Poona) presented the results of his studies on the application of Ziegler type catalyst for the polymerization of styrene using lithium isoamyl-titanium tetrachloride catalyst system in hexane and benzene media at 30° C. The rate of polymerization has been found to be of the first order with respect to catalyst and monomer concentration in hexane; the activation energy has been found to be 2.05 kcal./mole. On the basis of these results, a coordinated anionic mechanism of polymerization has been suggested.

Dr Shrikrishna Potnis (Bombay University) discussed the preparation, characterization and polymerization of 2-formyl- Δ^5 -dihydropyran (FDP), which can be polymerized most easily by cationic mechanism. It is also known to undergo spontaneous and anionic polymerization, but it cannot be polymerized by free radicals. Infrared spectral studies have shown that the polymers obtained by spontaneous polymerization or irradiation have polyacetal structure. Cationic polymerization seems to take place through vinyl ether linkage.

Dr M. R. Gopalan (Karnatak University) discussed some aspects of polyelectrolyte structure. Attempts have been made by several workers to correlate the observed size and shape of polyelectrolytes with theoretical models. The models proposed include rigid spheres, punctured sphere, or random coil with various types of charge distributions. Proteins have been assumed to have a four-fold architecture. The mathematical problems involved in the computation of some properties were also explained.

putation of some properties were also explained. Dr D. Joseph Francis (Loyola College, Madras) discussed the 'Kinetics and mechanism of the alkali catalysed condensation of the methylol phenols by themselves and with phenol' under various experimental conditions with the help of paper chromatography. Different products obtained under various experimental conditions were also discussed.

Dr N. Krishnaswamy (National Chemical Laboratory, Poona) gave a brief review of . Ion-exchange resins and membranes . Various terms used in ionexchange technology were explained. The resins are characterized on the basis of the nature of the pH titration curve. The perm selectivity of ionexchange membranes was discussed and the working of an electrolysis cell based on this property was explained. The working mechanism of ion-exchange resins developed at the National Chemical Laboratory, Poona, was discussed.

The paper presented by Mr Raj Kumar Sharma (Panjab University, Chandigarh) dealt with the 'Heats of mixing for solutions of polyoxyethylene glycols in polar and non-polar solvents'. The author described the working principle of the differential vapour pressure determination apparatus, designed in their laboratory.

Dr H. N. Bhargava (Gorakhpur University) discussed the 'Properties of polyelectrolytes with special reference to Graham's salt — a condensed phosphate $(NaPO_3)_n$ '. The viscosity and conductivity behaviour of aqueous solutions of Graham's salt are typical of a polyelectrolyte. Weight and number average molecular weight of these samples were determined by viscosity and endgroup titration methods respectively. The following empirical relationship has been found to be valid:

$\overline{Mw} = (\eta s p/c) K + I$

where K and I are constants and Mw, weight average molecular weight. All the results could be explained on the basis of Fuoss model assuming flexible chains.

Study Sessions on Advanced Topics

Study sessions were held on the following subjects: Stereo-regulation and asymmetric synthesis of polymers (Prof. S. R. Palit); Energy transfer of high polymeric systems (Dr Sadhan Basu); Statistical methods as applied to polymer distribution (Dr K. C. Majumder); Structural plastics and their development in India (Dr R. T. Thampy); and Theoretical techniques used for solving the problems of light scattering by macromolecules (Dr H. L. Bhatnagar).

Group Discussions

Three group discussions were arranged. Nine participants including the group leader, Dr S. L. Kapur, took part in the group discussion on 'Mechanism of polymerization'. Dr Kapur, in his introductory remarks, classified the various polymerization processes. Prof. Palit discussed some novel types of polymerizations which have lately been discovered, and which are of distinctly different mechanisms from those of conventional polycondensation, radical addition and ionic mechanisms; for example, caprolactum polymerization (by ring opening), acrylamide to polyalanine (by H-addition), Diels-Alder polymerization, cyclopolymerization, Macallum polymerization, etc. Dr R. T. Thampy

discussed the importance of polycondensation reaction in the production of industrially important plastics. Dr D. J. Francis discussed the mechanism of acid and alkali catalysed phenol formaldehyde reactions and the role of zinc ion in the process. Dr G. S. Misra discussed the overall kinetic scheme of vinyl polymerization, with special reference to termination by primary radicals. Dr D. Mangaraj indicated how the chemical structure of the monomer affects the rate of polymerization. Dr M. R. Gopalan stressed the importance of emulsion polymerization catalysed by transition metal ions for the production of synthetic rubber. Mr A. B. Deshpande discussed the usefulness of transition metal halides and organo-metallic halides for the production of stereo-specific polymers. Mr A. R. Mukherjee gave an outline of how the reactivity of a free radical can be assessed (in connection with some recent contributions in this field) and expressed in terms of polar and non-polar parameters and suggested how the polarity parameter can be determined from the Hammett's sigma constant. Dr H. L. Bhatnagar criticized this mechanism on the ground that the suggestion did not take into consideration the role of vibration energy. Dr S. Basu mentioned that in such complex reactions, it is always advisable to take recourse to parametric methods which can be checked by a number of experiments on homologous series of compounds, and in the present scheme, such a parameter has already been introduced through Hammett's sigma constant.

Group discussion on Newer industrial polymers' was held with Dr H. R. Chipalkatti as the group leader and eight participants. Dr Chipalkatti, in his introductory remarks, discussed the importance of resin, treatment of textile fibres to improve their *situ* by interfacial polycondensation. Dr P. K. Chowdhury reported the preparation of synthetic moulding powder from sawdust through conversion of pentosans in sawdust to furfural and subsequent phenol formaldehyde type of polycondensation reaction. Dr N. Krishnaswamy described a number of new ion-exchange resins useful for water softening and industrial deionization process, e.g. snake-cage polyelectrolytes, ion exclusion polyelectrolytes, ligand exchange resins, etc. Dr D. Mangaraj described the method of formation of high density polyethylene using metal oxide catalyst. Dr A. K. Sircar reviewed the present position of synthetic elastomers in automobile industry, specially tyre industry. Dr S. Potnis reported the usefulness of polyvinyl acetate (in emulsion form) in surface coatings. Prof. Palit advocated the use and manufacture of polypropylene in India because of its high quality and versatility. Dr R. T. Thampy reviewed the present position of synthetic fibre industry in India.

Prof. S. R. Palit was the leader of the group discussion on the 'Assessment of the present summer school and suggestion for future summer schools'. Practically all participants took part in the discussion and stressed the need for (i) personal contact among people working in various fields of polymer chemistry, (ii) effective dissemination of information on latest developments and newer experimental techniques, (iii) generation of new ideas of research through discussion by cross-fertilization, (iv) clarification of ideas and elucidation of fundamentals through group discussion and advanced study session, and (v) avoiding unnecessary duplication of research. Some useful suggestions were also put forward for organizing future summer schools, including publication of proceedings of the summer school.

The concluding lecture was delivered by Dr M. M. Das, Deputy Minister, Ministry of Scientific Research & Cultural Affairs, Government of India, on 10 June. The participants were requested to come forward with constructive criticisms and concrete suggestions which could help the Ministry in organizing future summer schools more efficiently. Dr Das then gave a brief history of summer schools and their role in building up the future of science in India. Incidentally, he referred to a few such summer schools which had already brought forth very fruitful and encouraging results. This was followed by an informal group discussion.

International Symposium on Continuum Mechanics

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THE importance of Continuum Mechanics to bridge the gulf between microscopic and macroscopic description of natural phenomena is now widely recognized. It has received attention from a large number of prominent workers all over the world. The International Union of Theoretical & Applied Mechanics (IUTAM) could not have done better than to hold a symposium on this subject at Tbilisi, Georgia, USSR, from 17 to 23 September 1963.

The analytical theory of functions plays a vital role in the mathematical description of continuum problems. It was, therefore, in the fitness of things that the symposium was held under the chairmanship of Prof. N. I. Muskhelishvili, President of the Georgian Academy of Sciences, who along with his coworkers has contributed a lot to the applications of the Theory of Functions of Complex Variables to problems in mechanics.

Participation in the conference was by invitation and 61 foreign workers and 55 Russian workers attended it. Twenty countries were represented and seventy research papers were presented, which included six general lectures. The participants included N. I. Muskhelishvili, L. I. Sedov, S. L. Sobolev, I. N. Vekua, L. A. Galin, D. I. Sherman, G. P. Cherepanov, A. Ya. Aleksandrov, A. I. Lur'e and G. K. Mikhailov from Russia; R. D. Mindlin, A. Busemann, M. P. Tulin and S. Bergman from USA; A. Ferri and G. Fichera from Italy; B. R. Seth from India; I. N. Sneddon and L. C. Woods from UK; M. Roy and J. Leray from France; and W. T. Koiter from Holland.

The general lectures reviewed the work of various schools. N. I. Muskhelishvili dealt with Elasticity and L. I. Sedov with Hydrodynamics. I. N. Sneddon, F. G. Tricomi, S. Bergman and L. A. Galin gave applications of Integral Equations. Nonlinear Problems were treated by B. R. Seth, Z. N. Dobrovol'skaya, A. A. Dorodnitsyn and J. P. Germain. A number of papers dealt with Contact Problems.

The spectral analysis of continuum phenomena can be split into two parts - linear and non-linear. The middle part of the spectrum is generally linear and has been extensively dealt with. But the transition from the linear to non-linear at the ends of the spectrum has not received sufficient attention. This involves the determination of asymptotic solutions at the turning points of differential systems. The theory of analytic functions of one or more complex variables whose use was extensively illustrated at the conference can be further extended to asymptotic solutions. Another modern trend to which attention should be drawn is the reduction of solutions of problems to integral equations, which can be readily solved on high-speed digital computers. In fact, one such problem arising out of the formations of small waves on a non-uniform bed was suggested by the digital computer. It is unfortunate that in India, we are still not very conscious of the importance of high-speed computers as a powerful tool to solve scientific problems. It is hoped that the start made in such computation at Bangalore, Kharagpur, Kanpur and Bombay will spread to many other centres in the country. The problem of asymmetrical stress distribution due to internal stress couples was discussed in two papers. Such situations arise on the microscopic level, and hence the treatment of such problems brings the two fields closer together. Thin and shallow shell problems were treated by a number of Russian workers. Magneto-hydrodynamical problems attracted few participants. In such cases, a disturbing effect is observed about the vanishing and reversal of lift, if the external magnetic field reaches certain critical strength in relation to the flow velocity. Attention was also drawn to problems in which the main difficulty lies in the fact that the regions in which the solution is sought is unknown. It was also shown that a number of problems like flow past cascades of profiles and the bending of plates weakened by an infinite set of periodical holes can be reduced to problems for automorphic functions.

Bradykinin, Kallidin, Substance P & Other Vasodilating Polypeptides

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✓ ININS* are a group of pharmacologically active polypeptides present as such or re-leased from precursors in blood or tissues, which stimulate the smooth muscle and produce vasodilation. Great interest has been aroused in these substances recently because of their possible role as mediators of functional vasodilation and inflammatory response and as agents causing accumulation and migration of leucocyctes. These substances have been known since 1925 (Frey1) and by now a number of such peptides have been reported from various sources, e.g. bradykinin and kallidin from plasma (also referred to as plasma kinins), urine kinin from urine, a pain producing substance (PPS) from plasma, substance P (SP) from brain and intestines (also referred to as neuro or entero kinin), colostrum kinin from colostrum and venom kinins from yenoms of wasp, hornet and scorpion. It is only recently, however, that two of them, bradykinin and kallidin, have become available in a pure state. This is in no small measure due to the great advances made in the art of isolation, structural studies and synthesis of polypeptides. The desirability of obtaining these substances in a pure state in order to study their function is shown by the story of SP, which had been considered to be a mediator of CNS function ever since its discovery, but after its purification2,3 doubts have been cast about SP being a neurotransmitter³. The chemistry and function of these polypeptides, with particular reference to bradykinin, kallidin and substance P, is reviewed in this communication.

Bradykinin and Kallidin

Isolation, structure and synthesis - As early as 1925, Frey¹ reported that urine contained a substance which produced a hypotensive response. Subsequently, pancreas was shown to be the most important source of this substance which was named 'kallikrein'4 (from kallikreas, the Greek word for pancreas). It was postulated that kallikrein was continuously released from the pancreas into the blood stream, where it circulated as an inactive complex and became activated when conditions such as pH were favourable. In subsequent work4,5, it was demonstrated that this vasodepressor response was caused by the release of a smooth muscle stimulating and hypotensive substance produced by the interaction of kallikrein and plasma, and this substance was named as DK (Darm Kontrahierende Substanz). Similarly, Feldberg and Guimerais⁶ in 1935 demonstrated that saliva, after electrical stimulation of salivary glands, contained a hypotensive substance which was neither acetyl choline nor histamine, and Ungar and Parrot⁷ identified this as kallikrein. However, the appre-

*For terminology, see Lewis, G. P., Phys. Rev., 40 (1960), 647.

ciation that kallikrein was the enzyme responsible for the release of the active substance from its substrate did not come till after the work of Rocha e Silva *et al.*⁸ on bradykinin, when the substance DK was rebaptized 'Kallidin' in 1948 (Werle and Berek⁹). This work was reviewed by Frey *et al.*¹⁰ in 1950. Recent work¹¹ has shown that some kallikreins act on the plasma proteins to release two hypotensive polypeptides, kallidin and bradykinin; the former has been shown to be lysylbradykinin (IV)^{11,12} and its structure has been confirmed by synthesis^{13,14}.

Much of the present developments in this field, however, stem from the work of Rocha e Silva et al.⁸ who made the observation that snake venom and also trypsin, when injected into animals, produced marked hypotension, and subsequently showed that a vasodilator and smooth muscle stimulating principle, polypeptidic in nature, was formed when trypsin or certain snake venoms acted on plasma proteins¹⁵. The name 'bradykinin' (Greek, slow moving) was given to this substance, because it caused a delayed and slow contraction of guinea-pig ileum, in contrast to the immediate and quick response of histamine. Considerable purification of bradykinin was achieved by these workers; they, however, failed to free their product from inorganic salts, used in their chromatographic procedure, and the amount obtained was insufficient for chemical work¹⁵.

Elliott et al.16 isolated pure bradykinin from bovine plasma by elution chromatography on carboxymethyl cellulose using the volatile buffer ammonium acetate. These workers also identified the constituent amino acids, their ratio and sequence, and in 1960 proposed an octapeptide structure (I) for bradykinin¹⁷. This octapeptide was soon synthesized by three different groups of workers18-20, but it was found to be completely devoid of any biological activity and also behaved differently in enzymic degradation and thus it became obvious that the structure proposed for bradykinin was incorrect. Synthesis of alternative sequence of peptides to prove the structure seemed a formidable task, as there could be many possibilities. However, Guttmann and Boissonnas²¹ ruled out a number of possibilities through very logical reasoning and synthesized the remaining three possible octapeptide structures, one of which (II) showed about 1/50th the activity of bradykinin, and also behaved in a manner similar to bradykinin in enzymic degradation. This indicated the necessity of a proline residue between serine and phenylalanine for the existence of biological activity and encouraged Boissonnas $et al:^{22}$ to synthesize a nonapeptide (III) (Chart 1) which had the left half of the originally postulated octapeptide structure (I), and the right part of the partially active octapeptide (II). This nonapeptide was found to possess

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Chart 1 — The synthesis of bradykinin [CBO, benzyloxycarbonyl; CTO, carbo-tert-butoxy; BZN, p-nitrobenzyl]

the full biological activity of bradykinin. Elliott et $al.^{23}$ subsequently revised their formula and confirmed that this nonapeptide sequence was the correct structure for bradykinin^{*}.

H.Agr.Pro.Pro.Gly.Phe.Ser.-..Phe.Arg.OH

(I) inactive H.Arg.Pro. —. Gly.Phe.Ser.Pro.Phe.Arg.OH

(II) slightly active H.Arg.Pro.Pro.Gly.Phe.Ser.Pro.Phe.Arg.OH (III) bradykinin

H-Ly3.Arg.Pro.Pro.Gly.Phe.Ser.Pro.Phe.Arg.OH (IV) kallidin H.Pyr.Pro.Ser.Ly3.Asp.Ala.Phe.Ileu.Gly.Leu.Met.NH₂ (V) eledoisin H.Asp.Arg.Val.Tyr.Heu.His.Pro.Phe.OH

(VI) angiotensin II

This was followed by two more syntheses^{24,25}, thus fully confirming the structure of bradykinin. The postulation of the partially incorrect octapeptide structure for bradykinin was due to a low value obtained for proline in hydrolysis; the reason for this is still inexplicable. It does, however, emphasize the need for alternative checks in such work.

Bradykinin is stable to the action of trypsin, pepsin and boiling hydrochloric acid (normal), but is inactivated by chymotrypsin and 0.1N sodium hydroxide.

Structure-activity relationship — In view of the powerful pharmacological action of bradykinin, it has become a most interesting molecule for the

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study of structure-activity relationship (SAR). However, this work is still in its initial stages and a lot more needs to be done before a clear picture of SAR can be obtained. A major difficulty in assessing the SAR is the fact that different workers have used different test systems and some of them only one test system. Since bradykinin possesses different types of pharmacological activities, one test system is not enough to evaluate bradykinin like activity of an analogue; only in the case of 'all or none' activity can the result be considered conclusive.

Due to internal hydrogen bonding, polypeptides tend to take up a secondary structure, which is in many cases helical. A helical structure has been postulated for angiotensin²⁶ which accounts best for its physical properties and biological activity. However, in case of bradykinin, there seems to be no evidence that internal hydrogen bonding contributes to its activity, since no alteration in biological activity takes place by treatment with urea or arginine, which are known to disrupt hydrogen bonds and interfere with biological activity of molecules like angiotensin²⁷ and ribonuclease²⁸. Moreover, a helical model for bradykinin, held together by hydrogen bonds, cannot be constructed due to the rigid bond angles of the three proline residues.

Most of the data obtained so far on the biological activity of bradykinin and its analogues²⁹⁻³¹ is summarized in Table 1.

The most striking fact about the structure of bradykinin is the presence of arginine at both ends of the molecule. Replacement of 1-arginine by lysine or ornithine leads to a considerable loss of activity, which would indicate that the basicity of the end arginine is not the only important factor responsible for full activity; this is further supported by the fact that the replacement of terminal arginine by non-basic nitroarginine does not lead to a complete loss of activity. Similarly, the slight activity

^{*}In the later stages of this work, there was a very free exchange of information between various groups of workers particularly the ones at the National Institute of Medical Research in England and at Sandoz in Basle; a vivid account of this is given in the papers by these two groups which show how this helped in such rapid solution of this problem, which would have taken much longer if each group had worked independently. In less than 4 months of the proposal of the first structure by Elliott and his groups, the correct structure was found by the Basle group by synthesis and the whole position clarified.

Compounds Broncho- constrictor activity in guinea-pig	Broncho- M	Musculotropic	Hypotensive response			
	rat uterus	Guinea-pig	Cat	Rabbit	Rat	
Bradykinin	100	1100	100	100	100	100
Kallidin	33	70	66	60 + 12	190 + 40	200
Eledoisin		1.0		300	1200	3000
Retrobradykinin	_	0.02	-		*	_
1-Lysine bradykinin	1.5	·	2.4			
1-Ornithine bradykinin	0.1		0.5-1	-	-	
2-Lysine kallidin	0.2		2-4	_		
1-Citrulline bradykinin	0.02	0.15	0.5			
9-Citrulline bradykinin	0.1	0.25	0.5			
9-Histidine bradykinin	0.05	1	5			
1,9-Nitroarginine bradykinin		1	_	_		
1,9-Citrulline bradykinin		0.02			-	
1-Desarginine bradykinin	0.02	_	0.2-3			
9-Desarginine bradykinin	0.05		0.05		-	
7-Glycine bradykinin		1				
6-Glycine bradykinin		1 .				
6-O-Carbamoylserine bradykinin	0.05		1-10			
8-p-Fluorophenylalanine bradykinin	140		150			
8-D-Phenylalanine bradykinin	1.4		10		_	
6-D-Serine bradykinin	2.5		40			

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TABLE 1 - BIOLOGICAL ACTIVITY OF BRADYKININ AND ITS ANALOGUES

of 1-citrulline and 9-citrulline bradykinin shows that arginine can be replaced by a molecule closely related to it in shape and size, but lacking in basicity, without complete loss of activity. However, when citrulline replaces arginine at both ends, the resultant analogue, 1,9-citrulline bradykinin, is completely devoid of activity. Removal of both arginine residues leads to a complete loss of activity, which also happens when only C-terminal arginine is removed. In contrast, 1-desarginine bradykinin still possesses a fair amount of hypotensive activity, although a greatly reduced bronchoconstrictor action. A certain amount of dissociation of these two activities is discernible in some of these analogues, particularly in 9-citrulline and 9-histidine bradykinins.

The length of the chain seems to be important, as octapeptides having similar structure have greatly reduced activity. Further, 7-proline, which appeared to be important from earlier work of Boissonnas and coworkers²¹, can be replaced by glycine, thus maintaining the chain length, without complete loss of activity. However, it is not only the chain length that is important, but also the nature of amino acids separating the two arginine residues, since neither L-arginyl heptaglycyl-L-arginine nor retrobradykinin '32,33 has bradykinin like activity, although in the latter only the sequence of amino acids has been reversed and the amino acids in position 1, 3, 5, 7 and 9 are common to bradykinin and 'retrobradykinin'. In addition to the amino, guanidino and terminal carboxyl groups of arginine, the only other functional group in the molecule is the hydroxyl group of 6-serine whose role is still not quite clear. L-Serine can be replaced by Dserine without much loss of activity and 6-glycine bradykinin is reported to have the full activity of bradykinin, when tested on rat uterus; the alcoholic hydroxyl of serine, therefore, seems unnecessary for this activity. On the other hand, 6-O-carbamoylserine bradykinin has no bronchoconstrictor and hypotensive activity. These facts are difficult to reconcile. Of course, it would be possible that the O-carbamoyl group on account of its bulk interferes in the approach of the peptide to the bioreceptor, while the hydroxyl by itself does not contribute much to this binding and so its absence does not interfere with activity. Replacement of 8-L-phenylalanine by its D-enantiomorph still retains hypotensive activity, while its replacement by p-fluorophenylalanine leads to an increase of hypotensive activity.

A consideration of SAR of these peptides will not be complete without a reference to eledoisin, a peptide isolated from the salivary glands of a mollusk³⁴, and recently synthesized and studied by Sandrin and Boissonnas³⁵. Though it has an entirely different chemical structure (V) it exhibits many of the biological properties of bradykinin, some of them even to a greater degree (Table 1). This shows that the structure of bradykinin is not specific for this type of activity and much has yet to be learnt about SAR in this field.

Mechanism of release, inactivation and antagonism — Bradykinin and kallidin are released from their precursor, bradykininogen (or kallidinogen), present in α_2 -globulin fraction of plasma by certain enzymes, such as 'kallikreins', trypsin and those in some snake venoms.

Werle et al.³⁶ using whole serum had proposed the existence of the same precursor for bradykinin and kallidin, but Van Arman³⁷ who showed the presence of kininogen in Cohn's fraction IV-6³⁸ gave some evidence for and against the identity of bradykininogen and kallidinogen. Habermann³⁹, however, in his recent work has conclusively shown that kallidinogen and bradykininogen are identical, and this common precursor, which will now be referred to as kininogen, is present in Cohn's fraction IV-6. As evidence for their identity, he

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showed that the exhaustion of substrate by trypsin or venom of *Crotalus adamantus* prevented the further release of activity by kallikrein and vice versa.

Kallikreins are high molecular weight, thermolabile enzymes of endogenous origin, which are found either as such or are released from their precursor, kallikreinogen, by the action of certain proteolytic enzymes and physico-chemical processes. These are present in an active form in saliva40-42, urine⁴¹, sweat glands⁴³ and accessory sex glands⁴⁴, and in an inactive form in pancreas⁴, submaxillary glands⁴⁴, blood⁵ and intestine⁴¹. Their concentration, however, is highest in glandular structures. Kallikreins from different sources are different in nature and can be distinguished from each other in their response to various inhibitors45 or antibodies46-49, in their electrophoretic mobility50, and in their ability to release kallidin and/or bradykinin from blood plasma⁴⁵. Specific antibody to human urinary kallikrein, for example, inhibits the bio-logical activity of human urinary and pancreatic kallikreins but not that of hog pancreatic kalli-kreins⁴⁹; and egg white inhibits human urinary kallikrein but not human and hog pancreatic kallikreins⁴⁵. Similarly, bird kallikrein cannot liberate kallidin from the serum of mammals, and salivary kallikrein of guinea-pig fails to release kallidin from its plasma but effectively releases kallidin from other mammalian sera^{51,52}. Thus each kallikrein probably has a unique structure, and appears to be both species-specific and organ-specific.

The various physical and chemical processes which effect the activation of kallikreinogen in plasma to kallikrein include acidification^{53,54}. treatment with acetone^{55,56} or dilution⁵⁷. The release of kallikrein is probably effected by the dissociation of an inactivating moiety. Such dissociation, however, is not peculiar to this system, as a similar effect of dilution is observed in the case of trypsinantitrypsin mixtures58 and toxin-antitoxin mixtures59. It is, however, possible that dilution may not directly activate any of the components involved in the release of plasma kinins, but may act by inactivating the inactivators and thus rendering the system more sensitive to other marginal factors⁵⁸. Human plasma rapidly generates a kinin on contact with glass⁶⁰ and this was called PPS (pain producing substance) since on contact with a cantharidine human blister base, it produced pain. Margolis⁶¹ suggested a two-stage mechanism for this kinin formation; in the first stage, a precursor in the plasma (component A) is converted into an active agent, termed ' contact factor ', which in turn interacts with another substance (component B) to form the plasma kinin. PPS is indistinguishable from bradykinin⁶¹, and the contact factor of Margolis, therefore, is closely related to or identical with kallikrein. Activation of plasma kinins can be prevented by heating the plasma or by the action of soybean trypsin inhibitors, which are known to inactivate kallikreins⁶². The effect of the permeability enhancing factor in permeability-globulins (G-2)⁶² is also now attributed to serum kallikrein, which would release kallidin (the method used in the preparation of G-2 globulins would activate serum kallikrein).

Kallikreins, by their action on their substrate kininogen, release kallidin (earlier called kallidin 10 or kallidin II) or bradykinin (identical with the peptide earlier referred to as kallidin I or kallidin 9) or in some cases both these peptides. The ratio of the two peptides is dependent upon the conditions of the experiment as also the source of the enzyme^{45,63}. Webster and Pierce⁴⁵ showed that incubation of fresh human plasma with pure human urinary kallikrein for 1.5 min. at 24°C. yields both kallidin and bradykinin, while the same kallikrein could not convert pure kallidin to bradykinin. Incubation of pure kininogen with this urinary kallikrein gave only kallidin, and no bradykinin could be detected. Human and hog pancreas kallikerins gave similar results; when incubated with human plasma they formed approximately equal quantities of kallidin and bradykinin, but failed to attack pure kallidin. Human plasma kallikrein, on the other hand, gave only bradykinin when incubated with human plasma or purified kininogen, while it failed to convert kallidin to bradykinin.

Based on all this evidence it has, therefore, been suggested⁴⁵ that glandular and urinary kallikreins, so far investigated, release kallidin from kininogen, which is then converted into bradykinin by an aminopeptidase present in plasma. Plasma kallikrein, on the other hand, releases bradykinin directly since this enzyme preparation is incapable of converting kallidin to bradykinin. The presence of both kallidin and bradykinin in acid-treated plasma is probably due to the simultaneous action of human urinary kallikrein and the plasma kallikrein on kininogen.

The snake venom of Agkistrodon contortrix and trypsin give mainly bradykinin on incubation with human plasma. Though the venom is incapable of converting kallidin to bradykinin, it gives both these peptides on incubation with pure kininogen. It, therefore, seems probable that the venom has two enzymes, one acts like a glandular kallikrein and releases only kallidin, while the other is like plasma kallikrein and releases bradykinin directly. Trypsin, however, can convert kallidin into bradykinin. Trypsin, therefore, either first releases kallidin from kininogen, which is then converted into bradykinin by the combined action of trypsin and aminopeptidase in plasma, or trypsin simultaneously attacks the arginine and lysine bonds of kallidin in kininogen.

The exact significance of the *in vivo* conversion of kallidin to bradykinin is not clear. The situation seems analogous to that of angiotensin I and II; kallidin, however, is as active as bradykinin and in some tests even more potent⁴⁵. The *in vivo* activity of kallidin is, therefore, not dependent on its conversion to the nonapeptide, as the decapeptide *per se* is biologically active.

The enzymatic action of kallikrein is abolished by various kallikrein inhibitors particularly those present in blood⁶⁴. Kallikrein inhibitors have also been reported in extracts of a number of tissues of various animals⁶⁵ and in potato⁶⁶ and soybean⁶⁷. These inhibitors are basic in nature, are partially dialysable and can be destroyed by peptidases and are, therefore, probably basic polypeptides. The kallikrein inhibitors in blood can be destroyed either by heating^{64,68} or by high (10.5) and low (4) pH. The yield of kallidin produced by the action of kallikrein is, therefore, much higher when the kallikrein-inactivators have been previously destroyed.

Plasma globulins also contain a kininase⁶⁹⁻⁷¹ which rapidly inactivate kinins in the plasma. It is not yet certain whether the same enzyme acts on both kallidin and bradykinin or there are two separate enzymes. The enzymes act like a carboxypeptidase and destroy bradykinin, and probably also kallidin, by cleaving the peptide bond of the C-terminal arginine. Kininase occurs in several tissues particularly in kidneys⁷² and liver⁷³. Acidic ρ H destroys the activity of these enzymes in plasma⁷⁴, and cystein⁷² and EDTA⁶⁰ inhibit them⁷¹.

Thus in the formation of kinins in plasma several reactions take place simultaneously, e.g. activation of plasma kinin forming enzymes and its inhibition by an inhibitor, the formation•of the plasma kinins by the action of this enzyme on its substrate, and inactivation of plasma kinins by kininases (carboxypeptidase) present in the fraction of plasma proteins containing the substrate. The whole picture is presented in Chart 2.

Nature of Kallikreins

Kallikreins have a powerful esterolytic action and can hydrolyse arginine esters but have no effect on amides^{68,75}. It has also been shown that bradykinin formation is inhibited by arginine esters and not by the corresponding amides^{75–77}. It, therefore,

appears probable that the esterolytic action of kallikreins is responsible for the release of kinins. It has been suggested that kinins are attached to their substrate through an ester linkage - either by the serine hydroxyl group of the kinin with carboxyl group of a polypeptide or polysaccharide or by the carboxyl group of the kinin with the hydroxyl group of serine of a polypeptide or of the carbohydrate of a glycoprotein⁶³. Since esterolytic enzymes are ubiquitous in the body, presumably all tissues are capable of releasing bradykinin from the plasma. The release of bradykinin by trypsin also seems to be related to the esterase activity of the latter rather than to its proteolytic activity^{78,79}. Snake venom is a salivary excretion and it is likely that its action is also esterolytic⁸⁰. Hamberg and Rocha e Silva⁸¹ found that heating of snake venom brought about a rapid destruction of its proteolytic activity towards casein, whereas the activity towards benzoyl arginine methyl ester was reduced much more slowly. This slower esterase destruction ran parallel time-course to the destruction of the bradykinin releasing activity. Holtz et al.82 could bring about a separation of the proteolytic activity from the bradykinin-forming and esterolytic activity of snake venom by dialysis. Webster and Pierce⁸³ and Habermann⁸⁴, however, have presented evidence against the esterolytic nature of this release of kinins. Habermann implicates the attachment of the kinins to the substrate through the N-terminal arginine or lysine⁸⁴. This point can only be settled after pure kininogen is isolated.

KALLIKREINOGEN



Chart 2 — Origin of kallidin, bradykinin and angiotensin and their possible effect on the regulation of blood pressure $[\longrightarrow$ activation; --- \rightarrow inhibition]

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All kallikreins lose their ability to release kinins, to hydrolyse synthetic esters and to react with natural kallikrein inhibitors by preincubation with diisopropylfluorophosphonate (DFP) which is known to react with the OH group of serine⁸⁵. This amino acid, therefore, must be a part of the active centre of kallikrein. Further, the fact that the maximum esterolytic activity of the enzyme is exhibited near pH 8.5 suggests that histidine is perhaps another amino acid in the active centre⁸⁶. Kallikrein, when inactivators. Hence serine appears to be involved in the binding of inactivators also⁸⁶.

Antagonists - Specific antagonists of these kinins would be of immense use in understanding the function and also the SAR of these polypeptides, but so far no specific antagonists have been found. As these kinins have been implicated in the inflammatory response, various anti-inflammatory and antipyretic drugs have been tried as antagonists⁸⁷⁻⁸⁹. It has been found that only analgesic-antipyretic drugs like acetylsalicylic acid, phenylbutazone, amidopyrine and phenazone antagonize the bronchoconstrictor effect of bradykinin in the guinea-pig, potently and specifically, but have no effect on its other actions such as those on blood vessels or bronchodilation. As some of these agents also relieve chronic asthma, it raises the question whether kinin release plays a part in this disease. However, there are other anti-inflammatory agents like cortisone which do not antagonize bradykinin but relieve asthma⁹⁰.

Plasmin and kinins — In addition to kallikrein, the fibrinolytic enzyme plasmin has been implicated by several workers as a kinin-releasing enzyme⁹⁰⁻⁹². Bhoola *et al.*⁹³, however, found that a preparation of plasmin which was highly fibrinolytic failed to release significant amount of kinin *in vitro*, and failed to increase vascular permeability *in vivo*. Thus serum kallikrein and not plasmin is involved in the release of plasma-kinins^{94,95}.

Other Kinins Present in Free (or Active) Form

In addition to the kinins described above which are released from an inactive precursor, there are other kinins which exist in the free or active form. The presence of vasodilator substances in urine has been reported by a number of investigators⁹⁶⁻⁹⁸.

Werle and Erdos⁹⁹ isolated this kinin like substance from human urine and named it substance Z. Gomez¹⁰⁰ and later Gaddum and Horton⁷⁴ showed the close similarity of this substance with bradykinin. The latter workers also showed that kinnin was excreted continuously in urine¹⁰¹. Its origin, however, is still obscure. It may represent the renal clearance of kinnis from plasma; or it may be formed locally, and have some role in the adjustment of renal blood flow.

Active kinins have also been isolated from the venoms of wasp^{102,103}, hornet¹⁰⁴ and scorpion¹⁰⁵, where they occur along with histamine, serotonin and acetyl choline; kinin like polypeptides have been reported recently from a Brazilian spider¹⁰⁶. All these kinins possess bradykinin like activity, but can be distinguished from it, and from one another

by paper or column chromatography^{104,107} and by their susceptibility to inactivation by trypsin and chymotrypsin^{103,108}. The pharmacological potency of partially purified wasp-kinin suggests that this peptide may be even more potent than bradykinin or kallidin⁹⁵. The similarity of biological action¹⁰⁹ of the wasp-kinin and bradykinin, however, suggest that they are very closely related in structure. There is no doubt that these kinins contribute to the pain and inflammation caused by the stings of these insects.

Pharmacology

Kallidin and bradykinin cause a slow contraction of most smooth muscle preparations such as the intestine of the guinea-pig, rabbit, cat and dog, but relax the duodenum of the rat^{8,74,110}. This stimulant action on smooth muscle of guinea-pig is resistant to atropine and antihistaminics and to paralysing concentration of nicotine^{111,112}. As a stimulator of smooth muscles, bradykinin is equipotent with histamine on weight basis and hence much more active on a molar basis, and is as potent as oxytocin in causing contraction of isolated rat uterus. Kallidin and bradykinin produce bronchoconstriction in the guinea-pig on intravenous administration and contract the isolated tracheal chain but fail to contract isolated bronchial muscle of dog or man^{87,88}. The dose required to produce bronchoconstriction in the guinea-pig is considerably lower than that of histamine or acetyl choline¹⁸.

In all species of mammals so far studied (rats, guinea-pigs, rabbits, cats and dogs) a fall in arterial blood pressure follows the injection of bradykinin and as little as 1 μ g./kg. can produce an appreciable fall¹¹³. Vasodilator effects of bradykinin are strong-ly potentiated by sympatholytic drugs as well as by some centrally acting hypotensive drugs such as apresoline, chloropromazine and reserpine¹¹⁴, but are insensitive to atropine and antihistaminics¹¹⁵.

Capillary permeability is increased markedly by bradykinin and kallidin, as seen by the spread of high molecular weight dyes^{113,116-19}. In guinea-pigs, for example, into which pontamine blue has been injected intravenously, an intradermal injection of bradykinin will, result in an area of blueing at the site of injection¹¹⁸. This results in the formation of oedema and a migration of leucocytes into the region of intradermal injection¹¹⁹. These effects are more pronounced than those produced by histamine, and this seems to be due to a discontinuity produced in the endothelium¹²⁰.

When bradykinin is brought into contact with the base of a cantharides blister, pain is produced⁶⁰. Stimulation of pain fibres seems a general property of various kinins.

Physiology

The concept that various tissues are capable of controlling their blood supply independently of the central nervous system (CNS) has gained acceptance within recent years¹²¹. Bradykinin seems to be one of the agents involved in this local humoral control of blood flow. It has been shown that when the perfusate collected from the actively secreting salivary gland is incubated with plasma, the plasma develops vasodilating and smooth muscle stimulating properties due to the formation of a substance. which cannot be differentiated from bradykinin^{121,122}. It, therefore, appears likely that upon stimulation the salivary gland cell releases kallikrein into the interstitial fluid, which acts upon its substrate to produce bradykinin. The enzyme is released from the salivary gland when the gland is stimulated by chorda tympani or by acetyl choline¹²³. When the salivary gland is inactive, insignificant amounts of bradykinin forming enzyme are found in the salivary gland perfusate. Similar observations have been made on sweat glands of human forearm by Fox and Hilton¹²⁴. In a series of carefully controlled heat experiments on human subjects, they found a marked increase in bradykinin in the saline perfusate from the forearm subcutaneous spaces of treated subjects. The bradykinin thus released would cause vasodilation which would provide extra fluid for sweat formation, resulting in the loss of body heat. The tongue of cats and dogs releases bradykinin forming enzyme after nervous stimulation, and the functional vasodilation of this system in cats and dogs may also be associated with the control of body heat¹²⁵.

In view of these observations and the fact that most of the glandular secretions, e.g. saliva, pancreatic juice and sweat, are such sources of kallikrein, it has been suggested that bradykinin formation is the mechanism by which certain glandular tissues regulate their blood supply¹²⁶. These glands need a mechanism to produce a large increase in blood of rapid onset and short duration. On the other hand, no such functional vasodilation occurs in the glands such as endocrine glands which are continuously active over relatively long periods of time. This would, perhaps, explain the absence of kinin forming enzyme from the secretions of such glands as ovary, thyroid and prostrate (the prostrate gland of guineapig is rich in kinin forming enzyme, which seems to be a special case). Recently, bradykinin has also been shown to increase coronary and cerebral blood flow in a variety of laboratory animals^{127,128}. As it is very rapidly inactivated by blood and lymph, its activity is largely restricted to the tissues in which it is formed. The source of activation of the bradykinin forming enzyme in the glandular tissue is the glandular cell itself.

Bradykinin like material is present in the perfusate of human skin exposed to noxious stimuli. It has, therefore, been suggested¹²⁹ that an enzyme liberated locally after a painful stimulus acts on globulins to form bradykinin, which increases permeability, lowers pain threshold, induces vasodilation, oedema and other reactions relevant to inflammation.

Pathophysiological Significance

Bradykinin thus seems to be of great physiological interest as an agent controlling functional vasodilation. However, it may also play a role in certain pathological reactions. For example, in tissue injury, the histamine released immediately upon injury may allow bradykininogen to enter the interstitial fluid, where it comes into contact with proteases (very likely kallikrein) from injured cells to form bradykinin. In a study of lymph draining an area of damaged tissue, Edery and Lewis¹³⁰ found that whereas normal lymph contained only a small amount of kinin forming enzyme, the concentration of the enzyme increased 3-8 times after injury. This increase in concentration occurred in spite of a simultaneous increase in the lymph flow, which would tend to dilute the enzyme. Thus bradykinin may be the primary mediator of the inflammatory response.

Bradykinin may also be released by the tissue in ischaemia. Acidification of blood results in activation of kallikrein forming enzyme. Since acid metabolites such as lactic acid and carbon dioxide accumulate during ischaemic periods, the resulting acidification of the blood could possibly activate plasma kallikrein. This mechanism may explain the vascular responses of reacting hyperaemia. A similar mechanism may be operative in producing the pain of ischaemic myocardial tissue in angina pectoris. It is possible that the pain associated with the tissue injury of sunburn is also due to the liberation of bradykinin.

During anaphylactic shock, the serum is altered so that it increases capillary permeability and becomes more fibrinolytic¹³¹⁻³³. It has been suggested that bradykinin is liberated during these reactions due to an increase in proteolytic activity. This would result in generalized vasodilation and circulatory collapse would develop. It is most likely that bradykinin is one of the 'slow reacting' substances implicated in anaphylaxis¹³⁴.

Bradykinin or a similar material has been found in the blister fluid after burns¹³⁴, and in blood and urine of animals infected with *Babesia rodhaini* and other pathogenic organisms¹³⁵. It, therefore, seems that many traumatic episodes lead to activation of proteolytic enzymes with subsequent release of bradykinin.

Cerebrospinal fluid (CSF) from normal subjects does not contain bradykinin forming enzyme. However, CSF from patients with inflammatory disease of the CNS and from patients with migraine headache and chronic schizophrenia contains bradykinin forming enzyme as well as free bradykinin¹³⁶. Bradykinin and bradykinin forming enzyme may, therefore, be implicated in local vasomotor control within the central nervous system and when in excess, the components of the system may be relevant to disease. The pain of vascular headache of the migraine type may be the outcome of the combined effects of dilation of large arteries and of the pain threshold lowering action of these kinins which accumulate in walls of blood vessels and perivascular tissue.

Substance P (SP)

Substance P (= powder) was first discovered by Euler and Gaddum¹³⁷ in the brain and intestine tissue extracts of the horse. Since then its presence has been demonstrated in a wide variety of animals which include mammals, amphibians, fish and ascidians¹³⁸⁻⁴⁰. Like kallidin and bradykinin, SP stimulates most smooth muscles and produces vasodilation. However, it can be easily differentiated from them by other tests, e.g. it contracts

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the duodenum, while kinins relax it. Similarly, hen rectal caecum which is insensitive to kinins contracts in the presence of SP^{141} . Contraction of goldfish intestine has also been described recently as a fairly specific test for SP^{142} . These effects of SP are not blocked by atropine, antihistaminics or ganglion-blocking agents, and therefore it seems to act directly on the fibres of the smooth muscle¹⁴³.

Distribution — SP is present mainly in the gastrointestinal tract (GIT), central nervous system and retina. In the GIT it is present all along the digestive tract, but its concentration is highest in segments which have the most pronounced motility. There is a close correlation between its concentration, the degree of peristaltic activity and the occurrence of ganglion cells in the intestine wall¹⁴⁴. Stomach contains very little SP, while rectum has fairly large amounts¹⁴⁵. Further, the muscularis mucosa seems to contain more of it than any other layer of the outer wall.

In the central nervous system, it is present in all parts, but the concentration in different parts varies over a wide range; the grey matter contains more SP than does the white matter. The highest concentration is in the hypothalamus, caudate nucleus, area-postrenia, nuclei-cunneatus and gracilis, and in the grey matter of medulla spinalis^{143,146}. Its distribution in the CNS roughly parallels that of norepinephrine and serotonin.

In a very elegant study involving SP analysis of differential centrifugates of bovine vagus and splenic nerve press juice, Euler¹⁴⁷ has shown that SP is carried down with the granules, which indicates that SP is present in the bound form. SP granules are stable in neutral, isotonic solution up to a temperature of 37°. SP is rapidly released from these granules in hypotonic solution or when exposed to acid.

Chemistry - Substance P presents unusual difficulties in its purification due to its great instability; pure preparations of SP are particularly unstable. The biological activity of pure SP decreases on keeping even in dry form. The purest preparations available today are those of the Sandoz^{2,148} and the Hoffmann-La Roche³ groups of Basle, who obtained SP from horse and cattle intestines as a chromatographically homogeneous powder by an elaborate procedure involving repeated adsorption and ionexchange chromatography and countercurrent distribution. Their products are over ten times more active than the previous best preparation of $Pernow^{143}$ (135,000 units/mg.). SP from horse is more active than that from cattle³. The chemical purity of the latter preparation, however, has still to be established with certainty. The amino acid analysis of these preparations showed the presence of lysine, alanine, arginine, aspartic acid, glutamic acid, proline, glycine, valine, leucine, isoleucine, phenylalanine, serine and threonine. It has arginine at the N-terminus as in bradykinin, but the C-terminus is different¹⁴⁸. SP, in contrast to bradykinin, is degraded both by trypsin and chymotrypsin, and is also unstable in the presence of acids and alkali.

Pharmacological actions and physiological significance — Most of the pharmacological studies on SP have been done with crude preparations and it is not very clear whether the activity attributed to SP is its own, or is exerted by the impurities present. SP, of course, contracts smooth muscle and causes vasodilation. It is a powerful stimulant of intestinal motility in several species of animals, when administered intravenously or intraluminally¹⁴⁹⁻⁶¹. SP is associated with intramural plexus in the alimentary canal and it has been suggested that it participates in the control of the activity of the intestinal smooth muscle¹⁴⁹.

The wide occurrence of SP in the CNS has focused greater attention on its possible role in neurotransmission. As its distribution in the CNS roughly parallels that of norepinephrine and serotonin, it has been suggested that SP may be a non-cholinergic transmitter and is the chemical transmitter liberated by the sensory neuron^{152,153}. SP, when given - intrasisternally or intraventricularly, produced a long-lasting stimulation of respiration and a general inhibition of spontaneous activity¹⁵⁴. Intracarotid injections of SP produced changes in the EEG patterns, indicating stimulation of the ascending activating system of the reticular formation¹⁵⁵. SP. when injected subcutaneously in mice, caused an inhibition of the spontaneous movement and sedation. This effect was also evinced in animals pretreated with psychomotor stimulants^{156,157}. Similarly, a definite long-lasting taming effect has been observed in wild hares given quite low doses of SP158. At higher doses SP could potentiate barbiturate hypnosis and antagonize harmine tremors and picrotoxin or strychnine convulsions, and produce hyperalgesia^{157,159}. Zetler¹⁵⁷, therefore, considered SP as an inhibitory transmitter (Stern and Milin¹⁵⁸ termed it 'physiological tranquillizer'). Stern and Hukovic¹⁶⁰, however, have reported that whereas crude preparations of SP had the activities described by Zetler, purified SP did not possess many of these properties. Similarly, Vogler *et al.*³ working with purified SP could not get the clear cut CNS effects as obtained by earlier workers with crude SP preparations. Krivoy¹⁶¹, on the other hand, has cast doubts whether these authors are at all dealing with real SP. In the standard method of purification, a bioassay for musculotropic activity is performed at each stage and according to Krivov it is possible that during purification the neurotropic component is lost and the musculotropic component purified. According to Zetler¹⁶², crude SP preparations consist of more than one active polypeptide, and the presence of seven active polypeptides has been reported from horse intestine extracts. The chemical identity of SP and its possible, role in the CNS have yet to be settled with certainty. Although it is difficult to assign any definite role to SP at present, the fact that SP is so widely distributed in the CNS does teleologically point to some definite function for it.

Other Active Polypeptides

A number of other active polypeptides have been described in recent years. However, these are rather poorly characterized and it is difficult to say anything about their biological significance. Many of them will probably turn out to be similar,

if not identical with some of the biologically active polypeptides known today. There are, for example, pepsitensin, pepsitocin and pepsanurin obtained by the hydrolysis of blood serum with pepsin¹⁶³ which have biological effects resembling those of angiotensin and other polypeptides of neurohypophysis. Acidification of serum globulin similarly leads to the formation of a powerful oxytocic and pressor polypeptide named anephrotensin¹⁶⁴. Some other such polypeptides reported are substance A from fraction IV-4 of plasma protein165, hysterotonin from decidua and amniotic fluid¹⁶⁶, anaphylotoxin from serum¹⁶⁷ and leucotaxin from inflammatory exudates¹⁶⁸. This field is receiving a great deal of attention and with the interplay of physical and biological sciences a great deal more will be learnt in the near future about the biological role - and structure-activity relationship of these polypeptides.

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Range of Interaction in Metals*

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HOUGH atomic forces govern the entire thermal and mechanical properties of solids, often their nature cannot be stated definitely. For convenience of calculation and understanding they have been classified into a number of parts and one can choose the desired number to suit the problem. The subject of crystal vibrations has been approached from (i) the phenomenological and (ii) the theoretical points of view. In the phenomenological approach, one considers an atom or ion interacting with a group of neighbouring atoms or ions by Hooke's law of forces. It is customary to confine this interaction to the nearest and next nearest neighbour interactions^{1,2}. To account for the electron-lattice interaction especially in metals, an empirical constant is introduced without attempting to calculate it^{3,4}. The theoretical approach has been developed by Born and his associates, Kellermann⁵, Lyddane and Herzfeld⁶ and Bhatia⁷. The atomic forces are divided into three parts: (1) Coulombian, (2) exchange repulsion, and (3) volume forces. In the case of aluminium, Walker⁸ employed such a multi-force constant model.

In the phenomenological picture wherever a large discrepancy was found between its predictions and observations, it was ascribed to the neglect of distant neighbour interactions. In the theoretical model of Kellermann and others, Coulombian interaction is a long-range interaction and is, therefore, summed up for the entire lattice. In this model metals deserve a special mention. A metal by current concepts may be envisaged as a lattice of positive ions embedded in a sea of electrons, with zero total charge. But this is also the definition of a plasma (Langmuir⁹). The possibility of exciting plasma oscillations in metals was first pointed out by Steenbeck¹⁰. The study of effects of plasma oscillations remained in oblivion till the subject was revived in a series of papers by Bohm and

Pines¹¹ and by Bardeen and Pines¹². The electrons shield the charge, reduce the range of Coulombian interaction and modify the lattice frequencies. In this paper, the effect of plasma oscillations on the range of (1) electron-electron interaction and (2) electron-lattice interaction is considered.

Calculation of Interactions and **Plasma Frequencies**

Motion of Electrons in the Absence of Thermal Motions

Electron-electron interaction - Even at 0°K. all the electrons are not in the same energy state. The motion of the electrons perturbs the static value of the potential energy, which varies according to the perturbed value u_p . Thus, the density of states function can be written as

$$n(\epsilon) = n_0(\epsilon - u_p) \qquad \dots \qquad \dots \qquad (1)$$

That is, the density of states function $n(\epsilon)$ in the perturbed state is equal to the density of states function $n_0(\epsilon - u_p)$ in the unperturbed state. For an adiabatic case applying the Poisson equation we have

$$\nabla^2 u_p = -4\pi e^2 n(\epsilon_F) - n_0(\epsilon)$$
$$\approx 4\pi e^2 u_p \frac{\partial n_0}{\partial \epsilon} \bigg]_{\epsilon} = \epsilon_F$$

where ϵ_F is the energy near the Fermi level and] denotes the scalar differentiation.

Thus For a spherically symmetric case

$$\nabla^2 u_p = \frac{\partial^2 u_p}{\partial r^2} + \frac{2}{r} \frac{\partial u_p}{\partial r}$$

The potential must be of the form

$$u_{p} = \frac{e^{2}}{r} \exp(-kr), \ k = \frac{2\pi}{\lambda} \dots \dots (3)$$
$$k^{2} = 4\pi e^{2} N(\epsilon_{F})$$

with

Thus the potential is sufficiently reduced when r = 1/k. According to the calculations of Bohm

^{*}Paper presented at the Symposium on Lattice Defects and Lattice Dynamics, held at the National Physical Laboratory, New Delhi, in October 1962.

and Pines, for sodium this cutoff wavelength $\lambda_c = 9.8$ A. Even from physical considerations, similar to those adopted in lattice vibrations, λ_c = twice the distance between electrons

 $= 4r_e = 8$ A. for sodium, where $r_e =$ radius of the spherical volume assigned to the electron. The cutoff wavelength of the electron-electron Coulomb interaction becomes inappreciable for distances larger than λ_c . In other words, one need calculate the electron-electron interaction only for distances of the order of λ_c .

Plasma frequency - Due to thermal motions the densities of the positive ions and the electrons fluctuate and the tendency for charge neutrality results in overshooting the mark and the process is repeated. Thus longitudinal oscillations (called plasma oscillations after Langmuir) are set up. The value of the plasma frequency can be deduced from very simple considerations. The polarization

 \hat{P} set up in a plasma in unit volume is given by $\hat{P} = -ne\hat{x}$ which gives rise to an electric field

$$\hat{E} = -4\pi\hat{P} = 4\pi ne\hat{x}$$

The restoring force \hat{F} on an electron due to this field is

$$\hat{F} = -e\hat{E} = -4\pi ne^2\hat{x}$$

Hence, the equation of motion can be written as

$$m\hat{x} = -4\pi ne^2\hat{x}$$

From this the plasma frequency ω_{ϕ} is obtained by the relation

$$\omega_p^2 = \frac{4\pi n e^2}{m} \qquad \dots \qquad (4)$$

Substituting the values of n, e and m we obtain $\omega_p = 10^{10} \text{ sec.}^{-1}$ for a gas and $\simeq 10^{16} \text{ sec.}^{-1}$ for a metal.

Since the frequency of the phonons is of the order of 10-13 sec.-1, it means plasma oscillations cannot be excited thermally.

Motion of Electrons in the Presence of Thermal Motions

The value of ω_p obtained above is true for a simple model. It gets modified due to thermal motions; Bohm and Pines have found the modified frequency as given by13

$$\omega^2 = \omega_p^2 + \langle \hat{k} \cdot \hat{v}_i \rangle^2 \rangle \quad \dots \quad \dots \quad (5)$$

where v_i is the average velocity of electrons. For Maxwellian distribution $v_i^2 = v^2/3$.

The electron-lattice interaction and the modification of the ionic plasma frequency due to the thermal motion of the ions has been calculated by Bardeen and Pines, a brief outline of which is presented below.

Electron-lattice interaction - The complete Hamiltonian under adiabatic approximation can be written as

$$H = H_{ii} + H_{ee} + \sum_{i \ 2m} \frac{p_i^2}{i_j 2m} + \sum_{i,j} \frac{p_i^2}{x_i - X_j} + \sum_{i,j} \frac{\text{compensated}}{\text{sated}}$$
(ion-ion (electron-
interac- electron elec- interaction) interaction trons)

It is assumed that the individual electrons move in a potential $V(\mathbf{x})$ which is the potential of the ions compensated by a uniform negative charge

$$V(\hat{x}) = \sum_{i} v(\hat{x} - \hat{X}_{i}) + \text{compensated charge}$$

Expanding the electron-ion interaction for the ionic displacements \hat{X}_i by Taylor's series and regrouping the terms we get

$$H = H_{\text{ln}} + H_{\text{tr}} + H_{ee} + \sum_{i} \frac{p_i^2}{2m} + \sum_{i} V(\hat{x}_i) + H_{\text{int, }}.$$
(togi-
(transverse)
(transverse)

which reduces to

$$H = \frac{1}{2} \sum_{\text{zone}} (P_k P_k^* + \Omega_k^2 q_k q_k^*) + H_{\text{tr}} + \frac{1}{2} \sum_k M_k^2 \rho_{-k} \rho_k$$
$$+ \sum_i \left(\frac{p_i^2}{2m} + V(\hat{x}_i) \right) + \sum_k q_k^* \underline{v}_{-k}^i \rho_k \qquad \dots \dots (6)$$

in terms of the normal coordinates for the first Brillouin zone. Here

 $\Omega_k = \text{ion interaction and lattice frequency of the}$ kth mode;

 $M_k^2 = \frac{4\pi e^2}{k^2}$ in the free electron approximation;

 $P_k = \sum_i e^{-\hat{k}\cdot\hat{x}_i}$ the matrix elements due to the ionic displacement;

$$\underline{v}_{k}^{i} = -(NM)^{-1} \int \Psi_{k+k}^{*} \{ \sum_{j} \epsilon_{k} \nabla v \left(\hat{x}_{i} - \hat{X}_{j}^{0} \right) \}$$

exp $(i\hat{k}.\hat{X}_{i}^{0})\Psi_{k}^{*}d\tau$

Similarly, v_k^e the matrix elements corresponding to the electronic displacements can be computed. The displacements of the ions from their equilibrium

position \hat{X}_{j}^{0} are given by

$$\delta \hat{X}_j = \hat{X}_j - \hat{X}_j^0 = (NM)^{-\frac{1}{2}} \sum_{k\sigma} q_{k\sigma} \hat{\epsilon}_{k\sigma} \exp(i\hat{k}.\hat{X}_j^0)$$

in terms of normal coordinates, & is a unit vector along the direction of propagation, σ is the polarization vector, which is ignored while dealing with only one type of mode, namely longitudinal. The Taylor expansion of the interaction term is

$$\begin{split} \Sigma v(\hat{x}_{i} - \hat{X}_{j}) &= \sum_{i,j} v(\hat{x}_{i} - \hat{X}_{j}^{0}) - \\ (NM)^{-\frac{1}{2}} \sum_{k} \hat{\epsilon}_{k} q_{k} \exp((i\hat{k} \cdot \hat{X}_{j}^{0}) \nabla v(\hat{x}_{i} - \hat{X}_{j}^{0})) \end{split}$$

The second term may be written in an integral form in terms of the matrix elements

$$\underline{v}_{k}^{i} = -(NM)^{-\frac{1}{2}} \int \Psi_{k+k}^{*} \{ \sum_{j} \epsilon_{k} \nabla v(\hat{x}_{i} - \hat{X}_{j}^{0}) \exp(i\hat{k} \cdot \hat{X}_{j}^{0}) \Psi_{k}^{*} d\tau$$

The total electron-lattice interaction can be written

 $v_k = v_k^i + v_k^e$

In the foregoing mathematical expressions, the capital letters $(X, P, \Omega \text{ and } M)$ stand for ions and the corresponding small ones $(x, p, \omega \text{ and } m)$ for the electrons. The other symbols are explained in the text.
Evaluation of ω_p — The equation of motion of the *k*th sound wave (i.e. motion of ions in the presence of electrons) is given by

$$\dot{P}_{k} = -rac{\partial H}{\partial q_{k}^{*}}$$
 $\ddot{q}_{k} + \Omega_{k}^{2} q_{k} = -\underline{v}_{-k}^{*} \rho_{k} \quad \dots \quad \dots \quad (7)$

The electronic density fluctuation P_k consists of two parts

$$\rho_k = \rho_k^0 + \delta \rho_k

 Motion of electrons
 when no wave sound wave is passing$$

For pure Coulomb interactions between free electrons $\delta \rho_k$ is related to the Fourier components of that part of the effective one-electron interaction potential v_k associated with the electronic response v_k^{ϵ} by Poisson equation

$$k^2 v_k^e q_k = 4\pi e^2 \delta \rho_k$$
 or more generally

$$v_k^e q_k = M_k^2 \,\delta \varphi_k \qquad \dots \qquad (8)$$

value of M_k^2 for free electrons is $4\pi e^2/k^2$

The value of M_k^2 for free electrons Here* $v_k^e = n \underline{v}_k^e$ and $v_k^i = N \underline{v}_k^i$.

By substituting $\delta \rho_k$ from Eq. (8) into Eq. (7) we obtain

$$\ddot{q}_k \! + \! \omega_k^2 \, q^k = - ec{v}_{-k}^{*} arphi_k^0$$

where ω_k is specified by the dispersion relation, namely

$$\omega_k^2 = \Omega_k^2 + M_k^{-2} v_{-k}^i v_k^e \qquad \dots \qquad (9)$$

 ω_k is the modified frequency of the ions, as a result of electron-lattice interaction.

Evaluation of v_k^e — For evaluating v_k^e consider the density of states function for electrons

$$\rho(\mathbf{\hat{x}}) \propto [E_F - \delta V(\mathbf{\hat{x}})]^{3/2}$$

where $\delta V(\hat{x})$ is the effective potential acting on the electrons due to ionic motions. The change in density $\delta \rho(\hat{x})$ associated with the sound wave potential $\delta V(\hat{x})$ is

$$\delta \rho(\hat{x}) = -\frac{3}{2} \frac{n}{E_F} \delta V(\hat{x})$$

 E_F being the Fermi energy of the electrons.

Carrying out the Fourier analysis and using the relation $v_k = v_k^i + v_k^e$ we have

$$\delta \rho_k = -\frac{3}{2} \frac{n}{E_F} V_k q_k = -\frac{3}{2} \frac{n}{E_F} (v_k^i + v_k^e) q_k \quad . . . (10)$$

For the treatment to be self-consistent, Eqs. (8) and (10) should be related as follows:

$$v_{k}^{e} = -\frac{v_{k}^{i}}{1 + \frac{2}{3}\frac{E_{F}}{n}M_{k}^{-2}} = -\frac{v_{k}^{i}}{1 + \frac{k^{2}u_{F}^{2}}{3\omega_{p}^{2}}}$$

$$\approx -v_{k}^{i}\left(1 - \frac{k^{2}u_{F}^{2}}{3\omega_{p}^{2}}\right) \qquad \dots \dots (11)$$

where u_F is the velocity of electrons near the top of the Fermi level, $\omega_p^2 = 4\pi n e^2/m$, and $v_k^e = 0$ for $k = \sqrt{3} (\omega_p/u_F)$. Thus, the effect of the field of the other electrons is to screen out the 'bare' electron-ion interaction within a distance of the order of u_F/ω_p ($\approx 10^{-8}$ cm.), i.e. a few atomic lengths.

For long wavelengths the effective matrix element for the electron-phonon interaction is thus drastically reduced to

$$v_k = v_k^e + v_k^i pprox rac{k^2 u_F^2}{3\omega_p^2} v_k^i$$

The corresponding expression for the sound wave frequency is

$$\omega_{k}^{2} = \Omega_{k}^{2} - \frac{k^{2}}{4\pi e^{2}} v_{-k}^{i} v_{k}^{j} \left(1 - \frac{k^{2} u_{F}^{2}}{3\omega_{p}^{2}} \right) \qquad \dots \dots (12)$$

This result of Bardeen and Pines is closely similar to the one obtained by Toya¹⁴. The ω_{ks} determinant is obtained from Eq. (6) as detailed in Appendix I.

The value of ω_k can be estimated by neglecting the effect of periodicity on Ω_k and v_k^i and considering only Coulombic electron-ion and ion-ion interactions. This corresponds to treating positive ions as plasma. The 'bare' phonon frequency is then

$$\Omega_k^2=\Omega_p^2=rac{4\pi N(Ze)^2}{M}$$
 , $\ \Omega_plpha$ 1013 sec.-1

 $v_{b}^{i's}$ have been evaluated by Bardeen and are

$$v_k^i = -\left(\frac{4\pi Z e^2 i}{k}\right) \left(\frac{N}{M}\right)^{\frac{1}{2}}$$

where $i = \sqrt{-1}$, N is the ionic density and Z the valency. We then have from Eq. (12)

$$\omega_k^2 = \frac{k^2 u_F \Omega_p^2}{3\omega_b^2} = \frac{mZ^2 u_F^2 k^2}{3M} \quad \text{for } n \approx N$$

and the longitudinal velocity

$$C_l = Z u_F \sqrt{\frac{m}{3M}}$$

The experimental values of C_1 for alkali metals differ by 20 per cent from the theoretical calculations. The elastic constants for sodium on the same model differ by 10 per cent from experimental data. The right order of agreement gives confidence in the method of approach.

It has already been pointed out that plasma frequencies ω_{ρ} are of the order of 10^{16} sec.⁻¹ and hence cannot be excited thermally; it is possible to excite them by swiftly moving particles. Quantizing plasma oscillation energy as in simple harmonic oscillators, the energy losses of fastly moving charged particles should show quantum jumps. Such quantum jumps called 'plasmons' have been observed in the energy loss spectra of fast electrons penetrating into thin metallic films¹⁵⁻¹⁷. Absorption spectra in the soft X-ray region ($\lambda = 500$ A.) should also reveal 'plasmons'.

Recently, Woods et al.¹⁸ have obtained dispersion curves for sodium from neutron diffraction data, and do not find a good fit with Toya's work, which

^{*}This step is confusing in the paper by Bardeen and Pines¹². Their equation is dimensionally incorrect.

is essentially the same as that of Bardeen and Pines. Daval and Sharan¹⁹ have compared the results with the calculations based on the phenomenological model of de Launay and have found a very good fit. The reasons for the failure of the theoretical model are not apparent, probably some more terms hitherto unknown need to be considered to give a better fit.

Summary

In a metal the Coulombian interaction has been considered as consisting of three parts, viz. ion-ion, electron-electron and ion-electron interactions. Ionion interaction contribution forms a slowly convergent series and hence has to be summed up for the entire lattice, while for the other two interactions the significant contribution is only from near neighbours. A fair agreement has been observed between the calculated value of the longitudinal acoustic wave velocity in sodium and that deduced from the present analysis.

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APPENDIX I

Secular Determinant

The secular determinant can be set up by expressing Eq. (6) in the form of a potential energy function. A simple way of doing it is as follows. The equation of motion of an ion of mass M can be written as

$$M\ddot{u}_{k\sigma} = -\frac{\partial\phi}{\partial u_{k\sigma}} \quad (\sigma = 1, 2, 3)$$

where $u_{k\sigma}$ is the displacement of the ion in the kth mode in the direction σ from its mean position and ϕ is equal to the total potential energy of the ion due to the entire lattice. Applying Taylor's expansion and taking terms up to the second only we obtain

$$M\ddot{u}_{k\sigma} = -\frac{\partial^2 \phi}{\partial u_{k\sigma} \partial u_{k\mu}} u_{k\mu}$$

The first term of Taylor series vanishes because of the equilibrium conditions. By substituting

$$u_{k\sigma} = \frac{1}{\sqrt{M}} q_{k\sigma} \exp (2\pi i k. r - i \omega t)$$

we have in terms of the normal coordinates

$$\omega^2 q_{k\sigma} = - \frac{1}{M} \frac{\partial^2 \phi}{\partial u_{k\sigma} \partial u_{k\mu}} q_{k\mu} = 0$$

For a non-trivial solution

$$|\omega^2 \delta_{\sigma\mu} - \sigma\mu| = 0$$

and the coupling coefficients

$$C_{\sigma\mu} = \frac{1}{M} \frac{\partial^2 \phi}{\partial u_{k\sigma} \partial u_{k\mu}}$$

Since ϕ is a function of k, so also are $C_{\sigma\mu}$. The vibration spectrum can be found by solving the determinant for the various values of k. Here Cou is the sum of the contribution from the various terms of Eq. (6). These contributions can be calculated separately. The usual way to find ϕ is to consider the interaction between the different neighbours and to sum it up for all. Bardeen and Pines only emphasize that the contribution to ϕ arising from the electron-ion interaction [last term of Eq. (6)] is insignificant for distances greater than a few atomic lengths and hence need not be summed up for the entire lattice. This, however, does not apply to the ion-ion interaction which forms a slowly convergent series and hence has to be summed up for the entire lattice. Thus for the ion-ion contribution to the force constants, the effects of even the distant neighbours are important while for the electron-ion or electron-electron, they can be ignored.

SOLIDS UNDER PRESSURE edited by William Paul (McGraw-Hill Book Co. Inc., New York), 1963. Pp. xvii+478. Price \$ 15.00

The subject matter of this book could, in certain respects, be regarded as a continuation of the studies described in the late Prof. Bridgmah's monumental work on the *Physics of high pressure*, which appeared in print more than three decades ago. The book under review is devoted to the exposition of some of the vast fields of investigation opened up by pioneers like Bridgman, who perfected laboratory methods of investigation of matter when subjected to extremely high pressures.

Though written by fourteen different authors, it is something more than a mere collection of papers, as there is a uniformity of purpose in the book, viz. they all deal with the different aspects of behaviour of solids under high pressures. At the same time, the individual chapters in the book are all selfcontained and each one could be studied without reference to the others. Readers should, however, bear in mind that this is not an exhaustive treatise on the subject. There are many aspects of the subject which could come under this title, but which have not found a place in this book in the form of contributions, because there has not been much of progress in those aspects of study. Thus, one could think of X-ray investigations, study of spectra and low temperature studies at high pressures as constituting such important fields of research under this title.

The topics which have found exposition in the book show a preponderance of thermodynamical properties, but include also electrical and magnetic phenomena and elasticity. The choice of topics has presumably been made on the basis of availability of contributions to the volume. The value of the book could, perhaps, have been enhanced by an introductory chapter (besides that of Bridgman) giving a broad survey of the entire field, as this would have enabled the reader to get an idea of the potentialities of high pressure research. Such a survey could, however, be introduced even in a later edition of the book.

Though essentially an exposition of different aspects of behaviour of solids under pressure, the study of the book requires some initial background of the subject. So, this volume cannot be recommended to undergraduates. Even research scholars specializing in the field would do well to first go through Prof. Bridgman's book before taking up the study of the present volume. Physicists as well as geophysicists will find this publication an extremely useful reference book. The extensive bibliography at the end of the book adds further to its value. The editors and authors have to be congratulated for having conceived the idea of bringing out this volume as a tribute to one of the greatest pioneers of science who dedicated his life to high pressure research.

K. G. RAMANATHAN

PLASMA PHYSICS AND MAGNETOFLUID MECHANICS by Ali Bluent Cambel (McGraw-Hill Book Co. Inc.,

New York), 1963. Pp. xiii+304. Price \$ 11.50 Many books have recently appeared on plasma physics and magnetohydrodynamics treating these subjects from different points of view. The present book is written primarily for students of applied science and engineering. It combines the various disciplines like the electromagnetic theory, thermodynamics and magnetofluid mechanics in one volume. There are a number of references to other books and papers meant for the research worker for supplementary study.

There are nine chapters. The first four chapters deal with fundamentals of electromagnetic theory, the next three chapters deal with the basic principles regarding the ionization and deionization processes, thermodynamics of real gases and transport phenomena. The last two chapters discuss the flow equations in magnetofluid mechanics and applications to Alfven waves, shock waves, Couette and Poiseulle flows, and the effect of wall friction and heat transfer on these flows. The two appendices give the fundamental constants and their conversion factors, and a set of problems for self-study. The book is a useful addition to the literature on the subject.

F. C. AULUCK

AN INTRODUCTION TO WAVES, RAYS AND RADIATION IN PLASMA MEDIA by Julius J. Brandstatter (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 690. Price \$ 15.00

The book under review consists of the following nine chapters: (1) Basic mathematical concepts of waves and rays; (2) The homogeneous electron plasma in a uniform magnetic field; (3) A résumé of hydrodynamical equations and shock conditions for gases; (4) The homogeneous ionic plasma in a magnetic field; (5) Energy considerations and electrodynamics; (6) The structure of waves in non-homogeneous media; (7) The theory of propagation of rays in an inhomogeneous, anisotropic, dispersive and absorbing medium; (8) Propagation phenomena based on the Boltzmann equation — microscopic considerations; and (9) Radiation in a plasma. Finally at the end, the author has provided a number of problems based on various chapters for the readers.

The book deals with one of the most important branches of scientific investigation which are engaging the attention of workers all over the world. The aim of the author is to bring out the synthesis of wave and ray aspects of the propagation of disturbances in an anisotropic and inhomogeneous plasma medium for the better understanding of both the theory and its application. The approach lies between the purely mathematical theory based on the characteristics and purely physical description in which the intuition provides a guiding line of thought and analysis. This has helped in bridging the gap between the abstract concepts and the applied nature of a variety of problems. The discussion of the problem of radiation in anisotropic media starts with the first principles and contains such specific problems as radiation from slot and current sheet dipole. Further, the author has considered these problems from both macroscopic and microscopic points of view. In presenting the microscopic point of view he has started his discussion from the Boltzmann equation, pointing out clearly the physical assumption underlying this approach.

The book is self-contained inasmuch as it sets the necessary mathematical methods and physical concepts in a clear and lucid manner. The use of vector, tensor and matrix notation has brought about the economy in the description.

Though the book is aimed at the senior graduate students of the universities in the United States of America, it will serve as a reference book for the research workers and also for the people who wish to apply these ideas in practical problems all over the world. The reviewer has great pleasure in recommending this brilliant book to all the workers in this field.

P. L. BHATNAGAR

DEVELOPMENTS IN APPLIED SPECTROSCOPY: Vol. I — Proceedings of the Twelfth Annual Symposium on Spectroscopy, Chicago, 15-18 May 1961; edited by W. D. Ashby (Plenum Press Inc., New York), 1962. Pp. x+260. Price \$ 9.00.

In the foreword the editor tells us that the purpose of this publication is to provide a source of reference for the papers presented at the Twelfth Annual Symposium on Spectroscopy, held in Chicago in May 1961. Twenty of the papers presented at the meeting are published in full in this volume and the abstracts of another nineteen are included. While fourteen of the papers are on the topic of X-ray emission and absorption, eleven are on ultraviolet and visible spectroscopy, and another eleven relate to infrared and Raman spectroscopy and gas chromatography. Three of the papers are devoted to paramagnetic resonance and NMR spectroscopy.

Not all the papers constitute valuable research publications or reviews, many of them dealing with particular materials, experimental techniques or instruments. The interest in contributions of this nature being necessarily limited, the reviewer would like to pose a general question about the utility of publishing such manuscripts in proceedings. As compared to proceedings, publication in scientific journals, where the material is subjected to the rigours of reviewing and refereeing, is perhaps to be more favoured. Some of the papers have already appeared in spectroscopic journals and others will presumably follow, resulting in duplication of publication as well.

The presentation and get-up are satisfactory and the price is not excessive. While any collection of scientific papers can find a place on a library shelf, the advanced student, research worker or instructor will not need to possess this book.

H. SHREEPATHI RAO

DIFFUSION IN SEMICONDUCTORS by B. I. Boltaks, translated from the Russian by J. I. Carasso (Infosearch Ltd, London), 1963. Pp. viii+378. Price 63s.

A large number of books dealing with the various aspects of the theory and applications of semicon-

ductors have been published during the last decade. Results of researches have, however, steadily mounted and the time has now come when the specialist's requirement can be met by treating some of these aspects in separate and independent volumes. Boltak does this job very well in respect of diffusion with a volume consisting of a 2-page introduction and 11 chapters. Fick's law and the concept of diffusion constant are introduced in the introduction. The first three chapters provide the background materials, e.g. crystal structure, crystal defects, classification of the main diffusion processes and the fundamental theoretical aspects relating to the interaction between impurities, vacancies and the like. Detailed mathematical treatments of diffusion in models of different types are given in Chapter IV. Descriptions of experimental methods generally employed for the study of diffusion form the subject matter of Chapter V. Experimental results obtained on diffusion are outlined in Chapters VI-X, which deal successively with germanium, silicon, elemental semiconductors, oxides and compound semiconductors. Descriptions of results are mostly supplemented by plausible theoretical explanations. Not wholly in line with the main theme of the volume is Chapter XI which gives a brief exposition of the problem of solubility of impurities in semiconductors. In general, the author has been able to maintain clarity, high standard and thoroughness of treatment throughout the volume. Many of the small lapses which have come to the notice of the reviewer could be avoided through a little more of editorial alertness. To mention a few of these are: the unfortunate mixing up of the terms chemical potential (p. 22) and Fermi level (p. 196), use of symbol f (p. 44) and ϕ (p. 48) for partition function, lack of any qualification while using the symbol ΔH in the general Eq. (11.31) and in Eq. (11.33b) valid for one mol, and the rather abrupt introduction of the term ' parabolic oxidation constant' (pp. 264, 272). Printing errors are few and within reasonable limits. Notwithstanding such blemishes, which are of course of minor type, the highly useful and specialized nature of the volume deserve praise in no uncertain terms. The research worker in the field of diffusion in solids would benefit immensely in having a copy of the book on his table. S. DEB

DIRECT AND CONVERSE THEOREMS: THE ELEMENTS OF SYMBOLIC LOGIC by I. S. Gradshtein, translated from the Russian by T. Boddington (Pergamon Press Ltd, Oxford), 1963. Pp. xviii+173. Price 30s.

The necessary and sufficient conditions for the existence of a theorem can be called direct and converse theorems. In like manner, we can treat inverse theorems and their converse. The first chapter of the book aims at explaining the logical relations between these ideas. Elements of set theory are used to illustrate concepts. A number of problems are given to sharpen the understanding of the reader. The second chapter, dealing with symbolic logic, deepens the understanding of the first chapter. Some ideas of mathematical logic, which are not always appreciated well by a student in the elementary stages, have been explained in a simple manner. For example, the well-known statement "the false statement can prove anything" is explained in a nice manner on page 97. All beginners interested in the study of mathematics will find the book stimulating. B. R. SETH

HYDRODYNAMIC SUPERPOSABILITY by Ram Ballabh (Asia Publishing House, Bombay), 1963. Pp. 45. Price Rs 6.00

This booklet has been published as an Uttar Pradesh Scientific Research Committee Monograph, and deals with the hydrodynamic superposability under the following eight sub-headings: (i) Definition of superposable fluids, (ii) Beltrami flows defined by curl $q = \lambda q$, (iv) Beltrami flows with λ constant, (v) Superposability of two Beltrami flows, (vi) Steady, uniplanar superposable flows in non-viscous fluids, (vii) Superposability and self-superposability of twodimensional flows, and (viii) Superposability and selfsuperposability of axi-symmetric flows.

The monograph mostly refers to the work done by the author and his colleagues. Considerable work has been done by other workers on this topic and some of the results have been incorporated in the monograph, though without specifically referring to those investigations.

The entire monograph deals with fluids of infinite extension in all directions and thus nowhere the boundaries have been taken into account. In a practical problem, however, there will always appear some rigid boundaries and consequently the value of the monograph would have been increased if this aspect of the problem had been included. Besides, the specific mentioning of some practical applications would have been useful for the workers who wish to start on the study of this topic.

The monograph is written in a lucid and clear style. The printing and get-up are attractive.

P. L. BHATNAGAR

COMPACT CALCULUS by Philip Franklin (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 239. Price \$ 6.50 or 50s. 6d.

The book under review is a brief, concise, compact and rigorous presentation of elementary calculus. The basic concepts are introduced rigorously. Starting from these fundamental definitions, results are derived which are stated in the form of theorems. A few advanced theorems from higher analysis are stated without proof at the appropriate places. Intuitive ideas based on geometrical notions are, to a great extent, avoided.

Some of the fundamental ideas like limit, derivative, continuity and differentiability of a function at a point are introduced in Chapter I. Definite integral, regarded as the limit of a sum, appears early in Chapter II, in which improper integrals, Simpson's and trapezoidal rules for the calculation of plane areas are also considered. Chapters III and IV deal with formulas of obtaining differential coefficients of algebraic, implicit, exponential, logarithmic, hyperbolic and inverse functions. Equations of the tangent and of the normal to a curve at a point, small errors, rate measure and maxima or minima of a differentiable function are some of the simple applications of differential calculus studied in Chapter V. Integration is defined as antidifferentiation in Chapter VI, wherein standard methods like integration by substitution and by parts are given. Chapters VII and VIII deal with the usual applications of definite integral to the evaluation of length of a curve, volume and surface area of a solid of revolution, moments of inertia, etc. Some simple tests of convergence and divergence of infinite series are considered in Chapter X before the introduction of Taylor's theorem which merits mention. Partial differentiation and multiple integrals are dealt with in the last chapter.

A set of good examples is given at the end of each chapter. A few printing mistakes (pp. 15, 16, 59, 60 and 82) which have crept in do not mar the excellence of the book. It is a good book with rigour as its keynote. One would unreservedly recommend it as an excellent text-book in calculus.

T. S. G. KRISHNAMURTY

ELEMENTS OF LINEAR SPACES by A. R. Amir-Moéz & A. L. Fass (Pergamon Press Ltd, Oxford), 1962. Pp. ix+149

Elements of linear spaces and the techniques of linear algebra are becoming increasingly essential for general science and technical students. This is reflected in the number of books on the topics that have appeared in recent times.

The book under review gives a clear and readable account of the elements of the theory, using a geometric approach and motivation. The first five chapters restrict attention to the matural 2,3-dimensional spaces. The second part deals with complex n-dimensional spaces, introducing the inner product, norm, orthonormal bases, and applications to geometry (the reduction of the quadratic form; discussion of quadric loci). The last section deals with the general (modern algebraic form) of vector spaces over a field, linear dependence, bases, unitary spaces, linear transformations in these, singular values and proper values of matrices.

Illustrations, exercises and a pleasant get-up are likely to make the book a popular text in the field. V. S. KRISHNAN

RATES AND EQUILIBRIA OF ORGANIC REACTIONS by John E. Leffler & Ernest Grunwald (John Wiley & Sons Inc., New York and London), 1963. Pp. xvi+458. Price \$ 11.00

The present book has been written in an apologetic as opposed to dogmatic attitude about the current linear free energy approach to the rates and equilibria of organic reactions. This has made it readable all through, though, I am afraid, the results are not yet compelling enough to surmount the energy barrier of the 'purists' who demand everything worth their condescension to be derivable from first principles. Leaving out the question whether the linear free energy relationships, or for that matter, any useful empirical relationships which are not derivable from accepted quantum mechanical equations, contribute to knowledge and science, there is no doubt that the present book would help chemists appreciate how the linear free energy approach has brought at least partial order where complete chaos reigned before.

One-third of the book summarizes the thermodynamic and statistical mechanical approach to the problem. The presentation is necessarily very compressed and somewhat sketchy, but this section has a definite refresher course value about the fundamentals, and successfully familiarizes the reader with the present-day theoretical approach to the basic problem of equilibria and kinetics. Illustrations have had to be drawn from simple, nearly ideal systems, but the authors are almost always on their guard to point out inadequacies of the theoretical approach.

The extrathermodynamic approach constitutes over two-thirds of the book. Here the authors expatiate over their beloved theme in fair details giving an up-to-date succinct account of the linear free energy and analogous approaches and their utility in generalization and prediction. Particular attention has been given to the following linear relations with respect to their derivation, domain of validity, etc.: rate-equilibrium relationship $(\log k - \log K)$; Hammett po relationship for aromatic meta and para substituents (in great details); Brown relationship for aromatic substitution, $\rho\sigma^+$ (also σ^-); relationship for aromatic side chain reaction; Yukawa and Tsuno equation using linear combination of σs ; Taft $\rho^* \sigma^*$ equation for aliphatic reactions; and finally (!) the now classical Brönsted relationship. This is followed by an extensive discussion of solvent effect where acidity function and mY equation figure prominently. Next comes a long chapter of 88 pages (about onefifth of the total) on enthalpy-entropy relationship in which Leffler's isokinetic relationship figures most prominently. The concluding chapter, entitled Some mechanochemical phenomena', is an able review of the field.

The book fills a number of definite needs. It at least serves as a compilation of excellent interconnected reviews of the subjects mentioned above and as such would be quite useful to researchers in organic reaction kinetics for better appreciation and presentation of their own results. The presentation is fairly balanced and smooth with pardonable perturbation by Leffler and Grunwald's personal leanings. Books like this, surcharged with a profusion of free energy, are bound to outdate fast, but the labours shall not have been in vain, as the reaction coordinate of the change would almost surely lie across the valley of ideas presented in this book.

S. R. PALIT

ADVANCES IN HETEROCYCLIC CHEMISTRY: Vol. I, edited by A. R. Katritzky (Academic Press Inc., New York) 1062 Devis 1476 Devis 6150

New York), 1963. Pp. xi+476. Price \$ 15.0 The interest of organic and biological chemists in heterocyclic chemistry at the present time is indicated by the appearance of at least four books and two series edited by Weissberger and Elderfield which have already run into 23 volumes. The object of the new series is to make available to research workers up-to-date reviews of developments in the large and bewilderingly complex area of heterocyclics. The authors of the chapters in Vol. I have been very carefully chosen, because each has made significant contributions to the branch of heterocyclic chemistry on which he writes. The emphasis throughout is on (a) reaction mechanism, (b) physical and physicochemical methods of investigation, and (c) biological properties. The following is a list of titles and authors: Recent advances in the chemistry of thiophenes (S. Gronowitz); Reactions of acetylenecarboxylic acids and their esters with nitrogen-containing heterocyclic compounds (R. M. Acheson); Heterocyclic pseudo bases (D. Beke); Aza analogs of pyrimidine and purine bases of nucleic acids (J. Gut); Quinazolines (W. L. F. Armarego); and Prototropic tautomerism of heteroaromatic compounds: (I.) General discussion and methods of study, and (II) Six-membered rings (A. R. Katritzky and J. M. Lagowski).

In comparison with other topics in the volume, thiophene chemistry has a limited field and this chapter, therefore, is a very detailed review of all the available literature supplementing Hartough's book on thiophene and its derivatives. The chapter on heterocyclic pseudo bases is limited to bases obtained from heterocyclic quaternary ammonium salts and specially to cotarnine. Gut has given a fascinating account of aza analogues of nucleic acid bases in which he has fully demonstrated their importance in studies of nucleic acid biosynthesis, the genetic code, and antimetabolite activity, although the 208 literature references exclude biochemical papers. The quinazoline chapter has short sections on alkaloids and biologically active compounds, which contain several references to Indian work. Particularly valuable are the two final chapters which discuss the general methods of studying the prototropic tautomerism of heteroaromatic compounds and their application to six-membered rings. A paper of E. Freese (1959) is cited to suggest the possible role of tautomerism of nucleic acid bases in the spontaneous mutation of genes the basis of evolution. Chemical, physico-chemical and physical methods are listed and briefly surveyed in turn. The one-page section on NMR spectroscopy illustrates its applications to tautomeric compounds and the need for considering fast proton exchange. The section on indanthrone which begins with the inaccurate statement that "The relative importance of structures 130 and 131 has long been discussed ... " may well have been omitted, and it represents an occasional weakness in the book as a whole the tendency to assume that recent work always represents an advance on earlier knowledge. There is no reference to M. Bailey's crystal structure determination of the stable *a*-form of indanthrone by X-ray analysis [Acta cryst., 8 (1955), 182], which fully confirms the well-established classical structure.

The paper, printing and binding conform to the high standards of the Academic Press, but the reference numerals are inconveniently small. Since the choice of topics is obviously arbitrary, the main object of offering timely reviews may be better fulfilled by releasing them as separate booklets within the shortest possible period after the receipt of the manuscript.

ORGANIC FUNCTIONAL GROUP ANALYSIS by F. E. Critchfield (Pergamon Press Ltd, Oxford), 1963. Pp. vii+187. Price 42s. net

The author is in the Research and Development Department of Union Carbide Chemicals Co. and the

K.V.

methods described in the book have been used routinely in the company's laboratories. Instrumental methods of analysis, such as vapour phase chromatography, are not included. As the title indicates, the chemical methods of analysis are based on functional groups and, therefore, cannot be employed for the analysis of hydrocarbons, ethers and mixtures of homologous compounds.

A brief introduction is followed by ten chapters dealing with acids and bases, nitrogen compounds, carbonyl compounds, hydroxyl compounds, 1,2epoxides, esters, anhydrides, peroxides and sulphur compounds. In each chapter the basic principles are briefly discussed and the experimental procedures are then described in detail. The limitations of each method are pointed out and there are numerous tables of reaction conditions for the estimation of specific compounds. The general treatment is from the point of view of the manufacturer and user of synthetic organic compounds, but by suitable applications of the methods useful procedures for attacking natural products can be developed. The choice of methods is based on practical experience, and a few such as titanous chloride reduction used in the analysis of dve intermediates are omitted. Organic chemists in need of analytical methods will find this small and compactly written book an excellent purchase at the price of 42 shillings.

K.V.

AN INTRODUCTION TO THE CHEMISTRY OF COMPLEX COMPOUNDS by A. A. Grinberg, translated from the Russian by J. Rovtaslech (Pergamon Press Ltd, Oxford), 1963. Pp. xxi+363. Price £ 5 s. net The book is the translation of the second edition (1951) of A. A. Grinberg's Vvedenie v khimiyu kompleksnykh soedinenii by J. Rovtaslech and edited by Dr D. H. Busch and Dr R. F. Trible (Jr) of USA and published by the Pergamon Press. The translation has been done with utmost care to the extent that the book can pass off as one written originally in English.

The book gives a vivid picture of the approach of the chemists of the Russian school to the study of complexes. Since the issue of the second edition of the Russian book in 1951, there have been excellent monographs giving detailed treatment of the chemistry of complexes. Even then, this book fulfils the need of a text-book treatment about the systematic development of the subject.

As mentioned by the editors in their preface, Grinberg's treatment of coordination chemistry is indeed classical. However, a sound knowledge of the behaviour of complexes being a prerequisite to a proper appreciation of the modern theories, the above mode of treatment is an advantage. Some of the most modern theories like the ligand field theory are not mentioned in the book, but this is understandable since the book was revised as far back as 1951.

Recently, the studies of coordination compounds have taken a different direction, particularly the study of complexes in solution by physico-chemical methods. A. K. Babko in his Kurnakov Lecture of 6 December 1961 said: "Even recently, if a complex was not isolated by a preparative method, its existence was doubted. At present, however, it is generally accepted that the composition of the solid phase isolated from solution often does not in any way characterize the state of the substance in solution. More important is the study of the characteristics of complexes in solution, since it is here and not in solid phase the properties of the complexes most important for the theory of the problem and for its application in various fields are manifested." In general, this important aspect of the study of coordination compounds has not been dealt with in any detail, though the author has in two pages in the introduction dealt with the methods of determining the composition of the complexes by conductometry, polarography and spectrophotometry and to a slightly greater extent in Chapter IX under 'equilibria' in solution of complex compounds.

The first half of the book deals mostly with the preparation and properties of coordination compounds isolated in solid state and consists of chapters on (i) compounds of the hexa, penta and tetravalent type, (ii) coordination theory, (iii) stereo-chemical consequences of the octahedral model, (iv) compounds of the tri-, di-, monoamine and hexacid types for the coordination number 6, (v) complex compounds of coordination number 4, and (vi) coordination, hydration and other stable types of isomerism for complex compounds.

In Chapter VII on 'The nature of the force of complex formation', the ideas of the maximum coordination number and the geometrical arrangement of the ligand anions have been deduced from a simple electrostatic model postulated by Kossel and later by Magnus. This is further supplemented in the case of neutral ligand molecules by concepts of polarization providing a simple explanation for the replacement of the water molecules by those of ammonia in complexes Cu2+, etc., even though to start with NH₃ has a lower dipole moment than water. The later part of this chapter deals with the covalent bond and the explanation of the coordination number and stereo-chemistry based on wave mechanical concept of hybridization. Here, one agrees with the author when he concludes: "Therefore, while according due importance and value of the wave mechanical approach and greatly valuing the prospect of its further development, we still feel that the use of cruder but simpler polarization picture can give many interesting and positive results for the chemistry of coordination compounds." The treatment is interesting and useful.

Chapters VIII and IX deal respectively with 'The mutual effects of coordination groups ' and 'Acid base properties, oxidation reduction properties and solution equilibria of complex compounds', while some special kinds of complex compounds such as polynuclear complex compounds, etc., are discussed in Chapter X.

Chapter XI contains a useful survey of the complexing ability of various elements in relation to their position in the periodic table.

The book is appended with bibliography, supplementary bibliography to English translation, author index and subject index.

As mentioned earlier in the review, the book fulfils the need of a text-book about the systematic development of the chemistry of complex compounds. ADVANCES IN ENZYMIC HYDROLYSIS OF CELLULASE AND RELATED ENZYMES, edited by Elwyn T. Reese (Pergamon Press Ltd, Oxford), 1963. Pp. xii+ 290. Price f 4

The exigencies of the last war gave a tremendous impetus to the isolation and identification of cellulosedecomposing microorganisms, particularly fungi. This phase has been followed by intensive studies in the biochemistry of cellulose decomposition in the USA, Canada, Australia, UK, Japan and other countries. The state of our knowledge in different aspects of this research is faithfully reflected in the present volume which gathers together the papers read at a symposium held at Washington DC in March 1962. Dr Elwyn T. Reese of the Quartermaster Research & Engineering Centre, Natick, Mass., who organized the symposium, has done a good editorial job in the arrangement of the papers. Most of these contributions review the background of recent research at some length in the particular field, in addition to reporting the latest results of the author's own studies.

In the first chapter, Cowling discusses the structural features of cellulose that influence enzyme hydrolysis, with reference to wood and cotton; supporting evidence could have been cited too from work on other substrates, such as jute, on some points, e.g. the effect of natural growth substances and the relative ineffectiveness of DP. In the next paper on the effect of cellulases on cotton fibre properties, Selby postulates A and B enzymes, the former having similarities with the C_1 enzyme of Reese *et al.* and the S-factor of Marsh. Whitaker's contribution, 'Criteria for characterizing cellulases ', is a model of clear, concise and informative writing; among other important points discussed are random and end-wise splitting. and criteria for homogeneity of cellulase proteins, his thesis being that the presence of different cellulases is only one among many possibilities that may give rise to the sort of evidence claimed to prove heterogeneity. Halliwell discusses the advantages and disadvantages of various methods of cellulase assay. Hashimoto and Nisizawa describe different methods for the purification of cellulases and related enzymes. In the longest chapter of the book, inhibition of cellulase due to physical factors and chemical action are exhaustively discussed by Mandels and Reese, and there is an interesting section of the possible role of natural inhibitors. Five approaches to the problem of determining whether cellulose is split randomly or end-wise are discussed by King, and in the next paper Nisizawa, Hashimoto and Shibata distin-guish 'more random' and 'less random' splits. Describing the action of β -glycanases on β -glycans of mixed linkage, Perlin shows how selective enzymolysis can provide structural information about complex polysaccharides, revealing their fine structure. Reese and Mandels provide a muchneeded and useful review of the enzymatic hydrolysis of β-glucans. Toyama describes the uses of a commercial cellulase preparation from Trichoderma viride, e.g. in the softening of cooked and raw foodstuffs. At the end, Siu provides a brief summing up. After going through the book one is left with the impression that though important problems like uni-enzyme or multi-enzyme hydrolysis,

and end-wise or random splitting have not been finally solved, great progress has been made in these and other fields.

Anyone interested in an all-round presentation of the latest knowledge on cellulase should find this volume of immeasurable value.

S. N. BASU

FLOW MEASUREMENT IN CLOSED CONDUITS (Her Majesty's Stationery Office, London), 1962. Pp. Vol. 1, iv+384; Vol. 2, iii+386-766. Price £4 4s. (both volumes)

The volumes under review contain the papers presented at a Symposium on Flow Measurement in Closed Conduits held at the National Engineering Laboratory of the Department of Scientific & Industrial Research, UK, during 28-30 September 1960. The scope of the symposium was confined to closed conduit flow, with bias towards the methods used for measuring large water flow rates. However, some of the methods discussed in the papers, such as those dealing with current meters, can be equally applied to open channel flow, and they are applicable not only to the measurement of flow of water but also to other liquids and gases.

The papers have been classified under seven sections. Section A deals with current meters and Pitot tubes. The papers belong to two broad categories, viz. (1) narrowly defined aspects of instrument performance and (ii) application of the instruments to flow problems. The advantages and disadvantages of current meters and practical aspects, as meter support, number of measuring points and test procedure, are considered. The significance of the component type current meter capable of recording the cosine component of the flow velocity under conditions of strongly inclined flow, as obtained in low-head power stations, is discussed. The utility of traversing with a Pitot probe, at three-quarter radius position, is described. The calibration work carried out with a high degree of accuracy of air flow through a double cubic arc contraction of the Hunter Rouse type, by means of pressure probe traverses in the throat, is described.

Section B deals with investigations on orifice plates. No other flowmeter in modern times has achieved the economic importance of the orifice plate, which is evidenced in the widespread application of the instrument throughout many sectors of industry to the extent of 85 per cent. The instrument is characterized by simplicity and robustness of construction and the minimum of attention required. The coefficient characteristics of the standard designs are known so that individual meter calibration could be dispensed with. Orifice plate performance depends upon many parameters of varying importance, the criterion being the demands made on meter range stability and accuracy. The same fundamental considerations apply regardless of orifice geometry. The present situation in the field of orifice meter research and development is discussed. There is evidently a need for coordination of research on an international plane and for a degree of standardization in test procedure, apart from a concerted and rationalized attack on the essential task of formulating the research objectives.

Section C contains papers on venturimeters. The venturi, in one form or another, is in every national code an acceptable method of measurement. According to the British code as well as the previous edition of the ASME code, 'Fluid Meters', the discharge coefficient seems to vary with pipe size.

The biggest problem in determining meter performance is caused by uncertainties in the roughness or smoothness of the pipe and meter, but no national or international code gives specification for the surface conditions which they would require. The codes are written to enable a user to make a single series of measurements, and pipe and flowmeter has to be examined before the test measurement is made to ensure their compatibility with the code. Hence the accuracy limits given in the codes could not be applied to continuous metering unless inspection is fairly frequent.

Section D contains papers describing other pressure difference devices. They range from a method used for turbines measuring 20 ft or more in diameter to the characteristics of clearances only a few hundredths of an inch wide, from laminar to full turbulent flow conditions and from old to relatively new technique. Two of the papers are concerned with low-loss venturi-type meters, another with annular orifice and one with a straightening device for collecting flow to an orifice plate, while the fifth deals with the Winter-Kennedy method for turbine testing.

Section E deals with salt dilution and salt velocity methods. These methods are primarily employed for the measurement of fairly large discharges on hydroelectric schemes. These have possibility of application in circulating water systems for conventional steam power plants.

Section F deals with the Gibson method of measurement of large flows in turbines.

Section G deals with special methods of fluid measurement, when the flow is pulsating. The true average of pulsating flow has to be measured. In one of the papers, two types of flowmeter to measure mass flow are described. The first depends upon the Magnus effect which was discovered by Magnus 107 years ago, although only used for flow measurement fairly recently. In the second, the torque necessary either to introduce angular momentum into the flow in the pipe or to remove it is measured. The second paper in this series by Mr Fischbacher describes the ultrasonic flowmeter. The third paper is related to turbine type gas flowmeter. The paper is mainly devoted to the effect of gas density on the calibration of this type of equipment. The main problem appears to have been to obtain adequate torque from the gas. relative to the friction of the bearings of the flowmeter, so that the errors due to friction would be sufficiently small. The special methods discussed in this section have come to the stage where they would soon be seen in normal use and accepted in the same way as some of the more traditional methods.

The quality of the papers contributed to the symposium was of high order. The proceedings of the symposium provide an up-to-date and comprehensive knowledge in the subject of conduit flow.

J. V. RAO

ADVANCES IN NUCLEAR SCIENCE AND TECHNOLOGY: Vol. I, by Ernest J. Henley & Herbert Kouts (Academic Press Inc., New York), 1962. Pp. 355. Price \$ 12.00

This volume contains seven review articles by various field workers on different aspects of atomic energy. The aim behind this compilation can best be expressed in the words of the editors of this volume: "The extreme depth and breadth of the atomic energy field present a bewildering information problem to both the expert working along its narrow crevices and the dilettante hoping to keep abreast of the ever-expanding frontiers. Clearly what is needed by both groups are well-organized review articles containing analysis, critiques and interpretations of current advances in the field. To serve the expert, the review must be authoritative and complete. To be of value to the dilettante, it should be coherent and critical."

One can get an idea of the subject matter of this volume from the following list of articles: (1) Thermodynamic analysis of nuclear power stations; (2) The GBSR: A graphite moderated boiling water steam superheat reactor; (3) Radiation-induced graft polymerization; (4) Diffusion in uranium, its alloys and compounds; (5) Performance characteristics of large boiling water reactors; (6) Economics of nuclear power; and (7) Chemonuclear reactors and chemical processing.

The articles, in general, do not assume more than the bare fundamentals and have been developed very nicely to give anyone, who is interested, a good understanding of the subject. But the range of subjects places a limitation and a 'dilettante' hoping to keep abreast of the ever-expanding frontiers of knowledge may not find each article interesting and at times have difficulties in understanding.

* For an expert, the developments in the different fields have been covered quite well and the bibliography is quite exhaustive. However, he is likely to be disappointed to a certain extent, because some of the authors do not go as deep as one would expect them to go from the title of the book. However, there are certains exceptions like article Nos. 4, 5 and 7.

Summarizing, it may be said that it is a book which is worth going through by everyone interested in the field of atomic energy.

S. R. PARANJPE

PRODUCTION AND USE OF SHORT-LIVED RADIOISO-TOPES FROM REACTORS: Vols. I & II — Proceedings of a Seminar, Vienna, 5-9 November 1962 (International Atomic Energy Agency, Vienna), 1963. Vol. I: Pp. 433. Price \$8.50 or Sch. 178.60 or 51s. Vol. II: Pp. 272. Price \$5.50 or Sch. 115.50 or 33s.

These two volumes give the proceedings of the seminar on the production and the practical applications of short-lived radioisotopes produced in small research reactors organized by the International Atomic Energy Agency, Vienna, 5-9 November 1962. The papers in Vol. I are classified under three sections: (1) Production and preparation of short-lived radioisotopes, (2) Preparation and application of shortlived radioisotopes, and (3) Industrial applications. In Vol. II of the proceedings, three more sections deal with papers on activation analysis, applications in medicine, and applications in biology respectively. Each paper is preceded by an abstract in four international languages, viz. English, French, Russian and Spanish, and followed by a brief account of the discussions that took place.

The seminar has brought out a large amount of detailed information in the actual production techniques of various short-lived radioisotopes (whose halflives are generally less than 3 days) such as sodium-24, potassium-42, iodine-131, copper-64, etc., and of their uses in industry (e.g. leak detection, in the metallurgy and chemical industries), in medicine (thyroxine turnover studies with iodine-132) and in activation analysis. Some papers describe the scope of the isotope programmes in different countries represented at the seminar, such as in Sweden and France. The broad principles of the work published in the above papers and read out at the seminar have been well known for a considerable amount of time and contributions describing work of a very original nature are rather few. The seminar has, however, given an opportunity for discussions on the techniques used and the actual details of various experi-Their publication in a composite volume ments. thus serves to bring out all this information in a readily available form.

The get-up and printing of the volumes are in keeping with the high standards of all IAEA publications. V. K. Iya

THE TECHNOLOGY OF THE TREATMENT OF URANIUM CONCENTRATES by N. P. Galkin, A. A. Maiorov & U. D. Veryatin; translated from the Russian by R. D. M. Hegarty and edited by R. W. Clarke (Pergamon Press Ltd, Oxford), 1963. Pp. xiv+ 204. Price 50s. net

The discovery of nuclear fission in 1939 provided impetus for the rapid growth of uranium industry, and the steadily growing demand has " compelled all countries to examine the problems of the economic working of many deposits of lean ores, to begin intensive prospecting for new deposits and even seek uranium in the main masses of rocks and underground water". It has been estimated that by the mid-1970s, world requirements of uranium would be over 50,000 tons per year. The production of uranium metal of nuclear purity is a complex technology calling for a variety of skills, information concerning which remained ' classified ' until the First Geneva Conference on the Peaceful Uses of Atomic Energy held in 1955. Since then, there have been quite a few publications in book and report form giving detailed coverage of the different aspects of this subject. The Russian monograph under review is, however, still valuable as it offers in about 200 pages a breezy summary of the basic concepts. Information released up to the date of the Second Geneva Conference (September 1958) is covered to include more than 250 references, and the citation of literature is balanced.

The first three chapters of the book give a résumé of the historical developments leading up to the present market for uranium, the nuclear and non-nuclear uses of uranium, and the physical and chemical properties of the element. Chapter 4 discusses the natural occurrence of uranium, names the major ores and deposits and includes a comprehensive table on the mineralogy of uranium ores. Available methods for the physical and chemical treatment of uranium ores, and for the purification of the concentrates, and the factors that govern the choice of an appropriate flowsheet are briefly presented in Chapters 5 and 6. Chapter 7, which compares the different methods of refining uranium concentrates, gives an excellent account of the aqueous chemistry of uranium complexes. Chapters 8-12 deal very briefly with the steps required to convert the refined uranium intermediate through UO2 to UF4, and the reduction of the tetrafluoride to the metal, giving details of industrial practices on the continent and in the USA. The last chapter is devoted to safety considerations in the refining of uranium concentrates. The text is punctuated with many flowsheets, block diagrams and tables that have been imaginatively compiled and that enhance its value.

There are a few mistakes, as for example, in Table 7 on page 56 where the values of the effective nuclear cross-sections for boron, cadmium and nitrogen have got mixed up, and on page 69 where a typographical error appears in the equation for the rate of formation of U_3O_8 . These can easily be rectified in the next edition. The book is commended to students of uranium chemistry and metallurgy as a concise, readable and informative account of uranium technology. C. V. SUNDARAM

COLOUR IN BUSINESS, SCIENCE AND INDUSTRY by D. B. Judd (John Wiley & Sons Inc., New York), 1963. Pp. x+500. Price \$9.50

Since the publication of the first edition, in 1952, of the book Colour in business, science and industry by Dr D. B. Judd, Head of the Photometry and Colorimetry Section, National Bureau of Standards. Washington, the measurement of colour has spread to the research and control laboratories of government departments and industrial firms, who have been mainly using earlier visual inspection methods for quality control and selection of goods. This has led to greater interest in understanding the mechanism of colour perception and also stimulated the development of new techniques of colour control, formulation of colorants and their applications to industrial problems. In the second edition, these newer developments in the basic understanding of colour vision phenomena and the industrial applications of colour measurements have been dealt with, thus bringing the book more up to date. The subject matter of the book has thus expanded by nearly one hundred pages.

In the presentation of the basic facts (Part I), new passages have been added on the theories of the colour vision, which give an account of the present state of knowledge of this difficult subject. The contents of the first edition on the basic facts, namely (i) the eye, (ii) basic terms in colour, (iii) colour matching, and (iv) colour deficiencies, are preserved.

In Part II there is considerable expansion, mainly owing to many advances in the subject matter dealt with in this portion. In the chapter 'Fundamental standards in colorimetry', a small new section on 'Ten-degree colour-matching functions' has been added. For practical colour matching, this is more desirable. The concept of metamerism in colorimetry is of considerable importance since different transmittance (spectral reflectance) curves for the same source give identical tristimulus values (x, y, z). Various aspects of metamerism have been discussed in a semi-quantitative manner.

In recent years, fluorescent materials have come in more common use and, therefore, measurement of colour of such materials has acquired importance. Since the determination of their tristimulus values by means of spectrophotometry and computation is considerably more complicated than for non-fluorescent materials, methods of colour measurement developed for this purpose have been adequately described.

An aspect of visual mechanism, which is of immense significance, is the ability of the eye to perceive the same picture even though the rate at which light enters the eye to form this picture varies over a wide range; the process by which the visual mechanism adjusts itself to the conditions under which the eye is exposed to light is called adaptation. A familiar example of this phenomenon is the time lag before one can see when one enters from bright outside to a dark cinema hall. The eye adjusts itself to darkness conditions through the process of dark adaptation. The eye can adjust itself to the range of luminance of 10^{12} to 1, which no man-made instrument has ever achieved. This subject is also discussed in some detail.

With the development of new man-made light sources, such as fluorescent lamps, mercury vapour lamps, low and high pressure xenon lamps, the problem of assessing colour-rendering properties of these sources has become of great practical importance. Many committees of international organizations are working in this field. A survey of this subject has, therefore, found an important place in Part II.

In ordinary life, the question of colour harmony frequently arises — which means, what type of two or more colours seen in neighbouring areas produce a pleasing effect. Presentation of basic facts is, therefore, very welcome.

The problem of uniformity of colour scales is also of great importance in commercial transactions and for this research several attempts in different countries have been made to devise such a scale. Solution has been attempted from different angles, which has brought about good deal of simplification. Researches, which have contributed to this simplification, have been well surveyed in Part II. This part also includes description of a large number of instruments used in colour measurement and colour grading.

A large proportion of the colour problems in industry is concerned with layers of compounded colorants such as varnishes, paints, vitreous enamel and ceramic glazes. In such cases, the appearance of the materials depends upon how much light is reflected, diffused or transmitted, which involve important theoretical principles. The last part (III) discusses various aspects of the problem such as gloss, opacity, Fresnel reflection coefficient and Kubelka-Munk analysis of the reflection and transmission of light by a light scattering layer with application to colour of pigments.

The book covers a wide field in colour and colour measurement with applications to industry, giving an adequate theoretical background. In bringing out a second edition, Dr Judd has been ably assisted by Dr G. Wyszecki from the National Research Council of Canada.

W. M. VAIDYA

OSCILLATIONS IN NON-LINEAR SYSTEMS by Jack K. Hale (McGraw-Hill Book Co. Inc., New York),

1963. Pp. ix+180. Price \$ 9.00

Although interest in non-linear oscillations has been evinced from the days of Poincare, there was even five years ago a great paucity in the number of available books on the subject. However, many new books have appeared in recent years. The present book is a useful addition to the available literature.

The book has been divided by the author into three parts. Part I provides a summary of the background material on matrices, linear differential systems and Liapunoff's stability theorems. Part II is mainly concerned with the methods of successive approximation for finding the periodic solutions of non-autonomous and autonomous differential systems with small perturbations; but some material on generalized characteristic exponents is also included. Recent developments in the methods of averaging and integral manifolds are presented in Part III.

The author develops the methods in logical manner giving at each step the necessary mathematical proofs. A number of examples are also given in order to clarify the methods and also to illustrate the different types of phenomena peculiar to non-linear systems. But the emphasis throughout the book is on the development of the mathematics and the style of presentation is similar to that of a mathematics book. The details of the phenomena associated with oscillations in non-linear systems are inadequately discussed.

One can hardly call the book "a perfect introduction to the subject for graduate students" as claimed by the publishers. The subject matter is of an advanced level and to understand the contents properly a student is required to have thorough familiarity with the material summarized in Part I. The theorems on which the methods are based would require for presentation to the students more explanatory notes than are given in the book. However, to readers acquainted with the subject of non-linear oscillations the book would prove to be an important contribution because of the new material included in it. The book also provides a good list of references which include almost all the major contributions on the subject.

B. R. NAG

TEMPERATURE RESPONSE CHARTS by P. J. Schneider (John Wiley & Sons Inc., New York), 1963.

Pp. 153. Price \$ 7.50

Recent developments in power generation, aircraft, missile and spacecraft industries have necessitated the need for temperature response data of material systems when subjected to heating and cooling environments. Many complicated components can be approximated to simple body shapes. The temperature responses of a number of simple shapes under a variety of boundary conditions and for a wide range of the Fourier and Biot numbers are presented in 120 charts. The shapes dealt with are those most often encountered in engineering practice such as singleand two-layer plate, semi-infinite solid, solid and hollow cylinder, sphere, cylindrical and spherical cavity, and the ellipse and ellipsoids. The boundary conditions treated are constant and variable heat flux, constant and variable surface temperature, constant and variable ambient temperature, and radiation.

Preliminary design calculations can be made for simple shapes using classical constant property solutions. In parametric studies, temperature response sensitivity, peak surface and back face temperatures can be evaluated with thermal properties and thickness of material, heat input and duration of heating varied. Final design studies of temperature response are, however, determined on computers to take into account complicated geometry, variable boundary conditions and non-uniform thermal properties.

The author is to be congratulated for bringing together systematically and with clarity the many numerical results on transient heat conduction in thermal systems of practical interest. This book will be an invaluable aid for heat transfer design engineers, stress analysts and designers of electronic equipment. Research workers in heat transmission and transport properties will find this book a useful addition to their library.

A. RAMACHANDRAN

ENGINEERING DESIGN: A SYSTEMATIC APPROACH by R. Matousek, translated from the German by A. H. Burton and edited by Prof. D. C. Johnson (Blackie & Son Ltd, London), 1963. Pp. viii+264. Price 45s. net

The subject of design in engineering has evoked considerable interest and discussion at the present time. Design is a conceptual process wherein a mental plan of action is necessary. Characteristic of the design problem to be solved is that there is no unique solution. There are usually several adequate answers, some of which may be "better' than others. The formulation of most design problems is incomplete and it is the function of the designer to himself define the problem.

As stated in the preface to the German edition, the purpose of the book is to present, in a systematic manner, a methodical work plan which will enable the young engineer tackling design problems to reach his objective by a rational route. This book completely fulfils this objective. Chapters 1, 2 and 3 respectively deal with general aspects, the qualities and attitudes required in a designer, and the factors influencing design. In Chapter 4, which forms the rest of the book, is dealt a large number of topics. The author has presented a working plan, method of obtaining various solutions and of optimizing the design. Factors influencing choice of materials, manufacturing processes and economic production have been treated adequately. The section on form design and how this is influenced by production methods, space factor, size, weight, appearance, power requirements, maintenance and repair is dealt with in a simple and lucid manner. A number of design problems have been included for the beginner practising design problems.

This book when first published in Germany in 1957 created widespread interest among engineering educators as no comparable book in the English language was available. It is clear that we have before us a unique book useful for engineering students, design engineers and engineering educators. The English edition is not just a translation; it has been edited by Prof. Johnson of Cambridge University, to whom many readers will be grateful for the service he has thus rendered to the engineering profession.

A. RAMACHANDRAN

PRINCIPLES OF AIR-CONDITIONING IN THEORY AND PRACTICE by P. M. Patel & A. K. Mehta (Allied Publishers Private Ltd, New Delhi), 1963. Pp. xiii +247. Price Rs 22.50

Air-conditioning systems to control temperature, humidity and dust content in the atmosphere are used in homes, offices, cinema halls, hospitals, etc. In the majority of the domestic installations in this country, what is primarily aimed at is cooling of the atmosphere during summer and, to some extent, heating during winter. Heating becomes necessary only in the plains in Northern India and at the hill stations where temperatures drop to uncomfortably low levels during winter. In larger installations such as in hospitals, offices, cinema halls, etc., attention has to be paid to other factors as well. The whole subject, however, needs a scientific approach and the subject is of importance to students as well as to practising engineers.

As indicated by the authors in the preface, the book has been primarily written for the purpose of explaining the fundamental principles of air-conditioning to engineering students. The first five chapters deal with the theory of air-conditioning, each chapter being complete with a set of exercises which students will find very useful. The subjects are dealt with methodically and in detail. The authors have chosen the Foot-Pound system which may be a drawback in view of the progressive switch over in this country to the Metric system. The majority of the charts and tables in the book have been reproduced from the *Heating ventilating and air-conditioning guide* 1960, primarily intended for use in conditions prevailing in the United States. Practising engineers will have to supplement the information by drawing on their own experience with conditions obtaining in this country.

The most widely used air-cooling system in this country — and the cheapest — is evaporative cooling. This may take the form of *Khas tattis*, desert coolers, spray coolers, etc. The authors have devoted two pages to this subject in Chapter 6, though, perhaps, in view of the extensive use of this system, its simplicity and the low cost, a more exhaustive treatment would have been justified.

The chapter on air-conditioning, control and instruments contains general principles of various types of instruments used in air-conditioning. Here, perhaps, a detailed description of typical instruments of well-known make and their construction details would have been more useful to students as well as to practising engineers.

The final chapter on servicing covering three pages is too brief to be of much use to practising engineers. The book is well written and should prove useful to engineering students.

N. DAS

THE FUNDAMENTALS OF FOOD ENGINEERING by Stanley E. Charm (AVI Publishing Co. Inc., Westport), 1963. Pp. 585. Price \$25:50

Westport), 1963. Pp. 585. Price \$ 25:50 This book is undoubtedly a valuable addition to the current literature on the subject of food engineering. It satisfies a long-felt need for a book that will deal with the characteristic problems of food technology with the quantitative approach of the engineer. Unlike most of the earlier books which confined themselves to descriptive accounts of the equipment or gave a simplified version of chemical engineering texts, the author of this book handles, with an analytical bias, problems specific to the food industry such as the heat penetration inside the can, determination of process time, factors in freezing and thawing of foods, drying of foods, particularly freeze drying, kinetics of biochemical reactions, etc.

In a book of this nature, it is difficult to deal with every topic related to the food industry. However, after going through the book one feels that some important subjects are missing. The most conspicuous is instrumentation. A good food engineer must also be familiar with at least the general principles of instrumentation, the different types of controlling mechanisms, etc. Equally important for a food engineer is the knowledge of instruments and techniques used to collect his design data — for measuring air velocity, centre temperature in a can, particle size or settling rate, etc. The subject of mechanical separations, pitting, peeling and shape classification also deserves some attention.

also deserves some attention. The first chapter 'An introduction to food engineering' seems more like a condensed refresher course in calculus and thermodynamics. The inclusion of this matter as an appendix probably would have given the book more homogeneity. The chapters on 'Thermal process evaluation; Freezing and thawing of foods; Freeze drying; Strength of food materials and equipment' are most useful. 'Kinetics of biological reactions', though not strictly food engineering, is still very welcome. The wide variety of data included in Appendix A is thoughtfully selected.

The author of the book must be congratulated on bringing out a very useful book on food engineering. S. S. KALBAG

SPARK ATLAS OF STEELS by Gerhart Tschorn (Pergamon Press Ltd, Oxford), 1963. Pp. 203. Price £ 5 5s.

Spark atlas of steels by Mr Gerhart Tschorn is possibly the only book of its kind today.

In any short-term or long-range research or investigation project, the normal instinct of a research worker is to try to visualize the end observations or results expected and in doing so, he often improvises empirical means to obtain short-circuited experimental clues that may often give parallel findings exceedingly close to precision-controlled results. Modern analytical qualitative and quantitative methods are today based on optical spectroscopic analysis, X-ray fluorescence spectroscopic analysis, polarography, photometry, etc., for determining the chemical composition of diverse materials. These up-to-date analytical methods require highly expensive although precisioncontrolled automatic electronic equipment. However, spark testing of different metals and alloys in a workshop is a favourite method and the results thereof are discerned by the experienced eye to identify often with uncanny accuracy the qualitative and even quantitative contents of a metallic material. These observations are, however, dependent largely on an individual and his experienced eye. There has been no known published record of the spark testing of different metals and alloys. This publication attempts to fulfil this lacuna, and to provide for the use of all — for the young to learn and for the mature eye to verify their spark indentification and testing ability. The publication contains black and white and colour prints of spark characteristics taken straight from the grinding wheel providing characteristic sparking details which even skilled engineers may often omit to note.

À notable feature of the publication is the standardized markings and symbols for designation of different materials including American, German, Soviet, Czechoslovak, Japanese, British, Swedish and French standards.

The author deserves the congratulations of all metallurgists and engineers for, what would indeed be for the first time, a masterly presentation of spark testing of materials; the publication undoubtedly will find its due place in the engineering library, as a book of daily use and reference for the metallurgists, workshop personnel, engineers and even for the theorist, for whom it could provide an unlimited scope of theoretical analyses for explaining diverse characteristics of a spark generated by a metal or an alloy against the grinding wheel.

B. R. NIJHAWAN

ISOTOPES IN ACTION by Dorothy Harper (Pergamon Press Ltd, Oxford), 1963. Pp. 172. Price 12s. 6d. net

The author of this book, Miss Harper, is to be congratulated on the excellent job she has done of explaining the uses of radioisotopes to students and the general public interested in science and who are likely to be the future users of radioisotopes. This book covering 162 pages of text gives a general survey of what radioisotopes are and how they are of use in industry, medicine, agriculture and research.

In the first two chapters, a brief history of the development of the concept of the atom and an account of the discovery of the radioactivity is given. The meaning of isotopes and how they are commonly made and detected are described in Chapter 3.

Chapter 4 deals with the use of radioisotopes in agriculture and how radioisotopes help the farmer. Thus tracer techniques using phosphorus-32-labelled superphosphate enable the proper utilization of fertilizers, and gamma irradiation from cobalt-60 has been used for effective mutations in plants, for disinfestation of grains as well as for the sterilization of vegetables and fruits for storage.

Chapter 5 gives an account of how radioisotopes are used in medicine. Thus cobalt-60 is used for cancer treatment and the principles underlying this are explained is simple terms. Iodine-131 is widely used for diagnosis and treatment for thyroid disorders, and phosphorus-32 and chromium-51 for treatment or studies of certain blood conditions.

The uses of radioisotopes in industry are described in Chapter 6 and interesting examples are given regarding their various uses. Thus, in the mining industry they are used for the location of uranium and beryllium sources, and for the logging of oil wells. Tracer techniques are also used for tracing the materials flowing in pipes and for the wear of engines with different lubricants.

The last chapter describes the use of radioisotopes like carbon-14 and tritium-3 for dating archaeological specimens. Also radioactive techniques using tritium for tracing underground water streams are described.

The style in which the book is written is excellent. It creates interest for persons equipped with a bare scientific background and explains clearly the basic principles of this sophisticated science.

V. K. IYA

INDUSTRIAL BLADDER CARCINOGENESIS by I. S. Temkin (Pergamon Press Ltd, Oxford), 1963. Pp. 367. Price £ 5

The English translation of I. S. Temkin's book on Industrial bladder carcinogenesis is a valuable guide to the clinicians as well as to the experimentalists dealing with occupational cancer. This aspect of industrial medicine deserves particular attention since the aniline dye industry has been a source of great potential hazard for many decades.

The author has been quite meticulous in his data collection. He has a broad outlook and displays great understanding of the subject. The style is lucid, although individually the clinician or the experimentalist may find certain aspects too lengthy. There are several printing errors all through the text.

The author begins with a good historical review on bladder cancer, taking the reader on a round-theworld journey. He also enters into the health problems and the safety acts of different countries and compares the incidences amongst different sets of populations. The next section deals with a series of chemical compounds and their role in etiology of bladder carcinoma. The author then develops the theme by illustrating several case reports in order to show the variations amongst individuals and the types of affections that develop in each. The diagnostic problem and the technique of cystoscopy are particularly emphasized.

The clinical course of the disease, the treatment and the prophylactic measures are described. A separate chapter is added to describe experimental bladder tumours in animals. Finally, a chapter on concluding remarks summarizes the author's observations and opinions.

It is the opinion of the reviewer that the book is a good treatise on bladder cancer and should find place on the book-shelf of the clinician, the biologist and the statistician as well as of the students of occupational cancer research.

KAMAL J. RANADIVE

PUBLICATIONS RECEIVED

- ICES ELECTROMAGNETIC SCATTERING (Proceedings of the Interdisciplinary Conference held at Clarkson College of Technology, Potsdam, NY, August 1962) edited by Milton Kerk (Pergamon Press Ltd, Oxford), 1963. Pp. xii+592. Price £7 net
- PHARMACOLOGY OF THE CAROTID BODY CHEMORECEP-TORS by S. V. Anichkov & M. L. Belenkii; translated from the Russian by R. Crawford (Pergamon Press Ltd, Oxford), 1963. Pp. xiv+ 225. Price 60s. net
- ADVANCES IN ORGANIC CHEMISTRY: METHODS AND RESULTS (Vol. 4) edited by Ralph A. Raphael, Edward C. Taylor & Hans Wynberg (Interscience Publishers Inc., a Division of John Wilny & Sons Inc., New York), 1963. Pp. vii+361. Price \$ 14.50
- FIRST INTERNATIONAL PHARMACOLOGICAL MEETING -MODE OF ACTION OF DRUGS, 22-25 August 1961: Part I - BRADYKININ AND VASODILATING POLY-PEPTIDES; Part II - PHARMACOLOGY OF THE LUNG; Part I edited by M. Rocha e Silva, Soco Paulo & U. S. Von Enler; Part II edited by Domingo M. Aviado; General Editor Borje Uvnas (Pergamon Press Ltd, Oxford), 1963. Pp. viii+193. Price £ 5 net
- PEPTIDES (Proceedings of the Fifth European Symposium, Oxford, September 1962) edited by G. T. Young (Pergamon Press Ltd, Oxford), 1963. Pp. xiii+269. Price 84s. net
- VARIATIONAL PRINCIPLES IN THE THEORY OF COLLI-SIONS by Yu. N. Demkov; translated from the Russian by N. Kemmer (Pergamon Press Ltd, Oxford), 1963. Pp. x+157. Price 42s. net
- THE FLOWERING PROCESS by Frank B. Salisbury (Pergamon Press Ltd, Oxford), 1963. Pp. xii+ 234. Price 50s. net
- EXPANDED PLASTICS (A collection of papers) edited by A. A. Moiseyev, V. V. Pavlov & M. Ya. Borodin; translated from the Russian by B. J. Hazzard; translation papers edited by Leslie N. Phillips (Pergamon Press Ltd, Oxford), 1963. Pp. ix+ +170
- INTRODUCTION TO FUNCTIONAL ANALYSIS FOR SCIEN-TISTS AND TECHNOLOGISTS (International Series of Monographs on Pure & Applied Mathematics, Vol. 32) by B. Z. Vulikh; English translation edited by Ian N. Sneddon (Pergamon Press Ltd, Oxford), 1963. Pp. xi+404. Price 70s. net
- THEORY OF APPROXIMATION OF FUNCTIONS OF A **REAL VARIABLE** (International Series of Monographs on Pure & Applied Mathematics, Vol. 34) by A. F. Timan; translated by J. Berry; English translation edited by J. Cossar (Pergamon Press Ltd, Oxford), 1963. Pp. xii+631. Price £ 5 net READINGS IN PHARMACOLOGY by B. Holmstedt & G. Hiljestrand (Pergamon Press Ltd, Oxford),
- 1963. Pp. x+395. Price 50s.
- INDUSTRIAL PLASTICIZERS by Ibert Mellan (Pergamon Press Ltd, Oxford), 1963. Pp. ix+302. Price 70s.
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Sons Inc., New York), 1963. Pp. xvii+845. Price \$23.75

- DEVELOPMENT OF THE BLUE STREAK SATELLITE LAUNCHER (Proceedings of the Second Space Engineering Symposium held at Hatfield College of Technology, Hertfordshire, 22 February 1963) edited by D. R. Semson (Symposium Division, Pergamon Press Ltd, Oxford), 1963. Pp. xv+128. Price 60s. net
- MICROMAGNETICS by William Fuller Brown, Jr (Interscience Publishers Inc., New York), 1963. Pp. viii+143. Price \$ 5.95
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- ELEMENTS OF ENGINEERING REPORTS by Dale S. Davis (Chemical Publishing Co. Inc. New York), 1963. Pp. 200. Price \$8.50 FUNDAMENTALS OF MICROWAVE ELECTRONICS by
- FUNDAMENTALS OF MICROWAVE ELECTRONICS by V. N. Shevchik; translated by L. A. Thompson; translation edited by W. A. Gambling (Pergamon Press Ltd, Oxford), 1963. Pp. xxxi+253. Price 70s. net
- REPRESENTATIONS OF THE ROTATION AND LORENTZ GROUPS AND THEIR APPLICATIONS by I. M. Gel'fand, R. A. Minlos & Z. Ya. Shapiro; translated by G. Cummins & T. Bodington; translation editor K. K. Farahat (Pergamon Press Ltd, Oxford), 1963. Pp. viii+366. Price 63s. net PROPAGATION OF RADIO WAVES by B. Chatterjee
- PROPAGATION OF RADIO WAVES by B. Chatterjee (Asia Publishing House, Bombay), 1963. Pp. 115. Price Rs 10.00

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Physics

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- ADVANCES IN ELECTRONIC CIRCUIT PACKAGING: Vol. 3, edited by Lawrence L. Rosine (Plenum Press Inc., New York), 1963. Pp. 460. Price \$16.50
- BRITISH TRANSISTOR, DIODE AND SEMICONDUCTOR DEVICES DATA ANNUAL 1963-64 edited by G. W. A. Dummer & J. Mackenzie Robertson (Pergamon Press Ltd, Oxford), 1963. Pp. 1680. Price f_{c} 10 net
- INVESTIGATIONS OF THE EARTH'S CRUST complied by M. Bath & V. Karnik (International Union of Geodesy & Geophysics, Paris), 1960. Pp. 50. Price \$ 0.80
- INTRODUCTION TO OCEANOGRAPHY by Cuchlaine A. M. King (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 337. Price \$ 7.95 or 62s.

- INFRARED PHYSICS AND ENGINEERING by John A. Jamieson, Raymond H. Mcfee, Gilbert N. Plass, Robert H. Grube & Robert R. Richards (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 680. Price \$ 19.00 or f. 7s. 6d.
- NEUTRON DOSIMETRY (IAEA Proceedings Series) (International Atomic Energy Agency, Vienna), 1963. Pp. 1000
- NUCLEAR ELECTRONIC INSTRUMENTS IN TROPICAL COUNTRIES (IAEA Technical Reports Series No. 13) (International Atomic Energy Agency, Vienna), 1963. Pp. 29. Price 6s.
- SELECTED TOPICS IN NUCLEAR THEORY (IAEA Proceedings Series) (International Atomic Energy Agency, Vienna), 1963. Pp. 452. Price 60s. THEORETICAL PHYSICS (IAEA Proceedings Series)
- THEORETICAL PHYSICS (IAEA Proceedings Series) (International Atomic Energy Agency, Vienna), 1963. Pp. 600. Price 72s.
- ONCE-FORBIDDEN BETA-TRANSITIONS by L. N. Zyryanova (Pergamon Press Ltd, Oxford), 1963. Pp. 116. Price 35s.

Chemistry

- ORGANIC GEOCHEMISTRY edited by I. A. Breger (Pergamon Press Ltd, Oxford), 1963. Pp. 734. Price £ 8 net
- CRYOGENICS: RESEARCH AND APPLICATIONS by Sitting (D. Van Nostrand Co. Inc., New York), 1963. Price \$ 6.00
- PEPTIDES (Proceedings of Fifth European Peptide Symposium) edited by Young (Pergamon Press Ltd, Oxford), 1963. Price 84s.
- MANUAL OF HYDROCARBON ANALYSIS (American Society for Testing & Materials, Philadelphia, Pennsylvania), 1963. Pp. xiv+670. Price \$ 14.00
- THE PERFECT GAS by J. S. Rowlinson (Pergamon Press Ltd, Oxford), 1963. Pp. 148. Price 30s. net
- SOLUBILITIES OF INORGANIC AND ORGANIC COM-POUNDS by V. V. Kafarov, H. Stephen & T. Stephen (Pergamon Press Ltd, Oxford), 1963. Pp. 5500. Price f. 62 10s. net

Biochemistry

- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 2 — FUNCTIONAL BIOCHEMISTRY OF CELL STRUCTURES edited by O. Landberg (Pergamon Press Ltd, Oxford), 1963. Pp. 310. Price £ 5 net
- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 3 — EVOLUTIONARY BIOCHEMISTRY edited by A. I. Oparin (Pergamon Press Ltd, Oxford), 1963. Pp. 366. Price £ 5 net
- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 4 — MOLECULAR BASIS OF ENZYME ACTION AND IN-HIBITION edited by P. A. E. Desnuelle (Pergamon Press Ltd, Oxford), 1963. Pp. 350. Price £ 5 net
- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 5 — INTRACELLULAR RESPIRATION — PHOSPHORYLAT-ING AND NON-PHOSPHORYLATING OXIDATION RE-ACTIONS edited by E. C. Slater (Pergamon Press Ltd, Oxford), 1963. Pp. 450. Price £ 5 net

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- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 7 — BIOSYNTHESIS OF LIPIDS edited by G. Popljak (Pergamon Press Ltd, Oxford), 1963. Pp. 446. Price f. 5 net
- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 8 — BIOCHEMICAL PRINCIPLES OF THE FOOD INDUSTRY edited by V. L. Kretovich & E. Pijanowski (Pergamon Press Ltd, Oxford), 1963. Pp. 326. Price 4 5 net
- PROCEEDINGS OF THE FIFTH INTERNATIONAL CON-GRESS OF BIOCHEMISTRY, MOSCOW: Vol. 9 — PLENARY SESSIONS AND ABSTRACTS OF PAPERS (Pergamon Press Ltd, Oxford), 1963. Pp. 648. Price £ 5 net; complete set of 9 volumes, £ 42 net

Biology

DIAGNOSIS AND TREATMENT OF RADIOACTIVE POISONING (International Atomic Energy Agency, Vienna), 1963. Pp. 446. Price \$ 9.00 or 54s. or Sch. 189 or F 36 or DM 31.50

Pharmacology

- FIRST INTERNATIONAL PHARMACOLOGICAL MEETING: Vol. 9 (Pts 1 & 2), by Uvnas (Pergamon Press Ltd, Oxford), 1963. Price 60s.
- PHARMACOLOGY OF THE CAROTID BODY by Anichkov (Pergamon Press Ltd, Oxford), 1963. Price 60s.

Technology

- THE ROLE OF SURFACE PHENOMENA IN METALLURGY, by V. N. Eremenko; translated from the Russian (Consultants Bureau Enterprises Inc., New York), 1963. Pp. 200. Price \$ 27.50
- THE EXPLOSIVE WORKING OF METALS by J. S. Rinehart & J. Pearson (Pergamon Press Ltd, Oxford), 1963. Pp. 360. Price 100s.
- SYMPOSIUM ON ADVANCES IN TECHNIQUES IN ELEC-TRON METALLOGRAPHY — STP 339 (American Society for Testing & Materials, Philadelphia, Pennsylvania), 1963. Pp. vi+72. Price \$ 3.25
- RADIOLYTIC YIELDS SELECTED CONSTANTS edited by M. Haissinsky & M. Magat (Pergamon Press Ltd, Oxford), 1963. Pp. 217. Price £ 8 8s. net
- EUTECTIC ALLOY SOLIDIFICATION by G. A. Chadwick (Pergamon Press Ltd, Oxford), 1963. Pp. 92. Price 35s. net
- THE DIFFERENTIAL THERMAL ANALYSIS DATA INDEX compiled by R. C. Mackenzie (Cleaver-Hume Press Ltd, London), 1963. 1662 cards. Price £ 55
- PRESSURE VESSEL DESIGN by Harvey (D. Van Nostrand Co. Inc., New York), 1963. Price \$ 11.75
- PHOTOGRAPHY: ITS MATERIALS AND PROCESSES by C. B. Neblette (D. Van Nostrand Co. Ltd, London), Sixth Edition, 1963. Pp. 520. Price <u>f.</u> 5 16s. net
- SYMPOSIUM ON FUNDAMENTAL VISCOSITY OF BITU-MINOUS MATERIALS (American Society for Testing & Materials, Philadelphia, Pennsylvania), 1963. Pp. vi+98. Price \$ 4.25

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- SYMPOSIUM ON PROPERTIES OF SURFACES (American Society for Testing & Materials, Philadelphia, Pennsylvania), 1963. Pp. vi+154. Price \$ 7.50
- DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS by N. Irving Sax (Reinhold Publishing Co. Inc., New York), 1963. Pp. 1500 approx. Price \$ 25.00
- MOLECULAR STILLS by R. Watt (Reinhold Publishing Co. Inc., New York), 1963. Pp. 342. Price \$ 15.00
- TREATMENT AND STORAGE OF HIGH-LEVEL RADIO-ACTIVE WASTES (IAEA Proceedings Series) (International Atomic Energy Agency, Vienna), 1963. Pp. 666. Price 78s.
- RADIOISOTOPE APPLICATIONS IN INDUSTRY (IAEA Technical Directory) (International Atomic Energy Agency, Vienna), 1963. Pp. 100
- THE TECHNOLOGY OF POLYESTER FIBERS by B. V. Petukhov (Pergamon Press Ltd, Oxford), 1963. Pp. 104. Price 30s. net

Engineering

- AGARD FIFTH COMBUSTION AND PROPULSION COLLOQUIUM by Hagerty *et al.* (Pergamon Press Ltd, Oxford), 1963. Price 140s.
- METHODS OF ENGINEERING by M. F. Avery (Wm Dawson & Sons Ltd, London), 1963. Pp. 208. Price 30s.
- PRINTED AND INTEGRATED CIRCUITRY: MATERIALS AND PROCESSES by T. D. Schlabach & D. K. Rider (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 420. Price \$ 13.50 or £ 5 4s. 6d. MICROELECTRONICS: THEORY, DESIGN AND FABRI-
- MICROELECTRONICS: THEORY, DESIGN AND FABRI-CATION by Edward Keonjian (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 383. Price \$12.50 or 97s.
- MECHANICAL ENGINEERING DESIGN by Joseph E. Shigley (McGraw-Hill Book Co. Inc., New York), 1963. Pp. 641. Price \$ 10.95 or 85s.
- INDUSTRIAL ENGINEERING HANDBOOK edited by Harold B. Maynard (McGraw-Hill Book Co. Inc., New York), Second Edition, 1963. Pp. 1600. Frice \$ 17.00
- JOHN H. PERRY'S CHEMICAL ENGINEERS' HANDBOOK edited by Robert H. Perry, Cecil H. Chilton & Sidney D. Kirkpatrick (McGraw-Hill Book Co. Inc., New York), Fourth Edition, 1963. Pp. 1900. Price \$ 23.00
- ENCYCLOPEDIA OF ENGINEERING MATERIALS AND PROCESSES by H. R. Clauser (Reinhold Publishing Co. Inc., New York), 1963. Pp. 800. Price \$ 25.00
- HANDBOOK OF HIGH VACUUM ENGINEERING by H. A. Steinherz (Reinhold Publishing Co. Inc., New York), 1963. Pp. 368. Price \$ 11.75
- CONCEPTS OF STRUCTURE by W. A. Zuk (Reinhold Publishing Co. Inc., New York), 1963. Pp. 80. Price \$ 5.95
- PROCEEDINGS OF THE THIRD INTERNATIONAL BATTERY SYMPOSIUM edited by D. H. Collins (Pergamon Press Ltd, Oxford), 1963. Pp. 488. Price <u>f</u> 6 net
- THE EFFECT OF DISTURBANCES OF SOLAR ORIGIN ON COMMUNICATIONS edited by G. J. Gassmann (Pergamon Press Ltd, Oxford), 1963. Pp. 358. Price 100s. net

NOTES & NEWS

Modulation of laser beams

A new technique for modulating the light emitted by solid state lasers has been developed at the Radio Corporation of America. Earlier attempts to modulate laser beams depended upon elaborate electro-optical systems outside the laser and have suffered from inefficiency, power loss and alignment problems. The new technique adopts the process of putting selected light frequencies generated in the laser into a resonant state by applying two magnetic fields — one being constant tunes the laser, while the other being an alternating magnetic field modulates the laser beam. This technique permits the laser to be turned on and off up to 100,000 times/sec. and can be applied to produce either amplitude or frequency modulation. The experimental system employs a liquid nitrogen-cooled calcium fluoride laser crystal containing traces of dysprosium. The crystal is placed at one focus of an elliptical chamber and activated by a powerful tungsten lamp placed at the other focus. At either end of the crystal is a coil of wire with which an alternating magnetic field is generated and applied to the crystal. Around the whole chamber is another coil which generates a steady state magnetic field.

The new technique promises to make possible practical laser radars and new high-capacity communication systems that can be tuned over the widest spectral range ever achieved [J. Franklin Inst., 276 (1963), 88].

Mechanism of laser-induced fluorescence

As a result of observations made recently at the Du Pont's Central Research Department, Wilmington, Del., on the delayed laser-induced fluorescence at room temperature in single crystals of anthracene, a mechanism involving the interaction of triplet excitons has been proposed to explain the observed

fluorescence. Earlier investiga-tions from different schools of research have resulted in attributing the fluorescence phenomena to a double-photon excitation from the singlet ground state to the first excited singlet state (or a direct double-photon excitation). But contrary to these earlier studies, the recent investigations of the delayed fluorescence (after the laser is turned off) point to a triplet state mechanism - the singlet state giving rise to the flourescence being produced by the molecular annihilation of triplet excitons generated directly by the ruby laser light. The earlier pro-posed mechanisms have failed to take into account the delayed fluorescence which has been observed by the Du Pont school as a gradual ' tail ' in the plot of the light intensity for the fluorescent light coming from the anthracene crystal versus time. Under the conditions of the Du Pont group's experiments, the delayed fluorescence comprises more than 10 per cent of the total emitted blue fluorescent energy. The delayed fluorescence decays as the inverse square of the time near the laser shut-off time, beyond which the decay becomes exponential. These observations can all be explained by assuming that the laser photons directly create triplet excitons, which in turn interact in pairs to form singlet excitons which then fluoresce to the ground state with a lifetime of 2.6×10^{-8} sec.

Processes proposed earlier (such as double quantum transitions directly to the singlet state and transitions from a triplet exciton to a singlet exciton by absorption of a photon) can be ruled out because of the following observations: (i) the observation of de-layed fluorescence amounting to more than 10 per cent of the total fluorescent light output; (ii) lack of discontinuity in the fluorescence emission versus time plot when the laser pulse is stopped; (iii) singlet lifetimes are of the order of 10⁻⁸ sec., whereas millisecond lifetimes have been observed

in delayed fluorescence; and (iv) the observation regarding the variation of the fluorescence intensity with the intensity of the incident laser radiation shows that the variation in the initial stages follows a square law, but later approximates to a linear relation [*Chem. Engng News*, **41** (23) (1963), 37].

Lanthanum trifluoride crystal_for laser systems

Philco Corporation Scientific Laboratory has recently produced, using new techniques, large crystals of lanthanum trifluoride suited for use as laser material. Crystals of lanthanum trifluoride grown by conventional methods have lanthanum oxide precipitated in the grown crystal resulting in severe light scattering, thus preventing laser action. In the crystals grown at the Philco Corporation rare earth is used as the host material as well as for the active impurity. This makes it possible to add a large amount of doping without distorting the crystals. Another special feature of the lanthanum trifluoride crystals is that the absorption band for optical pumping coincides with the emission band of the gallium arsenide injection light sources when operating at liquid nitrogen temperature. By using the combination of lanthanum trifluoride with gallium arsenide as the optical pump it should be possible to construct very compact efficient laser systems ideally suited for use in mobile ground and space equipment [J. Franklin Inst., 276 (1963), 186].

A new stress effect in semiconductors

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The manifestation of piezoelectric voltage which is proportional to the compressional or tensional bending in a semiconductor has been observed by F. Herber of the Republic Aviation Corporation, New York. This property could be used for the development of a new type of force measuring instrument. Even though semiconductors are already being employed as stress transducers, they make use of the changes in electrical resistance, i.e. piezoresistive effect, that accompany tension or compression. The new effect which is piezoelectric in nature has been observed in a thin film of titanium (5000 A. thick) deposited on a flexible, insulating base and part of it oxidized to semiconducting titanium oxide by anodization. The oxidized outer surface and the inner region of uncharged titanium together form a p-n junction. The graph connecting the reciprocal of the radius of curvature of the film and the voltage developed between the ends of the p-n junction is found to be a straight line. The maximum voltage developed is c. 0.1 V. [New Scientist, 18 (1963), 559].

Rapid method for focal length determination

A rapid method of determining the equivalent focal lengths (that are within tolerances set forth by American Association Standards) of precision lenses has been devised at the Refractometry Laboratory of the US National Bureau of Standards. The new technique makes use of a biprism which divides the light passing through it into two sets of parallel beams which make a fixed angle with one another.

For determining the focal length of a lens, the biprism is mounted between a collimated light source and a micrometer microscope and the lens under test is aligned between the microscope eyepiece and the biprism. The two light beams emerging from the biprism pass through the imaging lens and cause two images to form on the focal plane of the lens. From the measured separation between the images and the known angle of deviation between the two beams, the equivalent focal length can be evaluated [Tech. News Bull. U.S. Bur. Stand., 47 (1963), 111].

A new fuel cell using hydrocarbons

A new fuel cell which operates on inexpensive hydrocarbon fuels such as propane and natural gas at a moderate temperature (250-400°F.) has been developed at the General Electric Research Laboratory, Schenectady, New York. The two main obstacles in the successful exploitation of the principle of the fuel cell for commercial purposes till now have been the lack of (i) a convenient cheap fuel and (ii) a positive electrode that maintains a continuous and adequate flow of current. The new fuel cell permits the utilization of a broad range of hydrocarbon fuels much cheaper than hydrogen and can produce current densities up to 25 amp./sq. ft. The electrode structure of the new fuel cell uses thin gauge electrodes and a finely powdered form of platinum with phosphoric acid as electrolyte. The structure of these electrodes is such that the air and fuel fed into the cell are offered a large surface area for reaction without themselves being corroded. Another salient feature of the new cell is the almost complete oxidation of the fuels used, thereby increasing the efficiency. Because of complete combustion the resultant products are only water and carbon dioxide and hence it is possible to develop power sources fit for indoor operation.

However, further research and development is needed to replace platinum by some other catalyst and to increase the ratio of current density to weight, before the cell can be put to commercial and military applications [*J. Franklin Inst.*, **276** (1963), 87; *New Scientist*, **18** (1963), 367].

Mechanism of iron passivity

A study has been undertaken at the National Bureau of Standards in order to resolve the conflicting views as well as to provide a better understanding of the mechanism of iron passivity. The results of this study have confirmed the oxide theory of passivity for films formed in inorganic passivating solutions. Evidence in support of the different theories on the composition of the passive film which makes iron surfaces resistant to corrosion has been inconclusive because the investigators were not sure that they had initially film-free surfaces for study. In the present study, the passivity process in progress was observed through a combination of three experimental techniques - use of an ultra-high vacuum system, ellipsometry and potential measurements.

¹ Iron specimens are held at pressures of 10-⁹ Torr in a vacuum system to obtain clean, well-characterized surfaces. An inorganic passivating solution (air-saturated nitrite solution) is then introduced into the system to cover the specimens. Ellipsometric measurements of 'film-free' surfaces and of film growth permit calculations of film thicknesses of 5 A. From electrochemical potential measurements of the specimen surfaces during film growth, it is possible to determine film thicknesses that coincide with the onset of passivity.

In the ellipsometer, a polarized light beam is reflected from a metal surface in such a way that the ellipticity of the beam is altered after reflection. The relative phase retardation is used in calculating the thickness of the thin film. For very thin films, the mean thickness is proportional to the difference between the phase retardation value found for a film-free surface and that found for a film-covered surface.

The influence of metal structure on the breakdown of passive film formation has also been investigated by optical and electron microscopy: the breakdown sites were pinpointed by a technique that covered them with small crystallites. Two types of breakdown sites were found - cathodic sites covered by copper crystallites and anodic sites covered by gamma ferric oxyhydroxide. It was found that the number of sites per unit area varied with the crystallographic orientation of the iron surface, the [110] orientation always exhibiting the highest number. It was also found that no correlation existed between the breakdown sites and points where dislocation defects in the metal intersected the iron surfaces [Tech. News Bull. U.S. Bur. Stand., 47 (1963), 98].

Measurement of soil stability

A new method for measuring soil stability has been developed at Rothamsted Experimental Station, Harpenden, Hertfordshire. Unlike the previous methods, the present method is particularly useful for detecting small differences in soil stability and has been successfully employed for demonstrating the increase in soil stability caused by 1-3 years under grass on a light sandy loam soil and also for detecting the degradation of structure that follows ploughing of grass land on a clay soil. The method is particularly useful for assessing the need for restoring soil structure as well as for comparing the effects in experiments of practices that are intended to improve structure.

In this method, soil aggregates prepared from unfrozen, air-dried soil are used. A shallow bed of soil is slaked with water and mechanical vibration is used to diminish the mutual adhesion of the crumbs. The water remaining in the coarse pores between the aggregates is extracted at a set low tension, and its volume is compared with the volume extracted under the same conditions from a specimen of the same soil permanently stabilized with 'Perspex'. The difference in the volume of water extracted is a measure of the loss in pore space that occurs on slaking [Chem. & Ind., (1963), 1032].

Pyridinyl free radical

A new, stable organic free radical, 1-ethyl-4-carbomethoxy-pyridinyl, has been synthesized and isolated, employing metal reduction of a pyridinium salt (usually iodide) under high vacuum. The isolation of the free radical will permit the study of such problems as the factors that stabilize free radicals and their reactivity. The pyridinyl radical may also represent a new class of chemicals with little analogy to any other chemical. The radical is isolated in a simple manner from the reaction of granular zinc with pyridinium iodide in acetonitrile at 0°C. After the reaction most of the acetonitrile is removed, the residue extracted with *n*-heptane, the solvent evaporated and the radical distilled at 40°C. and 10-6 to 10-7 mm. Hg pressure. The yield may vary from 2 to 15 per cent, depending on the extraction method employed. 1-Ethyl-4-carbomethoxypyridinyl radical is a dark emerald-green oil at room temperature, and changes to a deep saphire-blue solid at 200°. The pure material is moderately stable at 25°. In acetonitrile solution, the radical yields pyridinium chloride when reacted with carbon tetrachloride. The procedures described for the preparation of the free radical are applicable to a variety of quaternary salts includ-

ing those derived from heterocyclic rings, phosphines, arsines and sulphides [*Chem. Engng News*, **41** (28) (1963), 52].

Structure of cyclized rubber

Additional evidence obtained from new unsaturation measurements coupled with infrared and kinetic analysis has pointed to a polycyclic ring structure for cyclized rubber, hitherto considered to consist of mono-, bi- and polycyclic segments. A high-purity commercial rubber after pretreatment was dissolved in either toluene or benzene and cyclized for different periods and temperatures, using stannic chloride as a catalyst. Oxidation with perbenzoic acid, phenyl iodochloride and ozone gave comparable values for the level of unsaturation in the cyclized rubber. In all cases, the values were well below the 56.7 per cent unsaturation value previously proposed. Highly cyclized rubber was found to have an unsaturation value of 18-20 per cent. These results point to cyclized rubber's content being well below the limits imposed by a predominantly monoor bicyclic structure. This can only be explained by assuming that cyclization proceeds beyond the bicyclic stage. In addition, the results discount the presence of isolated isoprene units, frequently referred to as 'window' units, along the chain. The infrared and gas chromatographic analysis support the proposal that the cyclized structure contains a tetrarather than tri- or possibly a disubstituted double bond. This is further supported by the studies carried out on cyclized dihydromyrcene as a reference material. A simplified version of a complex mathematical formula describing the kinetics of the rubber cyclization is 1/u = kt/q + 1, where u is the fraction of unsaturation remaining after time t, k is the pseudo reaction rate constant and 1/q is the parameter which determines the size to which the cyclized rings can grow in the absence of a forced termination. When 1/uis plotted against time the resulting graph veers slightly from linearity, in view of the approximations used in the simplified treatment. The residual unsaturation (hence the size of the cyclized ring clusters)

is independent of the catalyst concentration and of the rubber substrate concentration. The average size of the cyclic structure is above 5 units at 60° . It decreases to about two rings above 100° and increases to over 10 rings below 30° [Chem. Engng News, 41 (24) (1963), 44].

An improved synthesis of oestrogens

An improved method for the synthesis of equilenin and oestradiol has been developed at Takeda Chemical Industries, Osaka, Japan. The starting material, 6-methoxy-1-vinyl-1-tetralol, is condensed with 2-methylcyclopentane-1,3-dione in the presence of Triton B to give 3-methoxy-8, 14-seco-oestra-1,3, 5(10),9-tetrane-14,17-dione. Cyclization by heating the diketone alone at 140° or with an excess of phosphorous pentoxide yields isoequilenin.

For obtaining oestradiol, the 14,17-dione is converted by phosphorous pentoxide at 120° into the 17-ketone which on treatment with sodium borohydride in methanol at -30° yields 3-methoxyoestra-1, 3, 5 (10), 8, 14-pentaen-17 β-ol. Catalytic hydrogenation of this over Raney nickel is stereospecific, yielding 3-methoxyoestra-1,3,5(10), 8, 14-tetraen-17 β-ol. This compound is subjected to Birch reduction with potassium in liquid ammonia to obtain (\pm) -oestradiol 3-methyl ether which is identical with the natural product [Proc. chem. Soc., (1963), 139].

5-Iodo-2'-deoxyuridine labelled with iodine-131

A simple method for preparing 5-iodo-2'-deoxyuridine labelled with iodine-131 consists in the iodination of deoxyuridine by iodine monochloride. The method, developed at the National Institute for Medical Research, London, gives consistent yields (65-70 per cent) of 5-iodo-2'-deoxyuridine and iodine-131 uptakes of 55-60 per cent of the iodine-131 used and is suitable for preparing milligram quantities having high specific activity.

Carrier-free sodium iodide (containing iodine-131) in aqueous solution is placed in a conical 10 ml. stoppered test tube. Water is evaporated by placing the tube in a water-bath at c. 40° and gently blowing a stream of nitrogen over the solution. For the iodination of 1 mg. deoxyuridine, 0.066 ml. of a solution of iodine monochloride in acetic acid (0.0162 g./ml.) is placed in the test tube which is stoppered and heated in a water-bath at 60° for 1 hr to effect exchange of iodine-131 and stable iodine. The tube is cooled to room temperature and 1 mg. deoxyuridine is added. The tube is stoppered and heated in a water bath for a further 90 min. at 60° (the temp. should not exceed 65°) with occasional gentle shaking. After cooling to room temperature 1 ml. of water is added to the reaction mixture and the pH adjusted to 10 by addition of 1Nsodium hydroxide. The product is purified by placing the alkaline solution on a column of 'Dowex resin AGI' 2 cm. long and 1 cm. diam.

The column is washed with aqueous sodium hydroxide (15 ml.; 0.01N) and eluted with formic acid (0.1N) in 2 ml. fractions. Unchanged deoxyuridine comes off in the first 6 ml. of eluate. The next 20 ml. of eluate contain 95 per cent of the radioactivity which can be eluted with formic acid (0.1N). The purity of the product is checked by comparing it with authentic material by descending chromatography in ethyl acetate saturated with phosphate buffer (0.05M; pH 6.0) [Nature, Lond., 199 (1963), 1285].

Resolution of optical forms of *trans*-cyclic olefins

Complex formation between *trans*-cyclooctene and a platinum compound which contains an optically active amine has been used to resolve optically active forms of *trans*-cyclooctene.

Ethylene reacts with K₂PtCl₄ to give $K[PtCl_3(C_2H_4)]$. This is then treated with the optically active amine, a-methylbenzylamine, to give an ethylene-substituted platicomplex num coordination trans - dichloro - (trans - cyclooctene) (a-methylbenzylamine) platinum (II). This complex contains two asymmetric centres. One is due to the amine and the other to the molecularly asymmetric olefin. So two diastereoisomers are formed from the DL-olefin. These are separated by fractional crystallization. The two fractions, each containing a diastereoisomeric complex, are then decomposed separately with potassium cyanide. This liberates the amine and the cycloolefin. After separation of the amine by extraction with acid, the two optically active forms of the cycloolefin are obtained as pure liquids having specific rotations of about $+450^{\circ}$ and -450° respectively.

Partial resolution of trans-cyclooctene and cis-trans-1,5-cyclooctadiene have also been achieved using the complexes trans-dichloro-(transcyclooctene) (1-phenyl-2-aminopropane) platinum (II) and transdichloro-(trans-cyclooctadiene) (α methylbenzylamine) platinum (II) respectively [Chem. Engng News, **41** (22) (1963), 52].

Progress Reports

Indian Jute Mills Association Research Institute

The institute celebrated its silver jubilee during 1962. Starting with an original floor area of 1750 sq. ft and a staff of 5, it has now 17 laboratories covering a floor area of 50,000 sq. ft and a staff of about 80. During 1962, the work in the Physics and Physical Chemistry Section has been mainly concerned with the design and construction of instruments for production and quality control, standardization of test methods, performance evaluation and quality grading of yarns, etc. The section is also engaged in work on the elucidation of fine structures of fibres as studied by X-ray techniques and measurements of moisture absorption, swelling and density. A new addition to the range of testing instruments is a moisture meter for determining the moisture content of jute seeds. The range of problems being tackled cover moisture surveys, efficiency and production control studies, performance evaluation, moisture control, study of proapplication of ductivity and process control instruments and methods. Investigations concerned with the field trials of fertilizers and their effects on the fibre properties, performance behaviour of packed bags, machine utilization in relation to carding and wastage evaluation have been some of the

important problems handled during the year.

The work of the Chemistry and Chemical Processing Section is essentially concerned with studies on the chemical properties and composition of jute fibre along with the mode of association of the individual fibre components. Satisfactory progress has been achieved in the elucidation of the highly complicated composition of jute fibre. By modifying the fibre through chemical reagents, a jute material has been produced which is fast to sunlight.

The Microbiology Section has carried out extensive work on the mechanism of jute deterioration through exposure to atmosphere and to the action of microorganisms. Considerable progress has been made in evolving treatments for rot- and weather-proofing of jute by careful application of selected antiseptics in various combinations. The most effective antiseptic has been found to be a mixture containing hydroxide/ oxide of copper, cobalt and manganese applied with a resin binder. Another practical contribution from this section has been the culture softening technique by means of which the woody tissues of jute cuttings or roots can be softened in about 4 days without significantly damaging their fibre portion. Work is being undertaken towards the production of potent fungal and bacterial cultures on a large scale with a view to examining the effectiveness of softening cuttings in bulk.

Other problems on which work is in progress include the nature of cellulolytic enzymes from microbiological sources and their mode of action; microbiological decomposition of sun-exposed jute; and anaerobic bacterial decomposition of jute. The Chemical Technology Section has investigated an extensive range of chemical finishing operations and treatments to confer special properties on jute materials such as rot resistance, water resistance, fire resistance and resistance to insects. Studies have also been carried out on the bleaching and dyeing of jute, and on the production of a wide range of coated and laminated products by combining jute materials with plastics and other substances.

Warren Spring Laboratory, UK

The annual report of the Warren Spring Laboratory for 1962 records the research and planning activities in its three main fields of interest, viz. air pollution, chemical engineering, and process development and mineral processing. Considerable amount of data have been collected and analysed as part of the phased national survey inaugurated in 1961 with a view to obtaining an accurate picture of the pollution problem. The survey is being extended to cover more selected towns, villages and clean rural sites. Intensive investigation has also been made of local pollutions on a geographical and meteorological basis to study the build-up and dissipation of pollution with changing meteorological conditions. Work on such aspects as dispersion of chimney gases and removal of oxides of sulphur from flue gas has also been undertaken. A satisfactory and simple road test evolved has been found suitable to give an objective evidence of excessive smoke emission by diesel vehicles in support of subjective visual assessments. It has been observed that the peak level of smoke emitted during a free acceleration test is always lower than that under load at smoke levels which could be considered objectionable. The test would thus not over-estimate the potential smoke emission and the consequent pollution level,

Photographic studies of the mechanism of bubble formation at a sieve plate have enabled specification of many of the factors governing the design of a sieve plate, e.g. the conditions leading to the formation of an active froth have been related to the geometry of the plate and the process variables. An apparatus to measure the residence time distribution of the different elements of a mixed fluid flowing across a sieve trav has been completed and found satisfactory for use with full-scale industrial plants under different conditions. A novel type of froth contact heat exchanger has been developed in which the heat transfer rate is greatly increased by immersing the tubes in an air/water froth. In many circumstances the froth contact heat exchanger offers an

attractive alternative to the usual waterair-cooled exchangers. The laboratory has collaborated with other institutions having a common interest in the investigation of the phenomenon of dropwise condensation in heat exchange equipment. Radioactive stearic acid has been employed as the promoter in these studies of the factors influencing the adhesion of promoter molecules to the metal 'surface. The results have shown, contrary to the assumptions made till now, that the lifetime of a promoter on a copper surface is controlled by corrosion and dissolution mechanisms at the interface of the oxide surface and condensing steam inhibition of these processes, e.g. by presulphiding the surface, prolonged the promoter lifetime. In the field of solid state chemistry, it has been found that small traces of the order of 10-100 p.p.m. of manganese in ferric oxide provide trapping sites for electrons and the presence of 0.1 per cent magnesium makes ferric oxide (usually n-type) into a p-type material. This novel aspect of the work provided fresh insight into the conduction mechanism.

Work in the field of surface chemistry and catalysis related to such important aspects of current interest as surface-promoted oxidations, the electrochemical oxidation processes which occur on the electrodes of the fuel cell, controlled catalytic oxidation of hydrocarbons for obtaining partially oxygenated compounds, practical devices for removing trace impurities in air and study of physical structure of evaporated thin metal films on glass substrates. The laboratory offered advice on and demonstration of cleaning methods of oil pollution along coasts and beaches and in harbours. Field trials showed that the use of the emulsifiersolvent mixture developed is quite effective for removing oil floating on harbour or inshore waters.

Interesting results have been obtained in connection with work on the beneficiation of mineral ores by flotation employing cationic organic reagents as collectors. A novel apparatus has been devised for determining the zero point of charge of mineral suspensions. Solutions of naphthenic acids in kerosene and a number of com-

mercially available carboxylic acids have been found to be effective liquid-liquid extraction reagents. novel chlorination process A studied, involving the formation and recovery of non-ferrous metal chlorides by roasting in a twolayer bed, has been applied to the removal of non-ferrous metals from pyrites cinders. By controlling the operating conditions, elements such as copper, zinc and lead can be removed in the form of volatile chlorides which condense on the bottom laver from where they can be leached to recover non-ferrous metals and the bed material is then recycled. The separation and recovery of copper in the bottom bed has been found to be complete. A study of the basic reactions occurring in the sulphation roasting of nickel oxide has yielded valuable information on the role of the alkali sulphate additive generally used. Studies on the effect of relative humidity on the behaviour of charged mineral grains resting on a stainless steel plate have shown that the unexplained behaviour of minerals in the roll-type separator which is different from that in the laboratory experiments is related to the use of the corona discharge in the former.

Two types of density-gradient column separators have been designed for use with +100 BS mesh material and with material down to c. 10 µ. With these separators it has been possible to recover the individual mineral bands of the compound ore, thus obtaining a model analysis. Three rapid techniques have been established for setting up the required density gradients at preselected sensitivities and ranges, the maximum available density being 4.28. The method also provides a rapid means of establishing the number of minerals present in an ore and of providing high-grade mineral samples for subsequent study and identification.

Tobacco Research in India

The reports for the year 1961-62 of the Indian Central Tobacco Committee and the Central Tobacco Research Institute, Rajahmundry, record the main research activities directed towards improving the yield and quality of tobacco. Protection of seed beds in black soils with alkathene film has been found to give significant increase in the number of transplants as well as total seedlings as compared to exposed beds. Application of nitrogenous fertilizers at 50 kg./ hectare without any basal manure gave the highest number of transplants. Urea was found to be much better than ammonium sulphate as a nitrogenous fertilizer. In the case of the nursery in sandy area, covering the beds with tobacco midribs increased substantially the production of transplants and total seedlings. In the case of cigarette tobacco, burying of green matter brought from outside was found to be beneficial in improving the yield and quality of the leaf compared to green manuring.

At Guntur the yield and quality of flue-cured tobacco improved considerably by following the rotations (i) tobacco after chillies, (ii) tobacco after coriander, and (iii) tobacco after tobacco, instead of the commonly practised rotations of tobacco after rabi-sorghum, and tobacco after groundnut and sorghum.

Some of the improved cultural practices evolved at the institute include: (i) deep-ploughing or crowbarring in summer before the onset of monsoon, (ii) deep application of complete fertilizer consisting of nitrogen, phosphorous pentoxide and potassium oxide at the rate of 22, 56 and 56 kg./hectare respectively along the planting rows, (iii) planting the tobacco variety Delcrest' at a spacing of 80×80 cm., (iv) application of 50 per cent Dieldrin WP at 1.4 kg. in 1000 litres of transplanting water, (v) topping when 1/10th of the inflorescence is open, and (vi) periodical suckering.

Orobanche in tobacco plantations has been controlled by the application of allyl alcohol at a concentration of 1: 5000. The incidence of powdery mildew was effectively controlled by dusting sulphur at the rate of 45 kg./hectare in between rows of plants four weeks after planting. For control of aphids, the systematic insecticides, viz. Thiometon, sulphoxide of Demeton-methyl, Rogor and Phosdrin, were found to be more effective than the chlorinated hydrocarbon insecticides. Application of neem cake at 71 kg./hectare around each plant four days after transplanting was found effective in repelling the ground beetles, thereby preventing damage to young seedlings by the beetles.

Shri A. Rahman

Shri A. Rahman, Officer on Special Duty, Survey and Planning of Scientific Research, CSIR, New Delhi, has been holding charge of thepostof Chief Editor, Publications & Information Directorate, CSIR, New Delhi, since November 1963.

Shri Rahman (b. 2 February 1923; Delhi) had his early education at Jamia Millia, Delhi, and took the B.Sc. degree of the Aligarh Muslim University in 1942. Subsequently, he joined the Indian Institute of Science, Bangalore, where he carried out research in biochemistry leading to the Associateship of the Institute (1945). He then proceeded to UK and studied at the University College, London.

Shri Rahman started his career at the Central Laboratories for Scientific & Industrial Research, Hyderabad, where he introduced, for the first time in India, operational research in a laboratory. He held the post of Assistant Director, Publications, Operational Research, and Liaison & Information Services Division at the Central Building Research Institute, Roorkee, during 1956-60 and at the Central Food Technological Research Institute, Mysore, during 1960-62. Since 1962, Shri Rahman has been working at the CSIR Secretariat on survey and planning of scientific research.

Although trained as a biochemist, Shri Rahman has an abiding interest in history of science and during the past 15 years he has, been engaged in work on the history of science in India. He has compiled a bibliography of source material of about 7000 manuscripts in Sanskrit, Arabic and Persian, and is at present engaged in completing it in other Indian languages. In 1962, Shri Rahman attended, on invitation, the Tenth International Congress on History of Science held at the Cornell University, Ithaca, USA, and presented a paper on the history of science in India. He has to his credit many papers on history of science, operational research, information science, and planning and organization of scientific research.

Shri Rahman is closely associated with the scientific workers' movement in the country since its inception and has served in various capacities in the Association of Scientific Workers of India. He is a member of the Institute of Information Scientists, UK : founder-member and Vice-President. Institute of Information Scientists. India: and member. International Union of History and Philosophy of Science. He is also Secretary, Operational Research Society of India; member, Board of History of Science of India of the National Institute of Sciences of India; and member, Social Relations Committee of the Indian Science Congress.

Dr H. A. B. Parpia

Dr Husain Ali Bheemji Parpia has been appointed Director, Central Food Technological Research Institute, Mysore, with effect from 4 November 1963.

Shri Parpia (b. 5 September 1922) had his early education at Bhopal. After obtaining B.Sc. Hons. (MicrobiologyandChemistry) degree of the Bombay University in 1945, he proceeded to USA for higher studies and worked for over two years in several industrial units before joining the Oregon Agricultural Experiment Station in 1947 as Food Technologist. He was research assistant and research fellow during 1948-51. Shri Parpia was awarded M.Sc. and Ph.D. degrees in food technology, dairy technology and horticulture by the university in 1951 and the same year joined the university as Assistant Professor. On his return to India in 1952, he was appointed Chief Technologist and Production Manager, Pure Products & Madhu Canning Ltd, Bombay, where he continued up to 1956. In 1953, he was appointed honorary visiting professor at the Bombay University. He joined the Central Food Technological Research Institute, Mysore, as Assistant Director in 1956 and in 1959 he was appointed Officer on Special Duty (Extension) in the CSIR Secretariat and later was appointed Industrial Liaison and Extension Officer. In May 1961, he joined the Kissan Products Ltd. Bangalore, as Director (Chief Technical Adviser). His services

FORTHCOMING INTERNATIONAL SCIENTIFIC CONFERENCES, 1964

Date	Conference	Place
2-11 February	International Congress on Documentation and Scientific-Technical Information	Rome
12-14 February 12-21 March	International Solid State Circuits Conference Agrochimica International Symposium	Philadelphia Palermo & Catania Italy
3-5 April	Third International Symposium on Fleming's Lysozyme	Milan
6-8 April	International Conference on Non-linear Mag- netics	Washington
12-18 April	Third International Symposium on the Che- mistry of Natural Products	Kyoto
13-17 April	Second International Fermentation Sympo-	London
13-17 April 19-25 April	International Fluid Power Conference International Conference and Exhibit on Aerospace Electrotechnology	London Phoenix
27 April to 1 May	International Exposition and Congress of Foundry Equipment	Atlantic City
April	Sixth International Instruments and Measure- ments Conference	Stockholm
April	Third International Measurement Conference	Stockholm
April	International Symposium on Soil Mechanics	Grenoble
4-8 May	Third International Strata Control Congress	New York
19-21 May	International Symposium on Microwave Theory and Techniques	Long Island, NY
25-29 May	Sixth International Conference on Electro- deposition and Metal Finishing	London
May	International Conference on Heating	Paris
May	International Congress on Natural Gas	Paris
May	International Conference on Power Reactors and Radioisotopes	Canada
8-12 June	International Congress of Chronometry	Lausanne
8-13 June	International Congress on Fouling and Marine Corrosion	Cannes
9-11 June	International Symposium on Research & Test- ing of Synthetic Materials used in Building	Liège
15-19 June	Seventh International Conference on Hot Dip Galvanizing	Paris
29 June to 3 July	First International Congress on Vacuum in Space Research	Paris
8-16 July	Twelfth International Congress of Entomology	London
19-24 July 20-24 July	Third International Congress of Polarography International Symposium on Organic Reac-	Southampton Cork
20.25 Tula	Third International Congress on Catalusia	Amatandar
26-25 July	Sixth International Congress of Biochemister	New Vork
27-30 July	Fourth International Photobiological Congress	Oxford

as Chief Defence Coordinator have been availed of by the CSIR since December 1962. As Secretary of the Steering Committee for the Coordination of Scientific Research for Defence, Dr Parpia was responsible for setting up cells in many national laboratories.

Dr Parpia has to his credit 11 technological and scientific publications, 26 reports on development and improvement of commercial products and about 10 semi-technical and popular publications besides 12 project reports and industrial survey reports. He is the Editor of Indian Food Packer and was Chief Editor of Food Science for over three years.

Dr Parpia is a member of the Society of the Sigma XI and the Institute of Food Technologists,

USA. He is Vice-President, Association of Food Technologists, India; and member of the Executive Committees of the Operational Research Society of India and All India Food Preservers' Association. He is also a member, Development Council for Food Processing Industries and several government teams on regulatory control-development of food industries, etc. He is a member of the Development Panels of the Ministry of Defence for Materials, Food and Chemical Research, and Advisory Panel on Chemical Industry, Ministry of Economic and Defence Coordination. Dr Parpia is the convener of the Fruit and Vegetable Products Standardization Committee of the Indian Standards Institution and member of several committees concerned with food products.

Dr Parpia was Alternate Leader of the Productivity Team of the National Productivity Council which toured USA and Denmark in 1962. In 1963, he was invited by UNICEF and FAO as governmental and industrial representative to attend the meetings (in Rome and London) concerning the development of protein-rich food.

Announcements

Bulletin of the Indian Society of Earthquake Technology - The Indian Society of Earthquake Technology invites contributions in English or Hindi for publication in the Society's bulletin proposed to be published commencing from January 1964. The scope of the contributions may include the following subjects: analysis and design of structures for earthquake forces; design of dams in seismic zones; dynamic loading of soils and foundations; geological studies for engineering projects in seismic zones: instruments concerned with seismology and earthquake engineering studies; earthquake records and reports; and general topics having a bearing on earthquake technology.

 A Symposium on Glycosides and Saponins is being held in Calcutta during the first week of April 1964 under the joint auspices of the Council of Scientific & Industrial Research and the Bengal Immunity Research Institute, Calcutta. The subjects of discussion at the symposium are: (1) Isolation, detection, assay and therapeutic evaluation; (2) Structural evidences, (a) degradative processes, (b) enzymes and glycosides, and (c) structural evidence on aglycones and sugars; (3) Pharmacological properties including structure-activity relationship; (4) Pharmacognosy, role of glycosides in plant physiology and allied subjects; and (5) Economic production of the active principles. Papers intended for presentation at the symposium, accompanied by their abstracts, should be sent to Dr A. N. Bose, Honorary Secretary, Immunity Scientific Association, 39 Acharya Jagadish Bose Road, Calcutta 16, by 15 February 1964.

Supplement

ABSTRACTS

of Published Research Papers from National Laboratories and Sponsored Research Projects of CSIR

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ABSTRACTS

51 MATHEMATICS

518 Applied Mathematics

1. RANGARAJAN, S. K. (Central Electrochemical Research Institute, Karaikudi): On particular solutions of $\nabla^4 \phi = 0$ and $E^4 \phi = 0$, Def. Sci. J., 13 (1963), 199

The correspondence between the particular solutions of the equations $\nabla^4 \phi = 0$ and $E^4 \phi = 0$ is pointed out. The solutions have been compared with those obtained by Bhatnagar [Bhatnagar, R. K., *Def. Sci. J.*, **12** (1962), 1]. An elementary discussion of the operational equation $[F_1F_2(L_1+L_2)]\phi = 0$ is presented. The operations H_{ν}^2 , E_{ν}^2 , H_{ν}^4 , E_{ν}^4 are introduced.

53 PHYSICS

532.7 Kinetic Theory

 SAXENA, S. C. & GAMBHIR, R. S. (Physics Department, Rajasthan University, Jaipur): A semiempirical formula for the translational thermal conductivity of gas mixtures, *Indian J. pure* appl. Phys., 1 (1963), 318

A semi-empirical procedure is suggested for the calculation of translational part of the thermal conductivity of multicomponent gas mixtures in analogy with the multicomponent viscosities. The computation requires a knowledge of the thermal conductivity of the pure components as well as that of the mixture at one composition. The new formula suggested is simple for numerical calculation and needs no knowledge of the intermolecular forces. The validity of the formula has been demonstrated by calculating the thermal conductivities of binary and ternary mixtures of inert gases and comparing them with experimental values. The formula can also be employed for predicting the thermal conductivities of gas mixtures at high temperatures. This calculation requires only the values of thermal conductivities or viscosities of the pure components at that temperature and at a lower temperature, along with the thermal conductivity value of the mixture at the lower temperature.

 TRIPATHI, B. B. (Department of Physics, Banaras Hindu University, Varanasi): Equation of state of potassium iodide, *Indian J. pure appl. Phys.*, 1 (1963), 278

The equation of state of potassium iodide has been derived from a statistical thermodynamic relation connecting the pressure with the Helmholtz free energy. The static pressures for a non-vibrating lattice have been derived from the cohesive energy expressions of the alkali halides, while the thermal pressures have been computed by dividing the Brillouin zone into 125 miniature cells. The evaluated frequencies for the corner points of these cells have been plotted as a function of the volume and the Grüneisen constant at various volumes has been computed from the slope of the curves. Isotherms drawn from the calculated values show close agreement with experimental data only at a temperature of 348°K. The thermal expansion values have been found to agree well with the experimental values. The discrepancy between the experimental values and the values deduced from the equation of state is ascribed to the inadequacy of Born and Mayer's [Born, M. & Mayer, J. E., Z. Phys., 75 (1932), 1] interaction at larger volumes.

534 Acoustics

4. BALACHANDRAN, C. G., KRISHNAN, P. V. & BHAN-DARI, P. S. (Central Building Research Institute, Roorkee): Speech communication in a highly reverberant hall, *Indian J. Technol.*, 1 (1963), 328

As a result of a systematic study of the speech communication problem in a medium-sized highly reverberant hall, an economic and efficient method of acoustical correction has been developed to improve speech communication. The method involves the setting up of a loudspeaker column which would direct the sound to the audience area only. Objective acoustical tests employing short bursts of pure tone sound pulses emitted from a properly designed loudspeaker simulating speech sounds from a human source have shown the superiority of the directional source in producing the necessary improvement in speech intelligibility. Subjective listening has also revealed considerable improvement in the acoustical qualities of the hall, especially for speech communication.

534.8 Ultrasonics

 SATYANARAYANA MURTY, M. & KRISHNAMURTY, BH. (Physics Department, Andhra University, Waltair): A study of certain ultrasonic parameters of some metallic nitrates, *Indian J. pure appl. Phys.*, 1 (1963), 332

Molar sound velocity (R), acoustic impedance (Z), relative association (RA) and hydration number (n)have been calculated for ten metallic nitrates utilizing the ultrasonic velocity data for the same nitrates reported earlier by the authors [Satyanarayana Murty, M. & Krishnamurty, Bh., *Indian J. pure appl. Phys.*, 1 (1963), 234]. The dependence of the variation of R and Z with concentration (c) on the valency type of the cation and the dependence of RA on the radius

1 -

and the atomic number of the cation have been examined. It has been observed that the higher the valency of the cation the greater is the magnitude of the gradients of the linear plots of R versus c and Zversus c. The RA versus c plots are linear only up to c = 1.5 moles/litre in the case of all nitrates except for lithium nitrate for which the plot is linear over the entire concentration range studied. The gradients of the linear portions of the plots show a direct dependence on the radius of the cation. The calculated values of n in the case of some of these salts agree closely with the literature values.

535.214 Radiometry

 PADMANABHAMURTY, B. & KRISHNA RAO, A. V. R. (Department of Meteorology, Andhra University, Waltair): Studies on nocturnal radiation with Beckman and Whitely total and net radiometers, *Indian J. pure appl. Phys.*, 1 (1963), 308

Net radiation as measured by Angstrom pyrgeometer and Beckman and Whitley net radiometer has been compared. Atmospheric radiation measured by the Angstrom pyrgeometer has also been compared with that measured by Beckman and Whitley total hemi-spherical radiometer. The values of net radiation obtained by Beckman and Whitley radiometer and Angstrom pyrgeometer agree closely. The atmospheric radiation recorded by Beckman and Whitley total radiometer is always lower than that recorded by Angstrom pyrgeometer. A comparison of ground radiation, evaluated directly from surface temperature assuming the earth as a perfect black body, and that obtained indirectly from total and net radiometers revealed that the earth is radiating at a temperature slightly different from its own; this temperature is in between the surface temperature and the Stevenson screen air temperature.

535.25 Photoelectricity

 VENKOBA RAO, H. N., KUPPUSWAMY, J. & LAKSH-MINARAYAN, R. (Central Electrochemical Research Institute, Karaikudi): Some preliminary studies and observations on the chemically deposited photosensitive lead sulphide layers, *Indian J. pure appl. Phys.*, 1 (1963), 335

A procedure for the preparation of chemically deposited photosensitive lead sulphide layers used as infrared detectors is outlined and techniques for the production of infrared detector cells with reproducible characteristics are described. The sensitivity of the cell is found to increase on dipping it in stannous chloride solution and with ageing.

535.33 Spectroscopy

8. JAISWAL, R. M. P. & SHARMA, D. (Department of Physics, University of Gorakhpur, Gorakhpur): Near ultraviolet absorption spectra of *m*- and *p*-bromobenzaldehyde vapours, Indian .J. pure appl. Phys., 1 (1963), 338

The absorption spectra of m- and p-bromobenzaldehydes in the vapour phase have been photographed. Two systems of bands have been recorded in the regions 3020-2740 A. and 2460-2320 A. for the *meta* isomer and in the regions 2890-2650 A. and 2570-2440 A. for the *para* isomer. The intense bands at 33669 and 40904 cm.⁻¹ in *m*-bromobenzaldehyde have been identified as the 0,0 band of the longer and shorter wavelength systems respectively, while those at 35023 and 39501 cm.⁻¹ in *p*-bromobenzaldehyde have been taken as the 0,0 band of the corresponding system of the *para* isomer. The other bands of each of the systems have been interpreted in terms of a number of ground and excited state fundamental frequencies. All these band systems have been attributed to the π - π transitions of the phenyl group.

9. RAMAKRISHNA, J. (Physics Department, Andhra University, Waltair): Temperature dependence of chlorine pure quadrupole resonance frequency, Indian J. pure appl. Phys., 1 (1963), 314

The temperature dependence of chlorine pure quadrupole resonance frequency (ν_T) has been studied in three molecules, viz. chlorobenzene, p-chloroaniline and p-chlorophenol, using the simple Bayer's theory [Bayer, H., Z. Phys., 130 (1951), 227]. The calculated variation of v_T with temperature has been found to agree satisfactorily with the experimentally observed variation [Dean, C., Chlorine nuclear quadrupole resonance and its Zeeman effect, Ph.D. Thesis, Harvard University, 1952]. An attempt has also been made to study the variation of the torsional frequency (f_t) with temperature by calculating values of f_t at different temperatures. The study of the variation of f_t with temperature has been extended to three more molecules, viz. carbon tetrachloride, chloroform and methylene chloride. The values of ν_T at different temperatures for these molecules recalculated by assuming the exact values of moment of inertia of these molecules (evaluated from structural data), have been found to agree satisfactorily with the experimental values [Gutowsky, H. S. & McCall, D. W., I. chem. Phys., 32 (1960), 548].

537.226 Dielectrics

 DASGUPTA, S. & MITAL, P. K. (National Physical Laboratory, New Delhi): Dielectric properties of araldite, *Indian J. Technol.*, 1 (1963), 368

The dielectric properties of an epoxy resin containing different amounts of the hardener have been studied in the frequency range 5 c/s. to 50 Mc/s. The plasticized material shows definite maxima in the plot of dielectric loss against frequency which tend to disappear with decrease in the proportion of the hardener.

537.311.33 Semiconductors

 MARATHE, B. R. (National Physical Laboratory, New Delhi): Electrical properties of semiconductor surfaces: Effect of an electric field on silicon surfaces, *Indian J. pure appl. Phys.*, 1 (1963), 249

The effect of d.c., a.c. and pulsed electric fields applied perpendicular to the plane of a thin silicon specimen has been investigated. Assuming the existence of slow and fast surface states, the variation of change in conductivity $(\Delta\sigma)$ with the induced charge due to the applied electric field is discussed. The experimental data are used for the evaluation of density and energy levels of the fast surface states. It has been found that in the case of silicon a set of fast surface states of density 10^{12} /sq. cm. exist at an energy of c. 0-38 eV. above the centre of the energy gap.

 MOMIN, A. U. & SINHA, A. P. B. (National Chemical Laboratory, Poona): Optimum energy gap for P-N junction photovoltaic solar energy converters, J. Instn Telecomm. Engrs, 9 (1963), 286

Loferski et al. have theoretically investigated the conversion efficiency in P-N junction photovoltaic solar energy converters as a function of the energy gap of the semiconductor. These investigations show that the conversion efficiency vs. energy gap plot shows a maximum around 1.1-3.3 eV. Taking into account the fact that the solar converter is not only exposed to black body radiation but also to scattered radiation from the sky, we have recalculated the optimum energy gap and obtained the value of 1.6-2.0 eV. Our calculations indicate that silicon, once considered the best material from efficiency considerations, does not hold good any more. Thus a semiconductor material with energy gap of around 2-0 eV. will have a higher efficiency coupled with several other advantages.

538 Magnetism

 LAROIA, K. K. & SINHA, A. P. B. (National Chemical Laboratory, Poona): Ferromagnetic properties of sodium and potassium lanthanum ferrites, *Indian J. pure appl. Phys.*, 1 (1963), 296

The variation of saturation magnetization (σ) and coercivity $(_{I}H_{c})$ of sodium and potassium lanthanum ferrites has been studied as a function of sintering temperature. In the temperature range 900-1000°C. these compounds decompose causing an abrupt decrease in σ . With further increase in sintering temperature, i.e. in the range 1100-1300°C., σ has been found to increase due to a progressive increase in the proportion of the magnetoplumbite phase and the bulk density of the pellets. Above 1350°C. the value of σ starts decreasing again due to a partial loss of oxygen. The decomposition at 900-1100°C. is negligible in unground or sintered samples and increases with the time of grinding, suggesting that the decomposition is dependent on the particle size of the magnetic phase. The increase in the value of $_{1}H_{c}$ observed on sintering in the range 850-1050°C. is attributed to a decrease in the average particle size of the magnetic phase due to its partial decomposition at c. 950°C. Sintering at higher temperatures reduces the value of $_{I}H_{c}$ and this is attributed to the increased particle size due to sintering. The increase in the values of $_{I}H_{c}$ with decrease in particle size and vice versa is consistent with the fact that demagnetization in bigger particles can take place through domain wall motion which is absent in single domain particles. The kinetics of formation of the ferrites at different temperatures and the effect of the addition of bismuth oxide on the magnetic properties have also been studied.

539.19 Molecular Physics

14. NAGARAJAN, G. (Department of Physics, Annamalai University, Annamalainagar): Mean amplitudes of vibration and thermodynamic functions of cyanogen halides, *Indian J. pure appl. Phys.*, 1 (1963), 324

The mean amplitudes of vibration of cyanogen halides, viz. FCN, CICN, BrCN and ICN, have been evaluated employing recent vibrational and molecular structural data for the molecules. The computed numerical values of (i) mean-square amplitude quantities, (ii) generalized mean-square amplitudes, and (iii) mean amplitudes of vibration for the temperature $T = 0^{\circ}$ K. and $T = 298^{\circ}$ K. have been given. The statistical thermodynamic functions for these molecules have also been calculated, on the basis of a rigid rotator, harmonic oscillator model, for the temperature range 200-2000°K.

15. NAGARAJAN, G. (Department of Physics, Annamalai University, Annamalainagar): Mean amplitude of vibration for the dioxides of zirconium, titanium, silicon and boron, *Indian J. pure appl. Phys.*, 1 (1963), 322

The vibrational spectra of the dioxides of zirconium, titanium, silicon and boron have been briefly discussed and the force constants for these molecules have been calculated on the basis of the Wilson's group theoretical method. The computed numerical values of (i) mean-square amplitude quantities, (ii) generalized mean-square amplitude quantities, and (iii) mean amplitudes of vibration for molecules of these oxides at 0°K. and 298°K. are reported.

16. RADHAKRISHNAN, M. (Department of Physics, Annamalai University, Annamalainagar): Potential constants of some XY_5 type molecules, Indian J. pure appl. phys., 1 (1963), 437

The potential constants, including the forces between the non-bonded atoms, of PCl_5 , $NbCl_5$, $TaCl_5$ and SbF_5 have been evaluated by means of Wilson's group theoretical method using the Raman and infrared data.

 RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field—Planar XY₃ molecules, *Curr. Sci.*, 31 (1962), 329

Force constants of some planar XY_3 molecules have been calculated using a Urey-Bradley field type of potential function.

 THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Orbital valence force constants of the tetrahedral XY₄ type molecules, *Curr. Sci.*, **31** (1962), 374
 The force constants of tetrahedral XY₄ type molecules

have been calculated using orbital valence force field.

 VENKATESWARLU, K. & RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Orbital valence force constants of planar XY₃ molecules, *Curr. Sci.*, 31 (1962), 141

Orbital valence force constants of BO_3 , BI_3 and $AlCl_3$ have been evaluated using the force field introduced by Heath and Linnet.

 VENKATESWARLU, K. & RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Potential constants of polyatomic molecules — Part II, J. Annamalai Univ., 24 (1962), 38

The force constants obtained by various authors on the assumption of different force fields in the case of some pyramidal and planar XY_3 and pyramidal and planar XYZ_2 types of molecules have been tabulated for comparison purposes. Such a comprehensive tabulation, which has been attempted for the first time, appears to be interesting in revealing to a large extent the scope of each type of force field. Wherever necessary, for the sake of completeness, force constants of some molecules belonging to the types discussed in this investigation have been calculated on the assumption of different force fields.

 VENKATESWARLU, K. & RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field — Allene (C₃H₄), Proc. Indian Acad. Sci., 57 (1963), 186

The Urey-Bradley force field has been employed in the investigation of force constants for allene molecule. Using the Urey-Bradley force constants, the vibrational wave numbers have been calculated and compared with the observed bands reported for this molecule.

22. VENKATESWARLU, K. & RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field — Ketone and ketone-d₂, Proc. Indian Acad. Sci., 46A (1962), 258

Urey-Bradley force constants of ketene and deuteroketene have been evaluated by the normal coordinate treatment. Using these force constants the fundamental vibrational wave numbers for ketone and its deuterium analogue have been calculated and compared with the observed bands.

 VENKATESWARLU, K. & RAJALAKSHMI, (Miss) K. V. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field and thermodynamic properties — Planar XYZ₂ type molecules, Acta phys. polon., 22 (1962), 417

A normal coordinate treatment has been carried out for a few molecules of planar XYZ₂ type, using the Urey-Bradley type of potential force field. The thermodynamic properties of NO₂F and NO₂Cl molecules have also been calculated on the basis of a rigid rotor, harmonic oscillator approximation.

24. VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Potential constants of polyatomic molecules—Part I, J. Annamalai Univ., 24 (1962), 13 A comparison of the force constants obtained by different authors on the assumption of various force fields has been made for the bent symmetrical XY₂, tetrahedral XY₄ and XY₃Z type molecules. Wherever necessary, for the sake of completeness, force constants of some molecules on the assumption of different types of force fields have been calculated.

 VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field: Borine carbonyl and borine carbonyl — d3, Proc. Indian Acad. Sci., 56A (1962), 247

A normal coordinate treatment has been applied to evaluate the Urey-Bradley force constants of borine carbonyl and borine carbonyl -d3.

26. VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field: C₃O₂ molecule, Curr. Sci., 31 (1962), 186

Assuming a planar centrosymmetric zigzag model, belonging to the point group C_2h , for the C_3O_2 molecule, the Urey-Bradley potential energy constants of the molecule have been evaluated.

 VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field: SF₄ molecule, *Proc. Indian Acad. Sci.*, 57 (1963), 181

The force constants of SF_4 molecule have been evaluated using the Urey-Bradley force field and compared with those obtained by *F-G* matrix method. Using the Urey-Bradley constants, the fundamental vibration frequencies are calculated and compared with the observed frequencies.

 VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field: Tetrahedral XY₄ type molecules, J. sci. industr. Res., 21B (1962), 461

The force constants of 27 molecules and 6 radicals of tetrahedral XY_4 species have been calculated on the basis of the Urey-Bradley type potential force field.

29. VENKATESWARLU, K. & THANALAKSHMI, (Miss) R. (Department of Physics, Annamalai University, Annamalainagar): Urey-Bradley force field and thermodynamic properties of XY₃Z type of molecules. Acta phys. polon. 22 (1963) 423

molecules, Acta phys. polon., 22 (1963), 423 Urey-Bradley force constants of XY_3Z type of molecules have been evaluated by the normal coordinate treatment. The thermodynamic properties of SiHCl₃ and SiHBr₃ are calculated for the ideal gaseous state at 1 atmospheric pressure for 11 temperatures from 100° to 1000°K. using a rigid rotor, harmonic oscillator approximation.

539.2 Solid State Physics

30. DEO, P. G. & SHARMA, S. D. (Department of Applied Sciences, Panjab Engineering College, Chandigarh): Dissolution spirals in sodium

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chloride crystals, Indian J. pure appl. Phys., 1 (1963), 337

Sodium chloride single crystals have been chemically etched using the methanol etchant. With controlled etching, dissolution spiral structures, having large pitch, have been revealed on (100) faces of the crystals. The possibility of these spirals being due to screw or helical dislocation has been considered. It has been suggested that the film of reaction products which builds up in solution adjacent to the surface of the crystal may partly be responsible for the observed large value of pitch.

 SINHA, A. P. B. & SINHA, K. P. (National Chemical Laboratory, Poona): Electronic motion in some polar semiconductors, *Indian J. pure appl. Phys.*, 1 (1963) 286

A formal theoretical study of electronic conduction in some polar semiconductors has been made where the carriers are assumed to be localized. The electron-lattice coupling is separated into two parts, one dependent and the other independent of the coordinates of the excess charge carrier. The independent part gives rise to lattice polarization while the dependent part, treated as the perturbation, superposes some excited orbital states on the ground orbital state of the carrier located at the metal ion. The static potential of the other ions, treated as the perturbation, causes transition of the carrier from one site to another. This formulation automatically takes into account the role of the intermediate excited states in the hopping process. It is found that, under favourable conditions, these intermediate states furnish an easier path for conduction. In the high temperature region the dependence of carrier mobility on tem-perature is nearly exponential. This behaviour is in agreement with the experimental observations on some transition metal compounds.

53:548 Crystal Physics

32. NARASIMHAMURTY, A. (Physics Department, Andhra University, Waltair): Electron paramagnetic resonance in single crystals: Part III — Copper sulphate pentahydrate, Indian J. pure appl. Phys., 1 (1963), 275

With a view to verifying the g values theoretically calculated earlier, the paramagnetic resonance spectrum of single crystals of copper sulphate has been studied at 9.3 kMc/s. The experimentally observed variation of the g factors and line widths in the (100) and (010) planes has been compared with the theoretically expected variation obtained from a knowledge of the structure of the crystal. The agreement between theoretical and experimental results regarding the nature of variation of g and ΔH as well as the absolute g values is fairly satisfactory.

33. SINGH, A. K. & RAMASESHAN, S. (Department of Physics, Indian Institute of Technology, Madras): An integrating Weissenberg camera for low and high temperature studies, crystallography and crystal perfection (Academic Press Inc., New York), 1963, 309

The construction of an integrating Weissenberg camera is described. The mechanism of the angular

integration is very similar to that used in the original Wiebenga design. The linear integration is affected by rack and pinion arrangement. Both these are made repetitive, so that one complete integration takes place in c. 1 hr. A Fankuchen-Lipscomb cooling arrangement has been incorporated into this camera for the study of crystals at low temperature. The problem of removing the cassette for loading and developing without disturbing the cooling arrangement has been solved, by making the jacketed cold and warm air leads thin enough to pass through the slot of a conventional cassette. A high temperature attachment for study of crystals up to 500°C. has been made using a nickel foil both as a heater element and ax X-ray filter.

531.3: 548.71 Lattice Dynamics

34. UPADHYAYA, U. N. & SINHA, K. P. (National Chemical Laboratory, Poona): Interaction between lattice vibrations and spin waves in magnetically ordered crystals, *Indian J. pure* appl. Phys., 1 (1963), 269

A microscopic theory of interaction between lattice vibrations and spin waves in both ferro- and antiferromagnetically coupled lattices has been developed from first principles. The interaction terms are formulated using second quantization methods. For this purpose, the one-electron localized states on the magnetic ions are appropriately admixed with excited orbital states as a result of crystal field oscillations acting as perturbations. Formulation of the isotropic exchange interactions in terms of such perturbed one-electron orbital states furnishes the relevant interaction terms. Subsequent transformations to spin wave representation give the expressions for phonon-magnon collisions. Relaxation processes for both the one-phonon direct and two-phonon Raman processes have also been studied. The phonon-magnon relaxation frequency in ferromagnetically coupled lattices has been found to increase exponentially with temperature (T), whereas it is inversely proportional to T^5 in the antiferromagnetically coupled lattices.

535:548 Crystallography

35. CHAUDHURI, B., KAKATI, K. K. & BHATTA-CHARYYA, G. C. (Department of Physics, Gauhati University, Gauhati): Unit cell and space group of azobenzene-2-sulphenyl bromide and cyanide, *Indian J. pure appl. Phys.*, 1 (1963), 272

Unit cell and space group of azobenzene-2-sulphenyl bromide and azobenzene-2-sulphenyl cyanide have been determined from single crystal oscillations and Weissenberg photographs. Space groups Pbca and $P2_{1}2_{1}$ have been uniquely established for the bromide and cyanide respectively from an examination of the systematic absences in their intensity spectra.

 RAMA MURTHY, P. & PATEL, C. C. (Department of Inorganic & Physical Chemistry, Indian Institute of Science, Bangalore): Crystal structure of zirconyl perchlorate dihydrate by X-ray powder diffraction method, J. phys. Chem., 67 (1963), 1357

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The X-ray powder diffraction lines of zirconyl perchlorate dihydrate, $ZrO(ClO_4)_2.2H_2O$, have been indexed for orthrhombic system. The unit cell dimensions are: a = 4.20, b = 17.59 and c = 16.11 A. The number of molecules of the dihydrate per unit cell are 4. The symmetry of the crystals corresponds to P_{2221} (space group No. 17).

37. VAIDYA, S. N. & RAMASESHAN, S. (Department of Physics, Indian Institute of Technology, Madras): Some procedures in the determination of absolute configuration of crystals, crystallography and crystal perfection (Academic Press Inc., New York), 1963, 243

The routine procedures for the determination of the absolute configuration of a crystal by the Bijvoet method using anomalous scattering and photographic techniques are outlined. The method due to Peerdeman and Bijvoet for assigning correct indexes to the reflexion recorded by the equi-inclination Weissenberg method has been restated to include trigonal, monoclinic and triclinic classes. The pairs of reflexions - named Bijvoet pairs - whose intensities are to be compared for the determination of the absolute configuration have been listed for all the enantiomorphous space groups. The problem of the determination of absolute configuration of the crystal when only one crystallographic mounting is possible (as in the case of liquids crystallized at low temperatures) has been discussed. A simple double-layer method of recording reflexions of the type lkL and lkL has been evolved and its application to various crystal classes is given.

54 CHEMISTRY

541.124-8 Chemical Reactions

38. BISWAS, RABINDRA NATH (Department of Organic Chemistry, Jadavpur University, Calcutta): Studies in Dieckmann cyclization: Part III — Cyclization of trimethyl 3-phenylpentane-1,2,5tricarboxylate, Sci. & Cult., 29 (1963), 51

The course of cyclization undergone by trimethyl 3-phenylpentane-1,2,5-tricarboxylate has been studied in order to ascertain whether electronic or steric effects dominate the Dieckmann cyclization. The results indicate that the electronic factor due to the presence of carbomethoxyl group in 2-position is probably taking control of the reaction.

39. SRIVASTAVA, P. K. (Department of Chemistry, Banaras Hindu University, Varanasi): Oxidation of certain 1,3-diaryl- and alkylaryl thiocarbamides: Formation of related bis-(polysubstituted formamidine)-di- and monosulphide (salts) and amidinothiocarbamides, *Indian J. Chem.*, 1 (1963), 354

The oxidation of certain 1,3-diaryl- and alkylarylsubstituted thiocarbamides with thionyl chloride has been found to give bis-(polysubstituted formamidine)disulphide salts which have been converted into the corresponding monosulphide salts or/and formamidinothiocarbamides by treatment with absolute ethanol. 40. SUBBA RAO, B. C. & THAKAR, G. P. (National Chemical Laboratory, Poona): Selective reduction of carboxy and cyano groups in the presence of carbonyl groups, *Curr. Sci.*, 32 (1963), 404

A method has been evolved using diborane to reduce selectively carboxyl and cyano groups in the presence of keto groups.

 VERMA, V. K. (Department of Chemistry, Banaras Hindu University, Varanasi): Oxidative dealkylation in isodithiobiuret systems: Preparation of certain 1,5-disubstituted-2-S-allyliso- and 1,5diaryl-2-S-p-methylbenzyliso-4-thiobiurets and their oxidative dealkylation, *Indian J. Chem.*, 1 (1963), 300

Like the S-benzyl group the S-allyl and S-p-methylbenzyl groups of 1,5-disubstituted-2-S-alkyliso-4thiobiurets are removed by oxidation with jodine or bromine in concentrated chloroform solutions resulting in the formation of 3,5-disubstituted-imino-1,2,4dithiazolidines. In dilute solutions, however, the deallylation does not take place but the reaction follows a different course leading to the formation of N-2-benzothiazolyl-N'-aryl-S-allylisothiocarbamides. The reaction has been investigated with a number of 1,5-disubstituted-2-S-allyliso- and 2-S-p-methylbenzyliso-4-thiobiurets and the products depending on the reaction conditions have been identified as 3,5-disubstituted-imino-1,2,4-dithiazolidines and N-2benzothiazolyl-N'-aryl-S-allylisothiocarbamides. However, 1-p-tolyl-5-methyl-2-S-allyliso-4-thiobiuret, on similar oxidation, affords 2-p-tolyl-5-methylimino-3-S-allyl-1,2,4-thiadiazoline.

541.13 Electrochemistry

- 42. NARAYAN, R. (Central Electrochemical Research Institute, Karaikudi): The hanging mercury drop electrode, J. electroanalyt. Chem., 4 (1962), 123 The electrode described in the paper and developed in the Central Electrochemical Research Institute, Karaikudi, is an improvement over those used by other workers as regards construction, reproducibility and facility of handling. The removal of traces of organic impurities by specially treated activated charcoal is found to be very efficient.
- 43. NARAYANAN, K. & RANGARAJAN, S. K. (Central Electrochemical Research Institute, Karaikudi): Faradaic admittance and migration in the diffuse double layer: Effect on the phase angle, Aust. J. Chem., 16 (1963), 565

The effect of migration in the diffuse double layer on the phase angle between the alternating components of the Faradaic current and voltage has been discussed. It has been shown that the $\cot \phi$ vs. $\sqrt{\omega}$ relationship is non-linear; the modified equation for this case (i.e. when migration is taken into account) is given. Equations derived already by Matsuda are discussed. Theoretical studies on the variation of $(I_0)_{app}/(I_0)_{ms}$ with Gouy potential are also reported.

44. RANGARAJAN, S. K. (Central Electrochemical Research Institute, Karaikudi): Electrode processes with a preceding chemical reaction: Effect of the diffuse double layer, Canad. J. Chem., 41 (1963), 1469

The effect of migration in the diffuse double layer on the concentration field of the reactive species has been analysed assuming that the electrode reaction $O+ne \rightleftharpoons R$ is preceded by a chemical reaction $Y+\beta X \rightleftharpoons O$ ($Z_x = 0$). Comparison has been made with the solutions derived by Hurwitz [Hurwitz, H., Z. Electrochem., **65** (1961), 178] and also by Matsuda [Matsuda, H., J. phys. Chem., **64** (1960), 336] for particular cases.

541.183 Adsorption

45. RAMESHWAR PRASAD & DEY, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): Amphoterism of hydrous thorium oxide and the adsorption of Fuchsine by the hydrous oxide L inorg. nucl. Chem., 24 (1962), 1018

oxide, J. inorg. nucl. Chem., 24 (1962), 1018 The adsorption of Fuchsine on hydrous thorium oxide precipitated by adding different volumes of sodium hydroxide solution to thorium chloride solution has been studied. The sample prepared using 5 per cent excess sodium hydroxide possessed least adsorptive capacity, indicating that the conditions for its preparation correspond to the isoelectric point.

541.41 Complex Compounds

46. JANAKI, N., PATHAK, K. D. & SUBBA RAO, B. C. (National Chemical Laboratory, Poona): Action of sodium borohydride-Lewis acid complexes on acetals and ketals, *Curr. Sci.*, 32 (1963), 404

The action of sodium borohydride-Lewis acid complexes (SBH-AlCl₃: SBH-BF₃) on acetals and ketals under normal reduction conditions has been studied. It is found that under these conditions straight chain acetals and ketals are hydrogenalysed mainly to the corresponding ethers whereas cyclic acetals and ketals yield the corresponding alcohols.

 KUNDRA, S. K. (National Chemical Laboratory, Poona): Complex formation of rare earths with sodium triphosphate, *Indian J. Chem.*, 1 (1963), 362

In the pH range 3-4, sodium triphosphate in aqueous solution forms RHP₃O₁₀ type of complexes with the light rare earths. From ion-exchange equilibrium experiments, the log K values for the lanthanum, praseodymium, neodymium and samarium complexes at 30° and 0.3 ionic strength have been determined and found to be 6.61 \pm 0.04, 6.98 \pm 0.04, 7.15 \pm 0.03 and 7.42 \pm 0.03 respectively. A complex salt of the type NaRHP₃O₁₀, xH₂O has been isolated from the solution in the case of praseodymium.

48. SANGAL, SATENDRA P. & DEY, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): Spectrophotometric studies on the chelate formation between uranium (VI) and 1(o-arsono-phenylazo)-2-naphthol-3,6-disulphonate (thoron) in aqueous solution, J. prakt. Chem., 20 (1963), 219

The composition and stability of the chelate formed between uranyl ion (II) and 1(o-arsonophenylazo)-

2-naphthol-3,6-disulphonate (thoron) have been investigated using spectrophotometric method. The chelate is red in colour and has λ_{\max} at 510 mµ. The composition as determined by different methods is 1:1. The chelate is stable between ρ H 2·5 and 5·0. The values of log K as determined by two different methods are $4\cdot2\pm0\cdot25$ and $4\cdot54\pm0\cdot15$ respectively at ρ H 3·0 and at 25°.

49. SANGAL, SATENDRA PRASAD & DEY, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): Studies on some soluble palladium (II) chelates in aqueous solution: Part I — Spectrophotometric investigations of palladium (II)sulphodichlorohydroxydimethylfuchson dicarboxylic acid (trisodium salt) (Chrome Azurol S), J. Indian chem. Soc., 40 (1963), 464

J. Indian chem. Soc., **40** (1963), 464 Palladium (II) with Chrome Azurol S forms a 1:1 violet-coloured chelate (λ_{max} . 585 mµ). The chelate is stable between pH 3·5 and 8·0. The values of stability constant (log K) as determined by two different methods are 5·0 and 4·8 respectively at pH 4·0 (at 25°).

 SANGAL, SATENDRA P. & DEY, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): The 1: 2 lanthanum-thoron chelate, Z. anorg. Chem., 322 (1963), 107
 The composition and stability of lanthanum-thoron

The composition and stability of lanthanum-thoron chelate has been studied by the spectrophotometric method. This red-coloured chelate has λ_{max} at 515 mµ. The composition as determined by different methods is 1: 2. The chelate is stable between ρ H 4·0 and 8·0. The values of log K as determined by two different methods are 9.92 ± 0.25 and 10.25 ± 0.27 respectively at ρ H 5·5 and temperature 25°.

51. SETH, ROSHAN LAL & DEY, ARUN K. (Department of Chemistry, University of Allahabad, Allahabad): Chelate formation between molyb-denum (VI) and sodium alizarin 3-sulphonate: Studies on the composition and stability of the chelate, Z. anorg. Chem., 321 (1963), 278

The composition of the red-coloured molybdenum (VI)-(Alizarin Red S) chelate (λ_{max} . 470 mµ), determined by continuous variations method, the slope ratio method and the mole ratio method, comes out to be 1:2. The chelate is stable between pH 2·5 and 6·0. The value of log K is 9·2±0·1, the free energy change of formation at pH 3·5±0·2, ionic strength 0·1M (NaClO₄) and 25°C. being -12.6 ± 0.1 kcal./ mole.

52. SINHA, SURENDRA NATH & DEV, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): Sodium alizarin-3-sulphonate as a chromophoric reagent: Part V — Colorimetric determination of vanadium (V), J. prakt. Chem., 20 (1963), 225.

The formation of a red-coloured chelate (λ_{max} , 455 mµ) between ammonium vanadate and sodium alizarin-3-sulphonate has been taken advantage of in the colorimetric determination of pentavalent vanadium on a micro-scale. The colour formation is instantaneous and the colour intensity is constant between 5° and 70°C. and *p*H 3·5 and 5·8. The

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system adheres to Beer's law over a range of 0.10 to 3.67 p.p.m. of vanadium. The sensitivity is $0.051 \text{ } \gamma/\text{cm.}^2$ (Sandell) and $0.51 \text{ } \gamma/\text{cm.}^2$ (practical). Copper, beryllium, bismuth, iron, aluminium, cerium, uranium, thorium, tungsten, molybdenum, carbonate, borate, citrate and tartrate interfere in the determination.

53. SRIVASTAVA, SURESH C. & DEY, ARUN K. (Chemical Laboratories, University of Allahabad, Allahabad): Composition and stability of the chelate between uranium (VI) and sulfodichlorohydroxydimethylfuchson dicarboxylic acid (trisodium salt), *Inorg. Chem.*, 2 (1963), 216

The results of studies on the stability and composition of the Uranyl Chrome Azurol S chelate point to two possible positions where chelation might occur. The metal ion may be coordinated between (i) the phenolic oxygen and the adjacent carboxylic oxygen or (ii) the quinoid oxygen and the adjacent oxygen of the carboxylic group.

54. YAG DUTT & SINGH, R. P. (Department of Chemistry, Delhi University, Delhi): Determination of stability constants of complexes of some bivalent metals with 2-hydroxy-2',4',4-trimethoxybenzil, Indian J. Chem., 1 (1963), 402

oxybenzil, Indian J. Chem., 1 (1963), 402 A pH-metric study of the stability constants of some bivalent metal ions with 2-hydroxy-2',4',4-trimethoxybenzil has been made in 50 per cent dioxan medium (0·1M with respect to sodium perchlorate). The order of stability for the metal complexes investigated has been found to be UO₂>Cu>Be> Zn>Ni>Co>Cd>Mn>Mg.

541.61:662.66 Coal Structure

55. MAZUMDAR, B. K. (Central Fuel Research Institute, Jealgora): The suggested structural pattern of coal and the recent measurement of hydrogen distribution, *Fuel, Lond.*, **12** (1963), 263

The experimental values of $(H_{CH}+H_{CH})/H_{CH}$, (n.m.r.) for different ranks of coal are in satisfactory agreement with those calculated from the author's three hypothetical structural patterns, suggested before the actual determination of this ratio by n.m.r. studies, to portray three important steps in rank evolution.

541.63 Stereochemistry

56. RAMACHANDRAN, G. N., RAMAKRISHNAN, C. & SASISEKHARAN, V. (Department of Physics, University of Madras, Madras): Stereochemistry of polypeptide chain configurations, J. mol. Biol., 7 (1963), 95

When two peptide groups $(\alpha C - C'o - NH - \alpha C)$ are linked at an α -carbon atom α_{ci} it is possible to have a rotation of the groups around the bonds $N - \alpha C(\phi)$ and $\alpha C - C'(\phi')$. The two parameters (ϕ, ϕ') define a configuration of the two linked peptide groups. In a polypeptide chain if the configuration of the whole chain becomes specified, because of short contacts only restricted ranges of ϕ and ϕ' will be allowed. These have been worked out. The available data on

542.952 Polymerization

 JOSHI, R. M. (National Chemical Laboratory, Poona): Heats of polymeric reactions: III, Makromol. Chem., 66 (1963), 114

The heats of polymerization of several methacrylic, acrylic and vinyl esters have been measured using an isothermal distillation calorimeter working at 74.5°C. Size and other structural variations in the ester group of methacrylic esters appear to have a small but distinct effect on the energies of the bonds involved in polymerization and hence on the heat of polymerization. The esters in the other two series are less susceptible to such influence. In methacrylic esters the increase in ester length causes a progressive increase in the slope of the (linear) plots of initial rates of polymerization vs (initiator)¹, which may be attributed to the shielding effect of the ester group on the propagating free radical affecting termination more than the propagation. In the alternating copolymerization systems the average heat of cross propagation was found to be considerably higher than the average of the two heats of self-addition, accounting for the essentially 1: 1-molar composition of the copolymer and the high rates of copolymerization.

543 Chemical Analysis

 AGARWAL, M. M. & MENE, P. S. (Laxminarayan Institute of Technology, Nagpur): A method for the analysis of carbon tetrachloride-ethyl acetateethanol ternary mixtures, *Indian J. Technol.*, 1 (1963), 274

A method for the determination of compositions of mixtures of the ternary system carbon tetrachlorideethyl acetate-ethanol based on the construction of a standard density-viscosity composition diagram is reported. The method is rapid and enables the determination of the compositions of unknown mixtures with an error of ± 2 per cent (by wt).

 AGRAWAL, K. C. & BAHL, J. S. (National Physical Laboratory, New Delhi): Spot test method of detection of bismuth in presence of copper, *Curr. Sti.*, 32 (1963), 13

A method is reported for the detection of bismuth in the presence of copper, based on the formation of an insoluble red-coloured compound by bismuth with tetra-acetyl ammonium hydroxide in acidic medium and in the presence of alkali iodide.

60. SARAN, J., KHANNA, P. N. & BANERJI, SUKRITI (Central Drug Research Institute, Lucknow): A modification in universal fillings in a microcombustion tube: Microcombustion of certain heterocyclics, *Indian J. Chem.*, 1 (1963), 362

Insertion of an additional silver gauze in the 'universal fillings' in a microcombustion tube enhances the life of the fillings and more accurate values of carbon are obtained for certain heterocyclic compounds.

61. SINHA, SURENDRA NATH & DEY, ARUN K. (Department of Chemistry, University of Allahabad, Allahabad): Sodium alizarin-3-sulphonate as a chromophoric reagent: Part III — Colorimetric determination of thorium (IV) and molybdenum (VI), Z. anal. Chem., 195 (1963), 916

A method has been recommended for the determination of thorium and molybdenum when present in micro-quantities, based on the formation of a redcoloured water-soluble chelate ($\lambda_{max.} = 520$ nm. for thorium and $\lambda_{max.} = 470$ nm, for molybdenum) of the composition M : Re = 1: 2, with sodium alizarin-3-sulphonate. A large number of ions, however, interfere and should be removed before measurements are made. The solution of thorium chloride or ammonium molybdate may then be treated with a freshly prepared solution of Alizarin Red S. The pH should be kept within the range 3.2-8.0 for thorium, 3.5-5.6 (preferably at 5.0) for molybdenum and the colour intensity may be measured with a photoelectric colorimeter or with a spectrophotometer. Temperature has no influence on the colour intensity. Determinations are possible be-tween 0.23 and 16.70 p.p.m. of thorium and 0.19 and 6.9 p.p.m. of molybdenum.

 SUMATHI, S. C. (Central Leather Research Institute, Madras): Quantitative estimation of maleic and oxalic acids in a mixture, *Leath. Sci.*, 10 (1963), 351

A cerimetric method for the estimation of maleic and oxalic acids present in a mixture is described. By titration in the cold using iodine monochloride as catalyst oxalic acid is obtained. By refluxing with excess ceric sulphate and back titrating the excess, maleic and oxalic acids are estimated. The difference gives maleic acid.

63. VERMA, M. R. & AGRAWAL, K. C. (National Physical Laboratory, New Delhi): Spot test for the detection of bismuth in the presence of silver, *Microckim.•acta*, (1963), 395

A method is reported for the detection of bismuth in the presence of silver. The method consists in transferring drops of solutions containing bismuth and silver to the depression of a spot plate and adding two drops of alcoholic thiosalicylic acid solution (10 per cent), whereupon, depending upon the relative amounts, a bright yellow precipitate is formed. Then alkali cyanide solution is added. A persistent yellowish solution or precipitate indicates the presence of bismuth because the yellow colouration or precipitate due to silver is discharged by alkali cyanide. The method can detect 5 μ g. of bismuth in the presence of 0.5 mg. silver.

64. VERMA, M. R. & GUPTA, P. K. (National Physical Laboratory, New Delhi): Note on the colorimetric estimation of cobalt as thiocyanate complex, Z. anal. Chem., 196 (1963), 187

The colorimetric estimation of cobalt as thiocyanate complex has been studied and it has been found that in some organic liquids the colour intensity of the complex is higher. Conditions for the estimation of cobalt are given.

545.33 Polarography

65. GUPTA, S. L., SARASWATHI, L. & SHARMA, S. K. (Department of Chemistry, Birla College, Pilani): Comparative study of the effect of capillary characteristics on acute polarographic maxima and tensammetric peaks, *Indian J. Chem.*, 1 (1963), 283

The effect of varying the capillary characteristics, viz. mass of mercury flowing per second (m) and drop time (t), on (i) acute polarographic maximum and (ii) tensammetric peak has been studied using two capillaries, one with a fine bore and the other with a wider bore. The results show that the magnitude of the polarographic acute maximum is enhanced with increase in the value of m whereas it is independent of t. The magnitude of the tensammetric peak increases with decrease in m as well as in t. It is concluded that the causes for the occurrence of the two types of maxima are quite different.

545.844 Chromatography

66. VERMA, M. R., JITENDRA RAI & GANGOPADHYAYA, N. (National Physical Laboratory, New Delhi): Chromatographic method for the separation of dyes from butter and their identification, *Indian J. Technol.*, 1 (1963), 358

A chromatographic procedure for the separation and identification of fat soluble dyes, viz. annatto, coaltar dyes, etc., added to butter is described. The procedure consists in dissolving butter in benzene, absorption on alumina column and elution with suitable solvents to resolve into various fractions and finally identification of separated dyes by paper chromatography. Annatto which remains absorbed as a compact ring on the top of the alumina column can be separated by scraping and treating with alcoholic ammonia. This method has been applied for the identification of dyes present in some commercial samples of butter.

546.28 Silicon Compounds

67. MEHROTRA, R. C. & PANT, B. C. (Department of Chemistry, University of Rajasthan, Jaipur): Organic derivatives of silicon: Part III — Silicon and organosilicon derivatives of mandelic acid, Indian J. Chem., 1 (1963), 380

The reactions between di- and trialkylchlorosilanes and mandelic acid and the stepwise replacement of the ethoxy groups of tetraethoxysilane by the acyl groups of mandelic acid have been studied. Mandelic acid is less reactive than salicylic acid; two moles of salicylic acid replace three of the four ethoxy groups in tetraethoxysilane whereas two moles of mandelic acid are able to replace only two ethoxy groups. A mechanism explaining the replacement reactions of mandelic and salicylic acids with ethoxysilanes has been suggested which accounts for the greater reactivity of salicylic acid.

547.45 Carbohydrates

68. SRIVASTAVA, H. C., HARSHE, S. N. & SINGH, PREM PAL (Division of Chemistry & Chemical Technology, Ahmedabad Textile Industry's Research Association, Ahmedabad): Methylation of carbohydrates: Part I — Use of dimethyl sulphoxide in the methylation reaction, *Indian J. Chem.*, 1 (1963), 304

A modification of the method of R. Kuhn, H. Trischmann and I. Löw [Angew. Chem., 67 (1955), 32] for the methylation of carbohydrates is described which extends the methylation reaction to carbohydrate polymers, particularly higher oligosaccharides and polysaccharides. In the modified method, dimethyl sulphoxide is used in place of N,N-dimethylformamide as the solvent, the use of potassium cyanide for the coagulation of silver salts is avoided and anhydrous calcium sulphate (Drierite) is employed to maintain anhydrous reaction conditions. The modified procedure is simple, the isolation of the methylated products is relatively easy and the yields of methylated products obtained are better. a-D-Glucose, methyl a-D-glucopyranoside, D-fructose, sucrose, maltose and dextrin have been methylated by this method and the properties and infrared spectra of the products obtained have been compared with those obtained by the method of Kuhn et al.

547.466 Amino Acids

69. PATRIC TAURO, RAMACHANDRA RAO, T. N., JOHAR, D. S. & SREENIVASAN, A. (Central Food Technological Research Institute, Mysore): Studies on microbial production of glutamic acid, Food Sci., 12 (1963), 263

The conditions for the production of glutamic acid by *Micrococcus glutamicus* ATCC No. 13032 have been standardized. A medium containing glucose and urea has been standardized for inoculum and fermentation.

547.596 Terpenes

70. DUTTA, TAPAN & BASU, U. P. (Bengal Immunity Research Institute, Calcutta): Terpenoids: Part II — Isolation of a new triterpene saponin, monnierin, from Bacopa monniera Wettst., Indian J. Chem., 1 (1963), 408

An acidic component and a new neutral saponin, monnierin, have been isolated from *Bacopa monniera* Wettst. grown under controlled condition of cultivation. Monnierin is shown to be a triterpenoid saponin which on acid hydrolysis gives glucose and arabinose.

71. MATHUR, H. L. & BHATTACHARYYA, S. C. (National Chemical Laboratory, Poona): Macrocyclic musk compound: Part V — New syntheses of exaltone, exaltolide, dihydroambrettolide and Δ⁹-isoambrettolide from aleuritic acid, J. chem. Soc., (1963), 3505

Pentadecanedioic acid has been prepared by a modified Barbier-Wieland degradation of ethyl 16-acetoxyhexadecanoate (obtained from aleuritic acid) and cyclized to the acyloin, the acetate of which on reduction with calcium in liquid ammonia furnished exaltone as the main product. The intermediate, 16,16diphenylhexadec-15-en-1-ol, on oxidation with potassium permanganate under specific conditions afforded 15-hydroxypentadecanoic acid which was cyclized to exaltolide. Δ^9 -Isoambrettolide and dihydroambrettolide were prepared by cyclization of the respective ω -hydroxy acids obtained from ethyl 16-acetoxyhexadec-9-enoate and the corresponding saturated compounds.

 TYAGI, B. S., GHATGE, B. B. & BHATTACHARYYA, S. C. (National Chemical Laboratory, Poona): Terpenoids: XLIII — Base-catalysed reactions with N-lithioethylenediamine, *Tetrahedron*, 19 (1963), 1189

The application of N-lithioethylenediamine as an isomerizing and dehydrogenating reagent has been further extended. It is useful for partial aromatization of cadinenic terpenes and for the conversion of selenic compounds to heteroannular diene, optical rotation of which throws light on the absolute configuration of the parent compound. It is also useful for smooth isomerization of fatty acids.

547.94 Alkaloids

73. ADITYACHAUDHURY, N., GANGULI, G., CHATTER-JEE, A. & SPITELLER, G. (Department of Chemistry, University College of Science, Calcutta & Organisch Chemisches Institute, University of Vienna, Vienna): Further studies on rhazidine, a minor alkaloid of *Rhazya stricia* Decaisne, *Indian J. Chem.*, 1 (1963), 363

Indian J. Chem., 1 (1963), 363 A tentative formula, $C_{19}H_{26}N_2O$, has been proposed for rhazidine on the basis of the mass spectra of the alkaloid and its dehydro derivative. The elemental analyses lend support to the above formula.

547.96 Proteins

74. JOSEPH, K. THOMAS, MOHANA, RADHARRISHNAN, V. & RAMANATHAN, N. (Central Leather Research Institute, Madras): Studies on elastoidin: Part I— Occurrence of peroxide linkage, *Leath. Sci.*, 10 (1963), 413

From the identification of 3-chlorotyrosine in the hydrolysate of elastoidin it has been concluded that peroxide linkage involving tyrosine residues is probably one of the factors contributing to the high shrinkage temperature of elastoidin.

75. NATARAJAN, M. & BOSE, S. M. (Central Leather Research Institute, Madras): Studies on chemistry of gelatin: Part I — Effects of different methods of preparation on the physical properties: N- and C-terminal amino acid and nucleic acid contents

of buffalo hide gelatin, Leath. Sci., 10 (1963), 293 Fifteen samples of gelatin have been prepared from the same collagen precursor, viz. buffalo hide by subjecting it to different methods of pretreatment and extraction at neutral or acid pH or by hydrogen bond breaker. In two cases, ho pretreatment was given. The gelatin samples have been analysed for viscosity, jelly strength, N-terminal amino acids by DNP- and

PTC-techniques. C-terminal amino acids by thiohydantoin and hydrazinolysis techniques and RNA and DNA contents. All the fifteen samples of gelatin have been found to contain eleven N-terminal amino acids, viz. glycine, serine, threonine, alanine, aspartic acid, glutamic acid, valine, leucine, phenylalanine, lysine and proline, and also eleven C-terminal amino acids, viz. glycine, aspartic acid, glutamic acid, serine, threonine, alanine, proline, hydroxyproline, valine, phenylalanine and isoleucine, although differences in the concentrations of most of the N- or C-terminal amino acids in gelatin samples are noted. It appears that there is some correlation between the viscosity and the total content of N- or C-terminal amino acids of gelatins. The RNA content of alkali-treated gelatins has been found to be significantly lower than that of the acid-treated gelatins and also lower than the DNA content of the corresponding alkali-treated gelatins. The RNA and DNA contents of the gelatin which was not subjected to any pretreatment and extracted at neutral pH have been found to be appreciably lower.

76. RAMACHANDRAN, G. N. (Department of Physics, University of Madras, Madras): The triple helical structure of collagen, *Aspects of protein structure* edited by G. N. Ramachandran (Academic Press Inc., London), 1963, 39

The triple helical configuration of polypeptide chains, first put forward from Madras in 1954, has been found to be the basis of the structure of collagen and a number of related polypeptides, namely polyglycine II, poly-L-proline II and poly-L-hydroxyproline-A. The original prototype structure, with three-fold screw symmetry, is found for the polypeptides, while collagen itself takes a closely similar structure, with a further twisting of all the three chains about the central axis of the protofibril. Recent work at Madras has shown that the value of the twist for a height of three residues is close to 30°. Also, a value of 2.95 A. was found for the residue height in unstretched collagen, which is distinctly larger by about 0.1 A. than the previous determinations. Conforming to these data for the helical framework, a satisfactory structure has been worked out for collagen, with two hydrogen bonds for every three residues. This structure does not have any objectionable short contacts, and it is distinctly superior to the collagen II structure of Rich and Crick, which contains only one hydrogen bond for three residues and is also much less densely packed. The latest structure agrees well with X-ray and infrared data (better than the onebonded structure) and it also explains why collagen has a coiled-coil structure, unlike the simpler polypeptides. It is only very slightly different from the earlier model of Ramachandran and Kartha, and is topologically identical with it. When the sequence Gly-Pro-Hypro occurs in one of the chains, only fiveout of the six hydrogen bonds can be formed for a height of three residues, and a satisfactory alternative structure has been worked out for this case also. The evidence for the triple helical structure from other sources is briefly reviewed and the possibility of the structure occurring in other proteins is discussed. A table is given comparing the main properties of the alpha helix and the Madras triple helix, which

now appear to be the two main helical chain configurations which occur in polypeptides and proteins.

77. RAMACHANDRAN, G. N., RAMAKRISHNAN, C. & SASISEKHARAN, V. (Department of Physics, University of Madras, Madras): Stereochemistry of polypeptide and polysaccharide chain conformations, Aspects of protein structure edited by G. N. Ramachandran (Academic Press Inc., London), 1963, 121

A notation is developed for representing the configuration of a polypeptide or polysaccharide chain. It is shown that the sugar residue in the latter has a rigid configuration and the parameters describing its standard configuration have been worked out, analogous to the Pauling-Corey parameters for the peptide group. The relative configuration of two peptide groups joined at an a-carbon atom may be represented by two angles ϕ, ϕ' , which are the angles by which the two groups are rotated about the single bonds C_{α} -N and C_{α} -C' from a defined standard configuration (0°,0°). A similar notation is also possible for two sugar residues linked by two single bonds at a bridge oxygen atom. The allowed and forbidden ranges of (ϕ, ϕ') are worked out by examining the short contacts between the various atoms in the two linked units. In a helical structure the configuration (ϕ, ϕ') is the same at every linkage, and the helical parameters n(= number of residues per turn) and h (= resolved height of a residue along the helical axis) have been worked out over the complete range of ϕ and ϕ' for polypeptide chains and over a range closed to the observed structures in the case of polysaccharide chains. These stereochemical studies have revealed various interesting results, such as (a) the chain conformation of the individual chains in the triple helical structure of collagen is a very 'natural' one for a polypeptide chain, (b) ' ribbon structure ' is a structure likely to be observed in simple peptides and polypeptides, (c) the γ -helix is very unlikely to occur, and (d) the configuration at each bridge oxygen in cellulose and chitin is very nearly the same as in cellobiose.

54:58 Plant Chemistry

78. ABU GHANIM, ASIF ZAMAN & KIDWAI, A. R. (Department of Research in Unani Medicine & Department of Chemistry, Muslim University, Aligarh): Chemical examination of *Elephantopus* scaber Linn., *Indian J. Chem.*, 1 (1963), 320

The flavone glycoside, $C_{21}H_{20}O_{11}$, isolated from *Elephantopus scaber* Linn. has been identified as 7-glucoside of luteolin.

79. RAJADURAI, S. & THERESA, Y. MARGARET (Central Leather Research Institute, Madras): Studies on biosynthesis of tannins in indigenous plants: Part IX — Isolation of oleanolic acid from the fruits of Zizyphus xylopyrus Willd., Leath. Sci., 10 (1963), 222

Oleanolic acid has been isolated from the fruits of Zizyphus xylopyrus Willd.

80. SHARMA, R. C., ASIF ZAMAN & KIDWAI, A. R. (Department of Research in Unani Medicine &
Department of Chemistry, Muslim University, Aligarh): Chemical examination of *Ficus racemosa* Linn., *Indian J. Chem.*, 1 (1963), 365

 β -Sitosterol and lupeol have been isolated from the petroleum ether extract of the root bark of *F. race-mosa* Linn.

81. SHARMA, R. C., KHAN, MOHAMMAD S. Y., ASIF ZAMAN & KIDWAI, A. R. (Department of Research in Unani Medicine & Department of Chemistry, Muslim University, Aligarh): Chemical examination of Gentiana olivieri Griseb., Indian J. Chem., 1 (1963), 409

Oleanclic and ursolic acids have been isolated from the petroleum ether extract of the flowers of G. olivieri.

547: 542.915 Organic Synthesis

82. ARAVINDAKSHAN, P. A., BHRAMARAMBA, (Miss) A., NAIR, G. V. & NAMBURY, C. N. V. (Department of Chemistry, Banaras Hindu University, Varanasi): Interaction of potassium ethylxanthate with aromatic primary amines: A new method for the preparation of 1,3-diarylthiocarbamides, Indian J. Chem., 1 (1963), 395

amides, Indian J. Chem., 1 (1963), 395 A new method for the preparation of 1,3-diarylthiocarbamides by the pyrolysis of mixtures of potassium ethylxanthate and aromatic primary amines is described. Aniline, o- and p-toluidines, α - and β -naphthylamines, etc., give high yields of the respective 1,3-diarylthiocarbamides, whereas chloroanilines and nitroanilines afford none or poor yields of the expected 1,3-disubstituted thiocarbamides. Among the aliphatic amines employed, only benzylamine undergoes the reaction to give near quantitative yields of 1,3dibenzylthiocarbamide. Secondary amines, viz. methylaniline, ethylaniline and diphenylamines, do not react with potassium ethylxanthate. The reaction with primary aromatic amines is believed to proceed via the formation of the intermediate, thiourethane. The mechanism of the reaction has been discussed and a plausible explanation for the varying vields in different cases has been put forward.

 DUTTA, J. & BISWAS, R. N. (University College of Science, Jadavpur University, Calcutta): Syntheses of perhydro-5,8-dimethyl-indane-1,4-dione and -indan-1-one, J. chem. Soc., (1963), 2387

The preparation of perhydro-5,8-dimethyl-indane-1, 4-dione and -indan-1-one from dimethyl 1,4-dimethyl-3-oxocyclohexane-1,2-dicarboxylate is described. The stereochemistry of the products is unknown.

84. GANGULY, M. & SEN, D. (Department of Applied Chemistry, University College of Science & Technology, Calcutta): Synthesis of pyrimidine derivatives: Part V — Synthesis of some 2methylthio-(or 2-amino)-6-(substituted)-aminopyrimidines, Indian J. Chem.; 1 (1963), 364

The synthesis of following six new pyrimidine derivatives having possible activity against transplanted tumours is described: 2-methylthio-4-methyl-6-(2-hydroxyethyl) aminopyrimidine, 2-methylthio-4-methyl-6-[bis(2-hydroxyethyl)] aminopyrimidine, N,N'-bis(2-methylthio-4-methyl-6-pyrmidyl) ethylenedi-

amine, 2-methylthio-4-methyl-6-(2-amino-4-methyl-6pyrimidyl) hydrazinopyrimidine, 2-amino-4-methyl-6-semicarbazidopyrimidine and 2-amino-4-methyl-6-[bis(2-hydroxyethyl)] aminopyrimidine. The first four compounds have been synthesized by refluxing 2-methylthio-4-methyl-6-chloropyrimidine with ethanolamine, diethanolamine, ethylenediamine hydrate and 2-amino-4-methyl-6-hydrazinopyrimidine respectively. The last two compounds have been obtained by refluxing 2-amino-4-methyl-6-chloropyrimidine with semicarbazide hydrochloride and diethanolamine.

85. GHOSH, BINAY KUMAR, DAS, BIJAN PRASUN & BASU, U. P. (Bengal Immunity Research Institute, Calcutta): Isoquinoline derivatives: Part XVI — Potential antispasmodic compounds, Indian J. Chem., 1 (1963), 407

Eight isoquinoline derivatives containing a secondary or tertiary amine moiety along with other groups like phenyl, phenylethyl, phenylisopropyl and cyclohexyl and two isoquinoline derivatives containing another isoquinoline ring and a quinazolone moiety have been synthesized as potential antispasmodics. The synthesis is effected by condensing 1-chloromethyl-3methylisoquinoline with an appropriate amine.

 NARANG, A. S. & NARANG, K. S. (Department of Chemistry, Panjab University, Chandigarh): Synthesis of 4,11-thiopegan derivatives, *Indian* J. Chem., 1 (1963), 318

Some 4,11-thiopegan derivatives have been synthesized by condensing 6-N-carbethoxyaminopiperonal with 2-mercaptoethylamine and methyl or ethyl ester of 1-cysteine hydrochloride in the presence of sodium acetate. The structures suggested for 4,11-thiopegan derivatives find support from infrared and elemental analysis data.

87. NASIPURI, D. & ROY, D. N. (University College of Science & Technology, Calcutta): Synthesis of isonimbiol methyl ether — A hydrophenalene derivative isomeric with nimbiol methyl ether, *Indian J. Chem.*, 1 (1963), 322

Isonimbiol methyl ether, the major monoketonic fraction obtained by cyclodehydration and subsequent oxidation of 1,4'-methoxy-3'-methylphenyl-4,8-dimethylnon-7-en-4-ol, and isomeric with nimbiol methyl ether has been proved to have the hydrophenalene structure by an unambiguous synthesis.

88. NASIPURI, D. & ROY, D. N. (Department of Pure Chemistry, University College of Science & Technology, Calcutta): Synthetic studies in the diterpene series: Part III — Synthesis of (±)-nimbiol methyl ether and its degradation products, J. Indian chem. Soc., 40 (1963), 327

Methyl ether of (\pm) -nimbiol has been synthesized by two different routes. Three of its degradation products, namely 1,1,7-trimethyl-1,2,3,4-tetrahydro-, 1,1,7-trimethyl-6-hydroxy-1,2,3,4-tetrahydro- and 1,7-dimethyl-6-hydroxy-phenanthrenes; and their derivatives have also been synthesized.

89. SHARMA, R. C., ASIF ZAMAN & KIDWAI, A. R. (Department of Research in Unani Medicine & Department of Chemistry, Muslim University, Aligarh): Chemical examination of Buddleia asiatica Lour., Indian J. Chem., 1 (1963), 366

Quercetin and linarin (acacetin-7-rutinoside) have been isolated from the ethanolic extract of the flowers of B. asiatica Lour.

90. SIDHU, G. S., THYAGARAJAN, G. & NAGABHUSHAN RAO (Regional Research Laboratory, Hyderabad): Synthesis of some substituted quinazolines, Indian J. Chem., 1 (1963), 346

Seven Bz-substituted quinazolines have been synthesized by Riedel's method [*Chem. Zbl.*, 77 (1906), 1372] from o-nitrobenzaldehydes. The method has been modified to proceed in one step only. 2-Methylquinazoline has been prepared by using acetamide instead of formamide in the synthesis; reductive cyclization does not proceed if benzamide is used.

55 METEOROLOGY

551.46 Oceanography

91. KAPPANNA, A. N., SITAKARA RAO, V. & SYAMA SUNDAR, K. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): Iodine content in sea water collected from different parts of the Indian coast. Sci. & Cult., 29 (1963), 356

Indian coast, Sci. & Cult., 29 (1963), 356 The iodine content of eleven surface samples of sea water collected from different parts of Gujarat and South Indian coasts have been determined using the catalytic method of Barkley and Thompson [Analyt. Chem., 32 (1960), 154]. The values generally lie in the range 45-58 r/litre of sea water.

92. RAMA RAJU, V. S. (National Geophysical Research Institute, Hyderabad): Note on the bottom profiles of the western part of the Indian ocean, Bull. NGRI, 1 (1963), 48

The bottom profiles in the western part of the Indian Ocean have been analysed from the data collected in that area during the February-March 1960 period of the 31st cruise of the *Vitiaz*. A new sea-mount was discovered to the east of Mozambique rising to a height of 3 km. below the water surface. At a station in the region off Madagascar the corer brought up nodules of manganese. At a station off Zanzibar, the core sample hauled up from a depth of 4720 m. contained 1.8 m. of red clay and blackish-green mud and the rest sand.

93. SANKER NARAYAN, P. V. (National Geophysical Research Institute, Hyderabad): Strings of magnetic anomalies with exponentially decreasing amplitudes observed in Kansas and Wisconsin, USA, Bull. NGRI, 1 (1963), 17

Two isolated occurrences of strings of magnetic anomalies observed in Kansas and Wisconsin, USA, are discussed pointing out the peculiar pattern of an exponential decay in their amplitudes. Treating the anomalous bodies as simple bottomless rectangular prisms reaching the top of a flat basement (as inferred from borehole data in the areas), the possible susceptibility contrasts are worked out for each of the anomalous pulses. The resulting susceptibility values are seen to follow an exponential decay curve of the form $\Delta k = \Delta K.e^{-mD}$, where Δk is the susceptibility at a distance D from the spot where the susceptibility is ΔK and m is a constant whose value is seen to be 0.8, 0.4 and 0.29. In the Kansas profile the distance between the individual pulses is seen to be remarkably constant, whereas in the Wisconsin occurrence the distance itself is seen to vary in a logarithmic fashion. While an explanation based on solid or fluid diffusion of mafic material and subsequent concentration into parallel bands may meet with certain theoretical objections at the present time, it is felt that this pattern seems to offer a pointer in the solution of certain petrological and/or tectonophysical problems.

94. SEN GUPTA, R. & ANANTHANARAYANAN, S (Central Leather Research Institute, Madras): Volumetric estimation of sulphate in sea water using benzidine hydrochloride and determination of sulphate-chlorinity ratio, *Indian J. Chem.*, 1 (1963), 403

A volumetric method is described for the estimation of sulphate in natural and artificial sea waters using benzidine hydrochloride, involving the prior elimination of chloride by precipitation with silver nitrate and of cations by the use of an ion-exchange resin (IR-120 Amberlite). The sulphate content of sea water can be estimated by this method with an accuracy of ± 0.4 -0.5 per cent, whereas the accuracy obtained with the conventional gravimetric method is ± 1.7 per cent. The values of sulphate-chlorinity ratio calculated on the basis of sulphate values determined by the benzidine hydrochloride method are more consistent and reproducible than those obtained on the basis of conventional gravimetric method.

95. SEN GUPTA, R. & RAMASWAMY, D. (Central Leather Research Institute, Madras): Estimation of sodium and potassium in sea water by flame photometry, *Leath. Sci.*, 10 (1963), 255

Conditions have been established for the estimation of sodium and potassium ions in sea water samples in the presence of interfering ions by flame photometric method. The ratio of potassium to chlorinity has been investigated.

551.510.53 Ionosphere

96. ABHIRAMA REDDY, C. & RAMACHANDRA RAO, B. (Ionospheric Research Laboratories, Physics Department, Andhra University, Waltair): Polarization of radio waves in relation to their fading, *Indian J. pure appl. Phys.*, 1 (1963), 252

A detailed experimental study of the short-time fluctuations in the polarization of down-coming radio waves (2-8 Mc/s.) subject to different conditions of fading has been carried out at Waltair (geomagnetic latitude 7.4°N; dip angle 20°). The polarization patterns of twenty sets of echoes with different amounts of scatter components have been analysed graphically and it has been observed that there is no correlation between the polarization parameters (axial ratio and tilt angle) and the amplitude. A detailed analysis of the statistical distributions of the axial ratio, tilt angle and amplitude carried out for selected echoes, having apparently random and semiperiodic fading, has shown that there is no similarity between the distributions except in a few cases where the fading echo consists of a predominantly specular component. In general, the deviations from a symmetrical distribution of axial ratio and tilt angle have been found to be smaller for stronger signals than for weaker signals and still lesser for predominantly specular echoes. Further, the values of axial ratio have been found to have a greater tendency towards a symmetrical distribution than tilt angle values under all conditions of fading.

 RANGASWAMY, S. (Research Department, All India Radio, New Delhi): Lunar control of noon critical frequencies of the F₂ region, J. atmos. terr. Phys., 25 (1963), 545

The variation of noon critical frequencies with the phase of moon at three ' equatorial ' stations has been studied. The mean variation for lunation was determined separately for the three seasons, namely the June and December solstices and the equinoxes, for Madras (magnetic lat. 5.3°N). The phase of the lunar variation in the June solstice differed from that in the December solstice by nearly 5 hr (or 150°). The amplitude in June solstice was about half that in the December solstice. The phase of the equinox variation was nearly the same as in northern summer. The amplitude of the mean annual variation in 1957 and 1958 (sunspot maximum) was found to be nearly half of the amplitude in 1954 (sunspot minimum) while the phase for the two epochs is nearly constant. The reduction in amplitude in 1957-58 is due to large phase difference of the variation in the different seasons. For comparison, data from Kodaikanal (magnetic lat. 1.8°N) and Huancayo (magnetic lat. 0°) have been analysed. The seasonal change in phase of the lunar semi-diurnal variation was found to be about 90° for Huancayo between the solstices and about 150° for Kodaikanal. The value of the phase for Huancayo in 1957-59, when compared with that in 1941-44, shows that the change in phase is twice in 1957-59 than in 1941-44 for the two solstices. It is tentatively concluded that the seasonal change in phase of lunar variation in critical frequency varies with latitude and sunspot activity.

551.515 Atmospherics

98. CHIPLONKAR, M. W. & KAREKAR, R. N. (Department of Physics, University of Poona, Poona): The afternoon hump in the diurnal variation of atmospherics activity on 27 kc/s., *Indian J. pure appl. Phys.*, 1 (1963), 256

appl. Phys., 1 (1963), 256 The phenomena of 'afternoon hump' and 'sunset dip' observed in the diurnal variation of atmospherics activity on 27 kc/s. are discussed with reference to the data obtained at Poona during 1958-59. Two basic variations are considered: (a) the diurnal variation of winter months and (b) the afternoon hump of summer months. Any type of observed diurnal variation can be explained by them either individually or by their superposition. The processes by which these basic variations may be produced are also discussed. It is concluded that though the diurnal and seasonal variations of thunderstorm activity and their geographical distribution play an important part in the production of the afternoon hump, the late occurrence of sunset rise in winter and presence of sunset dip in summer suggest that the role of the ionosphere is of no less importance.

 Das GUPTA, M. K. & SEN, A. K. (Institute of Radio Physics & Electronics, Calcutta): Integrated field intensity of atmospherics in relation to local thunderstorms, J. atmos. terr. Phys., 25 (1963), 306

Preliminary analysis shows that on all 34 occasions in 1962 when the local meteorological department reported the onset of a nor'wester the recorded integrated field intensity of atmospherics showed a gradual rise from a few hours before the onset of the thunderstorm. It has been suggested that the method supplemented with directional studies of atmospherics would give a suitable method for forecasting nor'westers well in advance.

55 GEOLOGY

553 Economic Geology

100. SAHA, AJIT K. & CHAKRABORTI, SHYAMAL K. (Department of Geology, Presidency College, Calcutta): A quantitative petrological study of the Bahalda Road hornblende granodiorite, Mayurbhani L Decam geal Soc. 3 (1963) 50.

Mayurbhanj, J. Deccan geol. Soc., 3 (1963), 50 The Bahalda Road hornblende granodiorite, which forms a distinct unit of the huge batholithic mass of Singhbhum granite, extends as a 2-3 miles wide body for over 9 miles. A detailed quantitative petrological study of an area of 15 sq. miles in the northeastern part of this body has been carried out on the basis of 45 modal analyses. The granodiorite body shows considerable variations, most of it being IIP and IP granites and it includes sporadic occurrences of diorite. A new technique for the study of areal variations has been tried; this consists of (a) superposing a suitable square grid pattern on the geological map containing the data points, (b) calculating the average percentage for each constituent in each grid, and thence, (c) the average for each constituent for the entire area, and (d) preparing a contour map for " each constituent showing the areas of ' positive ' and negative' deviations with respect to this average. Consistent results have been obtained by using three different arrangements of the grids. A general ' welt and furrow ' (with northeasterly trends) type of variation over the sampled area is indicated for K feldspar and quartz percentages and the colour index. This simple technique has several advantages over the technique of trend surface analysis of compositional variations. Chemical composition of a typical sample of the granodiorite has been calculated from its mode. Correlations amongst the mineralogical variates (plagioclase, K feldspar, quartz, colour index) are weak and the r values turn out to be statistically nonsignificant when tested in the light of the recent work of Chayes. These quantitative data supplement the

field and textural evidences in favour of a metasomatic origin of the Bahalda Rd granodiorite.

57 BIOLOGICAL SCIENCES

577.1 Biochemistry

101. MALHOTRA, H. C., MISRA, U. K. & VENKITA-SUBRAMANIAN, T. A. (Department of Biochemistry, Vallabhbhai Patel Chest Institute, Delhi University, Delhi): Changes in heart lipids in experimental tuberculosis in chicken, *Indian J. exp. Biol.*, 1 (1963), 159

A decrease in total lipids and total phospholipid phosphorus, and an increase in total cholesterol are observed in the heart of tuberculous chicken. The phospholipids have a slower turn-over rate in the tuberculous birds than in the normal birds. A drastic reduction is also observed in the triglyceride level in tuberculous birds. The levels of all the phospholipids have been found to decrease in the tuberculous birds, the exceptions being lysolecithin, phosphatidyl serine and inositol mono-phosphatide which show a slight increase.

577.15 Enzymes

102. GEORGE, J. C., SUSHEELA, A. K. & VALLYATHAN, N. V. (Division of Animal Physiology & Histochemistry, Department of Zoology, M.S. University of Baroda, Baroda): Cytoplasmic (non-mitochondrial) lactic and succinic dehydrogenases in the red and white muscle fibres, J. Anim. Morph. Physiol., 10 (1963), 24

Cytoplasmic (non-mitochondrial) lactic and succinic dehydrogenase activity has been demonstrated histochemically in the red and white fibres of the pigeon breast muscle. The white fibres showed a higher concentration of cytoplasmic lactic dehydrogenase than the red ones. With respect to succinic dehydrogenase there was no perceptible difference between the two types of fibres. It has also been observed that testosterone has an inhibitory effect on the mitochondrial lactic dehydrogenase. The significance of the occurrence of these dehydrogenases in the cytoplasm is discussed.

- 103. NADKARNI, S. R. & SOHONIE, KAMALA (Department of Biochemistry, Institute of Science, Bombay): Isolation and purification of β -amylase from double bean, *Enzymologia*, 25 (1963), 337 The enzyme β -amylase from double bean [*Vicia faba* (Moench)] has been purified 24-fold. The purified enzyme, when studied chromatographically, was found to be β -amylase with no α -amylase contamination. The purified enzyme was found to be inhibited by heavy metals, *p*-chloromercurybenzoate, iodoacetate, Ca ions, ascorbic acid, the CN group and semicarbazide. The results indicate the likelihood of SH and carboxyl groups being present in the purified enzyme.
- 104. RAGHAVENDRA RAO, M. R., SUBRAMANIAN, S. S., RAHATEKAR, H. I. & PARANJPE, S. V.

(National Chemical Laboratory, Poona): Enzymatic hydration of citraconate to (-) citramalate, Biochem. Biophys. Res. Commun., 12 (1963), 78

During the study for a possible biological conversion of citraconate to mesaconate it was found that instead of a *cis-trans* isomerization there was enzymatic hydration of citraconate to citramalate brought about by an enzyme present in the cell-free extract of a fluorescent pseudomonad isolated from soil. The enzyme catalyses the hydration of citraconate to (-) citramalate and of mesaconate to (+) citramalate. The hydration of citraconate to (-) citramalate, i.e. citraconase activity, is stable to dialysis, whereas the formation of (+) citramalate from mesaconate, i.e. mesaconase activity, is lost. The two activities are distinct since the two geometrical isomers on hydration yield two optical antipodes of the same substance.

105. VALLYATHAN, N. V. & GEORGE, J. C. (Division of Animal Physiology & Histochemistry, Department of Zoology, M.S. University of Baroda, Baroda): Phosphorylase 'a' in bird and bat breast muscles, J. Amin. Morph. Physiol., 10 (1963), 15

Phosphorylase activity in the red and white fibres of the pigeon breast muscle has been determined by an indirect method based on the distribution pattern of the two types of fibres. The enzyme concentration was found to be higher in the superficial layers, where the broad white fibres are maximum and lower in the deepest layers where the narrow red fibres are maximum. A comparative study of the enzyme activity in the whole breast muscle of certain other birds, rosy pastor, myna, fowl and bat has also been carried out and it has been found that the concentration of the enzyme is indicative of the state of activity of the muscle and is not necessarily an index of the nature of the fuel utilized for energy by the muscle concerned.

577.16 Vitamins

106. BARUA, R. K. & NAYAR, P. G. (Organic Chemistry Laboratory, Gauhati University, Gauhati): Naturally occurring anhydrovitamin A₂, Curr. Sci., **32** (1963), 257

The liver oil of *Bagarius bagarius*, a fresh-water fish found in the inland waters of Assam, contains naturally occurring anhydrovitamin A_2 . The redbrown oil, obtained by cold extraction of the liver with petroleum ether (40-60°) and distillation of the extract under reduced pressure, was chromatographed on a column of alumina (5 per cent water). The fraction eluted with petroleum ether containing 10 per cent (vol./vol.) ether had an ultraviolet absorption spectrum having maxima at 350, 371 and 392 mµ and an inflexion at 333 mµ. With antimony trichloride reagent it gave a greenishblue colour with maximum at 693 mµ.

577.3 Biophysics

107. GANGULY, PANKAJ K. (Saha Institute of Nuclear Physics, Calcutta): Effect of X-rays on bacterial ribosomes, Biochem. biophys. Acta, 75 (1963), 59

Crude extracts from starved, non-irradiated and irradiated *E. coli* cells collected in M/300 phosphate buffer containing 0·01M Mg²⁺ have been analysed in a Spinco ultracentrifuge, model E at 39,460 r.p.m. The irradiated cells were found to contain diminished amounts of free RNA and 88S ribosomes. Starved cells also showed similar effects. At the various doses used, up to 90 kilorads, 70S particles were not affected, whereas the 88S particles were severely affected. It has been concluded that the enzyme system that controls the conversion of 70S to 88S particles is more susceptible to radiation damage. The marked diminution in the free RNA peak also shows that it must be involved in the protein synthesis of the cell.

108. GANGULI, PRASANTA K. & BHATTACHARJEE, SUKHENDU B. (Saha Institute of Nuclear Physics, Calcutta): Sedimentation studies on DNA from irradiated E. coli, Arch. Biochem. Biophys., 102 (1963), 132

Biophys., 102 (1963), 132 DNA prepared from E. coli cells irradiated by X-rays up to a dose of 60 kilorads showed neither any change in the zero concentration sedimentation coefficient nor any change in the mode of dependence of sedimentation coefficient on concentration. Heattreated DNA solution showed a large decrease in the concentration dependence. It has been concluded that there is no change in the molecular weight and configuration of DNA collected from irradiated E. coli.

58 BOTANY

581.1 Physiology

109. KAPOOR, L. D. (Regional Research Laboratory, Jammu): Site of synthesis of alkaloids in some plants, Curr. Sci., 32 (1963), 355

The site of synthesis of alkaloids has been shown to be the root in the case of *Physochlaina preleata* and *Datura innoxia* and leaf in the case of *Papaver* somniferum.

581.8 Cytology

110. VENKATESWARLU, J. & KAMESWARA RAO, C. (Department of Botany, Andhra University, Waltair): Some observations on the cytology in the genus *Tephrosia* Pers., *Curr. Sci.*, 32 (1963), 345

Tephrosia purpurea Pers. has been observed to be polymorphic, showing a normal erect form and a procumbent giant form referred as *T. purpurea* (2), both growing wild in the university campus, Waltair. These two forms and three other species of the genus *Tephrosia*, viz. *T. hirta* Ham., *T. maxima* Pers. and *T. pumila* Pers., have been studied cytologically and a *n* number of 11 chromosomes was observed in all of them. Evidence is provided from existing literature for the occurrence of different karyological races in some species of *Tephrosia*. The chromosomes are of the differentiated type. Morphology of the nucleolus-organizing chromosomes at pachytene has been studied in all the five materials and considerable differences in total lengths, arm ratios and amount of deposition of heterochromatin are recorded. Meiosis is regular in all the five materials. Fifty nuclei at diakinesis in each of the five materials and 30 nuclei each at metaphase I in *T. purpurea*, *T. purpurea* (2) and *T. maxima* have been analysed in respect of chiasma frequency per nucleus, terminalization coefficient and percentage of rod bivalents.

582.26 Algae

111. THIVY, FRANCESCA & IYENGAR, E. R. R. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): A new record of *Griffithsia rhizophora* (Grunow) ex Weber-van Bosse for India, Bot. Mar., 5 (1963), 33

The red alga *Griffithsia rhizophora* (Grunow) ex Weber-van Bosse has been recorded for the first time from India. The type specimen is from Ceylon, but the species had not been reported again from the Indian Ocean region. The antheridial and the cystocarpic plants, it would appear, have been found for the first time.

582.28 Fungicides

112. GEORGE, E. C., NANDY, S. C. & SEN, S. N. (Central Leather Research Institute, Madras): Fungistatic properties of some solvent vapours, *Leath. Sci.*, 10 (1963), 179

Tested against spores of \dot{A} . *niger*, chloroform shows better fungistatic property in comparison to acetone and ethyl alcohol. Exposing leather pieces to chloroform vapour for 24 hr (0.75-1 ml./litre capacity) in closed container would be useful in combating mould growth on leather goods.

113. JANARDHANAN, K. K., GANGULY, D., BARUAH, J. N. & RAO, P. R. (Regional Research Laboratory, Jorhat): Fungitoxicity of extracts from tannin-bearing plants, Curr. Sci., 32 (1963), 226

Tannin extracts of about a dozen tannin-bearing plants have been tested for their fungitoxicity to *Piricularia oryzae* Cav. and *Colletotrichum falcatum* Went, the respective causal agents of blast of rice and red-rot of sugarcane. Extracts from *Acacia arabica* Willd., *Emblica officinalis* Gaertn., *Terminalia arjuna* W. & A. and *Terminalia belerica* Roxb. have shown maximum toxicity, the extracts being toxic even at a concentration of 0.1 g./litre.

58:633.88 Medicinal Plants

114. KAPOOR, L. D., DUTT, A. K. & SARIN, Y. K. (Regional Research Laboratory, Jammu): Experimental cultivation of *Dioscorea deltoidea* Wall. in Kashmir, *Indian For.*, 89 (1963), 622

wall. in Kashmir, Indian For., 69 (1965), 622 Experimental cultivation of *Dioscorea deltoidea* Wall. has been taken up recently in Kashmir. The performance of the plant under cultivation, the growth of the tuber from 50 to 900 g. in 18 months and the diosgenin content of 2.3 per cent indicate that the plant can be successfully cultivated under the climatic conditions prevalent in Kashmir.

58:668.5 Essential Oils

115. SARIN, Y. K. & KAPOOR, L. D. (Regional Research Laboratory, Jammu): Some additions to the essential oil-bearing plants from North-west Himalayas, *Perfum. essent. Oil Rec.*, 54 (1963), 437

During a general survey of medicinal, quasi-medicinal and aromatic plants in Jammu and Kashmir and Punjab Himalayas, a number of plants have been collected, which possess an aroma of varied intensity in the field and are used for various purposes by the local inhabitants. On chemical and pharmacological screening of these plants quite encouraging results were obtained. This paper introduces four of these, viz. Prangos pabularia Lindl., Seseli sibiricum Benth., Heraclium candicans Wall. and Selinum vaginatum C. B. Clark, all belonging to the family Umbelliferae.

59 ZOOLOGY

591.1 Physiology

116. BANERJEE, SACHCHIDANANDA & BANDYO-PADHYAY, ASOK (Department of Physiology, Sardar Patel Medical College, Bikaner): Further observations on plasma lipids of vegetable oil fed monkeys, Proc. Soc. exp. Biol., N.Y., 113 (1963), 541

Plasma and fecal lipids and plasma insulin-like activity of Rhesus monkey fed sesame oil (iodine No. 110), mustard oil (iodine No. 104) and coconut oil (iodine No. 9), with and without cholesterol addition, have been determined after 8 months' feeding. Plasma cholesterol of monkeys fed different oils did not change considerably during the experiment. There was a slight increase at the initial stage but it decreased below the basal values after 8 months of feeding the oils irrespective of their saturation or unsaturation. Plasma cholesterol of monkeys fed cholesterol along with the oils increased considerably but the increase was highest when sesame oil was fed. Plasma β-lipoprotein cholesterol increased in proportion to total plasma cholesterol after the oils were fed. After an initial increase, plasma triglycerides decreased to normal level at the end of fifth month of feeding the oils. The same was true for the plasma non-esterified fatty acids. There was an overall increase in plasma phospholipids in all monkeys. Monkeys fed cholesterol along with oils had increased non-esterified fatty acid values of plasma possibly due to diminished plasma insulin. Fecal total lipid, Lieberman-Burchard reacting sterols and bile acid excretion diminished gradual-ly in all the monkeys. Fluctuations in plasma cholesterol in cholesterol-fed monkeys could be correlated with fecal excretion of sterols and bile acids.

591.4 Morphology

117. RASTOGI, MANJULA (Department of Zoology, Meerut College, Meerut): The head-skeleton of Indian schilbeid, *Clupisoma garua* (Ham.), *J. Morph.*, 113 (1963), 1

The skull of *Clupisoma garua* has been described laying stress on the topographical disposition of different bones.

591.8 Cytology

118. SESHACHAR, B. R. & KASTURI BAI, A. R. (Department of Zoology, University of Delhi, Delhi): Cytology of a new species of Oxytricha, Arch. Protistenk., 106 (1963), 456

An account of binary fission of a hitherto undescribed species of Oxytricha is given. It differs markedly from the other known species of the genus in the structure of its nuclear apparatus. The vegetative animal has a macronucleus formed of three oval bodies and a variable number of micronuclei. During fission, the three oval macronuclear bodies fuse into a single condensed mass which later elongates and divides into two. These two halves of the macronucleus again divide into two each, followed by cytotomy. The daughter individuals are provided with two macronuclear bodies, one anterior and the other posterior, and seven to fourteen micronuclei. Twenty-four hours after fission, the posterior macronuclear body divides again and the adult condition of three macronuclear bodies is reached. The micronuclei, distributed at random in the vegetative animal, assume a definite orientation during fission. They always arrange themselves in a linear row on one side of the condensed macronucleus and divide mitotically. They also show a striking synchrony in their division. Apparently, the cytoplasm plays a part in the induction of micronuclear mitosis. Amicronucleate forms which do not appear to differ from the normal ones are encountered frequently.

119. SUSHEELA, A. K. (Division of Animal Physiology & Histochemistry, Department of Zoology, M.S. University of Baroda, Baroda): The cellular organization and certain metabolite and enzyme contents of the goat diaphragm, J. Anim. Morph. Physiol., 10 (1963), 63

The cellular nature of the goat diaphragm has been studied and the presence of three types of fibres noted. The localization of the enzymes lipase and succinic dehydrogenase has been histochemically demonstrated in the fibres. The fat content, lipase and succinic dehydrogenase activity have been estimated quantitatively regionwise and practically no differences among the different regions were found, unlike what was observed in the rat diaphragm. The nature of the cellular organization of the goat diaphragm has been correlated with the low respiratory rate and metabolic rate of the animal.

592 Taxonomy

120. SESHACHAR, B. R. & SAXENA, K. N. (Department of Zoology, University of Delhi, Delhi):

Free amino acids and related compounds in different species of Blepharisma Perty (Ciliata:

Spirostomatidae), Physiol. Zool., 36 (1963), 174 The distribution of free amino acids and related compounds in six species of Blepharisma has been studied to understand the taxonomic and phylogenetic significance of these compounds. Each species showed varying degrees of fluctuation in the qualitative pattern of these compounds in different batches of individuals. These amino compounds can be arranged into four categories according to the degree of constancy in their presence in different batches of individuals of a species. The first category includes the following ten compounds detected in all the batches of individuals of each species: serine/glycine, alanine, glutamic acid, aspartic acid, cysteic acid, valine, tyrosine, leucine/isoleucine, and two unidentified compounds X1 and X2. The second category includes threonine and lysine which were detected in all the samples of B. japonicum, B. americanum and B. tropicum, but they were occasionally absent in a few batches of B. inter-medium, B. Seshachar and B. undulans. The amino acids belonging to the third category are citrulline and histidine which were found in 50 per cent of the batches of individuals of each species. The fourth category includes taurine which was occasionally detected in a few batches of B. intermedium and B. Seshachar but in none of the samples of the remaining four species. The fluctuation in the amino compounds of the last three categories appears to be due to differences in the metabolic condition of the animals at the time of test. The six species of Blepharisma thus seem to differ from one another in the metabolic processes which involve appearance or disappearance of threonine, lysine and taurine.

593.1 Protozoa

121. SINGH, B. N., DAS, S. R. & SAXENA, (Miss) USHA (Central Drug Research Institute, Lucknow): Virulence of strains of Entamoeba histolytica from India, with an account of a method for obtaining cent per cent infection in rat, Ann. Biochem., 23 (1963), 237

A method has been described for obtaining large number of healthy and young trophozoites of Entamoeba histolytica for intra-caecal inoculation. It has been found that cent per cent of the young rats inoculated with large number of these amoebae get infected. Three strains of E. histolytica, isolated from acute cases of amoebic dysentery, were found to be virulent to rat. Two of these strains became non-invasive on prolonged cultivation in culture. Out of the four strains isolated from carrier cases. three showed different degrees of virulence and the fourth one appeared to be non-invasive.

61 MEDICAL SCIENCES

611.6 Urogenital System

122. KAR, A. B. & KAMBOJ, V. P. (Central Drug Research Institute, Lucknow): Sterilization of males by scrotal inunction of cadmium chloride.

J. Reprod. Fert., 5 (1963), 461 Scrotal inunction of 20 or 40 per cent CdCl₂ in aqueous or aqueous-glycerine medium in rats caused irreversible destruction of the seminiferous epithelium but temporary degenerative changes in the interstitial elements; a 5 per cent solution was ineffective. The residual spermatozoa in the genital tract were immobilized and disintegrated almost simultaneously with tubular degeneration. These changes are comparable in nature and magnitude to those observed after subcutaneous (or intratesticular) administration of the salt, but the tempo of their appearance is somewhat slower after inunction. The possible importance of the vehicle for effective application of CdCl₂ and the prompt appearance of degenerative changes in the testes are emphasized.

123. PRAHLAD, K. V. & KAR, A. B. (Central Drug Research Institute, Lucknow): New evidence against the putative anti-implantation effect of metaxylohydroquinone, Fert. & Ster., 14 (1963), 372

Timed administration of metaxylohydroquinone during the first trimester of pregnancy in rats and employment of the delayed implantation procedure have demonstrated that the drug has no antiimplantation effect.

612.018 Hormones

124. KARKUN, J. N., KAR, AMIYA B. & SEN, D. P. (Central Drug Research Institute, Lucknow): Some extra-pigmentary effects of melanophorestimulating hormone, Ann. Biochem., 23 (1963), 253

Highly purified α - and β -MSH were administered to young male and female albino rats for the study of their effect on the thyroid, parathyroid, adrenal and the gonad. The thyroidal response was in-consistent and seemed to depend on the sex, dose and type of MSH administered. No effect on adrenals was discernible over a wide dose range. The ovarian weight was significantly reduced after β-MSH treatment. Parathyroid of females was particularly reactive to 3-MSH also; parenchymal hypertrophy was the predominant feature. Both aand β-MSH forms seemed to arrest spermatogenesis in early puberal rats. The possible significance of these findings is discussed.

612.39 Nutrition

125. JOSEPH, A. A., ROY CHOUDHURI, R. N., INDIRAMMA, K., NARAYANA RAO, M., SWAMI-NATHAN, M., SREENIVASAN, A. & SUBRAH-MANYAN, V. (Central Food Technological Research Institute, Mysore): Amino acid composition and nutritive value of the proteins of different varieties of potato, Food Sci., 12 (1963), 255

The essential amino acid composition of the proteins of three varieties of potato, President, Up-to-date and Great Scot, grown in India has been determined by chemical and paper chromatographic methods. The proteins of the different varieties of potato were found to be rich in lysine. The total sulphur amino acid content of President potato was higher than that of the Up-to-date or Great Scot varieties. The protein efficiency ratio of the proteins of President variety (1.99) was significantly higher than that of Up-to-date (0.95) and Great Scot (1.23) varieties. There were no significant differences in the protein efficiency ratio of the proteins of cooked potato and potato flour.

126. ROY CHOUDHURI, R. N., JOSEPH, A. A., AMBROSE DANIEL, V., NARAYANA RAO, M., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Effect of cooking, frying, baking and canning on the nutritive value of potato, *Food Sci.*, 12 (1963), 253

The effect of cooking in water, deep-fat frying, baking and canning on the chemical composition of three commercial varieties of potato, President, Up-to-date and Great Scot, has been studied. The protein (N 6.25) contents per 100 g. of raw, cooked, baked, fried and canned potato on fresh weight basis were 1.96, 1.93, 2.43, 3.73 and 1.6 per cent respectively. The loss of protein as a result of c-anning was c. 22 per cent. The vitamin C content/ 100 g. of raw, cooked, baked, fried and canned potato was 14.6, 11.6, 8.6, 13.2 and 4.6 mg. respectively. The losses of vitamin C as a result of different processing methods were as follows: cooking in water, 20-28; deep-fat frying, 50-59; canning, 65-70; and baking, 50-56 per cent.

127. ROY CHOUDHURI, R. N., JOSEPH, A. A., SREENIVAS, H., PAUL JAYARAJ, A., INDIRAMMA, K., NARAYANA RAO, M., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Nutritive value of poor Indian diets based on potato, Food Sci., 12 (1963), 258

The nutritive value of poor Indian diets based on three varieties of potato, viz. President, Up-to-date and Great Scot, with and without calcium supplement, has been evaluated by growth studies in albino rats as compared with poor rice diet. The beneficial effect of partial replacement of rice in rice diet by potato to the extent of 25 per cent was observed only in studies where the diets were supplemented with calcium; such a beneficial effect was not observed in the case of diets not supplemented with calcium. The livers of rats fed diets based on potato, rice or their mixtures showed parenchymal damage of the mild protein deficiency type and cytoplasmic vacuolation of the same order as those observed with poor rice diet. The histological changes in the livers of rats receiving diets supplemented with calcium were less severe than those of rats receiving the unsupplemented diets.

128. TASKER, P. K., JOSEPH, K., RAJAGOPALA RAO, D., NARAYANA RAO, M., INDIRAMMA, K., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Effect of feeding groundnut protein fortified with limiting essential amino acids on growth and composition of liver, blood, carcass and certain liver enzymes in albino rats, Ann. Biochem., 18 (1963), 279

Groundnut protein fortified with L-lysine, DLmethionine, L-threonine and L-tryptophan and at 10 per cent protein intake possesses a protein efficiency ratio (3·16) comparable to that of casein (3·06). No significant differences have been observed in the haemoglobin content and RBC count of blood, serum protein content, or in the mean fat, moisture, protein, RNA and DNA contents, xanthine and succinic oxidase activities of the liver of rats receiving the diets containing 10 per cent protein as casein or groundnut protein isolate fortified with amino acids. The results indicate that groundnut protein contains adequate amounts of all essential amino acids except those employed for fortification.

615 Pharmacology

129. GOKHALE, S. D., GULATI, O. D., KELKAR, V. V. & JOSHI, N. Y. (Department of Pharmacology, Medical College, Baroda): Effect of bretylium and guanethidine on some cholinergic effectors, Arch. int. Pharmacodyn., 145 (1963), 243

The effect of bretylium and guanethidine on cholinergic effectors has been studied using the rabbit and the rat intestine, the rabbit tracheal chain and the frog rectus as test preparations. The drugs reduced the responses of the rabbit and rat ileum, to acetylcholine. The inhibitory effect of guanethidine is probably mediated through a block of autonomic ganglia. The inhibitory effect of bretylium is not easily explained. Responses of the tracheal chain to acetylcholine were reduced by bretylium and guanethidine. Higher concentrations of bretylium had a stimulant action on the bronchial smooth muscle. Bretylium and low concentrations of guanethidine potentiated the responses of the frog rectus to acetylcholine. In addition bretylium exerted an 'anticurare' effect. Higher concentrations of guanethidine reduced acetylcholine responses.

130. GOKHALE, S. D., KELKAR, V. V. & GULATI, O. D. (Department of Pharmacology, Medical College, Baroda): Some observations on the possible mediation of carbon tetrachloride hepatotoxicity through the central nervous system, Arch. int. Pharmacodyn., '144 (1963), 423

Intracerebral injection of minute amounts of carbon tetrachloride has been found to produce effects typical of systemically administered carbon tetrachloride. An intraventricular injection of carbon tetrachloride in anaesthetized cats caused relaxation of the isolated blood-bathed rat stomach strip suggesting a peripheral release of catecholamines. Spinal section at C_2 abolished this effect of carbon tetrachloride. The effect of carbon tetrachloride was also absent in animals subjected to bilateral adrenalectomy indicating the adrenal medulla as the probable site of catecholamine release. It is

suggested that there is a central component to the hepatotoxic action of carbon tetrachloride and that this component is mediated through a peripheral release of catecholamines probably from the adrenal medulla.

131. PAUL, S. P., BOSE, A. N. & BASU, U. P. (Bengal Immunity Research Institute, Calcutta): Synthesis of biguanides as potential hypoglycaemic agents: Part IV—Structure-activity relationship, *Indian J. Chem.*, 1 (1963), 218 Three new biguanides, viz. N¹- α -isopropyl- β -phene-

Three new biguanides, viz. N¹- α -isopropyl- β -phenethyl-, N¹- α -isopropyl- β -phenethyl-N⁵- ρ -chlorophenyland N¹- α -*n*-butyl- β -phenethyl-biguanides, have been synthesized following the procedure reported earlier. Structure-activity relationships have also been deduced on the basis of hypoglycaemic activity determinations on 27 mono- and disubstituted biguanides. Hypoglycaemic activity is more when the substitution with β -phenethyl imparts the maximum activity to biguanides. However, substitution at N⁵ reduces the hypoglycaemic activity. Toxicity increases with increase in hypoglycaemic activity but not vice versa. A decrease in toxicity has been noticed when N¹-phenyl is replaced by N¹- ρ -substituted phenyl groups.

132. SAXENA, (Miss) USHA, DAS, S. R. & SINGH, B. N. (Central Drug Research Institute, Lucknow): Effect of new potential antiamoebic compounds and a plant extract on *Entamoeba* histolytica in vitro and in amoebiasis of rat, Ann. Biochem., 23 (1963), 231

Seventy-two new compounds belonging to Mannich bases of substituted phenols, anilides, pyrimidines, quinoxalines substituted p, p'-diamino-m, m'-dimethyldiphenylmethanes, substituted 1,5-diamino pentanes, 1,4-disubstituted piperidines and 1,4-disubstituted 3-ethyl-piperidines were tested against Entamoeba histolytica in vitro. Thirty-six of them were active in dilutions ranging from 1/1000 to 1/16,000. The remaining ones were inactive in 1/1000 dilutions. Eight compounds showing in vitro activities between 1/4000 and 1/16,000 were tested in experimental amoebiasis of rat. Only one showed slight activity and the remaining ones were inactive. Thirteen compounds belonging to Mannich bases of bi-anaphthyl, thiazoline, thiazolidine and camoform analogues of stilbene series and four extracts of Cissampelos pareira plants were tested in vivo. All of them were inactive.

133. VOHRA, M. M. & DE, N. N. (Central Drug Research Institute, Lucknow): Comparative cardiotonic activity of Carissa carandas L. and Carissa spinarum A. Dc., Indian J. med. Res., 51 (1963), 937

Evidence of positive inotropic activity in the extractives from root, stem and leaf of two species of Carissa, *Carissa carandas* and *Carissa spinarum*, has been obtained on hypodynamic guinea-pig heart and isolated papillary muscle preparation of a cat. The electrocardiographic changes produced in cats were typical of a cardenolide. The emetic and musculotropic activity were also studied. On the whole, cardiotonic activity present in C. spinarum is 4-6 times greater than that of C. carandas.

615.1 Pharmacy

134. MITRA, (Miss) R. K. & RAY, G. K. (Central Drug Research Institute, Lucknow): Estimation of aminopyrine and phenylbutazone in pharmaceutical preparations, *Indian J. Pharm.*, 25 (1963), 262

Suitable methods for the estimation of aminopyrineand phenylbutazone in tablets and injectables have been developed. From tablets, aminopyrine was extracted with 1N HCl, the extract was neutralized and treated with phosphomolybdic acid solution under specific conditions to develop the colour for the estimation of aminopyrine colorimetrically using a filter of 720 m μ . Phenylbutazone was estimated gravimetrically after extracting it from the residue with chloroform. In the case of injectables phenylbutazone was precipitated out by careful addition of hydrochloric acid to the hot injectable and estimated gravimetrically while aminopyrine remaining in the filtrate was assayed colorimetrically asabove.

135. SRIVASTAVA, S. K., SRIVASTAVA, B. B. P., RAY, G. K. & MUKERJI, B. (Central Drug Research Institute, Lucknow): Colorimetric estimation of atropine in pharmaceutical preparations, *Indian J. Pharm.*, 25 (1963), 304

A simple method for the estimation of atropine in atropine injection, ointment and tablet has been worked out. The method is based on the quantitative relationship between the concentration of atropine and the colour intensity of its chloroform soluble complex formed with bromocresol green solution at ρ H 5-6. The method is applicable in the concentration range of 20-120 µg, of atropine.

615.43 Pharmacognosy

136. ABROL, B. K. & KAPOOR, L. D. (Regional Research Laboratory, Jammu): Pharmacognosy of roots of *Prangos pabularia* Lindl., *Planta* med., 11 (1963), 128

The roots of Prangos pabularia are c. 16 cm. long and up to 4 cm. in diam., possessing sweet aromatic odour. A t.s. of the root is characterized by the presence of several layers of cork, a wide parenchymatous region containing numerous secretory oil cavities. Wood region formed by secondary growth is the principle tissue of the root. Xylem vessels possess reticulate thickenings on their walls. The medullary rays run in a wavy manner. Oil canals, towards the peripheral slide, are frequently filled with resinous matter. Cells of the oil canals and those of the medullary rays towards the periphery contain essential oil. The powder is characterized by the presence of broken or whole xylem vessels having reticulate thickenings, broken or whole oil canals, stone cells of varying types, broken parenchymatous cells and masses of resinous matter.

615.779 Antibiotics

137. GUPTA, V. S., PRABHAKARA RAO, A. V. S. & NARASIMHA RAO, P. L. (Department of Biochemistry, Indian Institute of Science, Bangalore): Antibiotic principles of *Garcinia morella*: Part VI — Antiprotozoal activity of α- and β-guttiferins and allied compounds, *Indian J. exp. Biol.*, 1 (1963), 146

Guttiferins (α -, β -, ∂ -, X- and Y-), α -guttiferic acid, ∂ -guttiferinic acid and hexahydro- α -guttiferin exhibit pronounced *in vitro* antiprotozoal activity towards non-pathogenic ciliate organisms, β - and Y-guttiferins being the most active. No relationship is observed between the antibacterial and antiprotozoal activities of these compounds, indicating thereby that different structural parameters in the compounds are responsible for the antibacterial and antiprotozoal activities.

616.1 Cardiovascular System

138. MAJUMDAR, A. C., SEN, RAMANUJ & MATHUR, P. D. (Central Drug Research Institute, Lucknow): Some observations in relation to properdin system: Part III — Relation between serum properdin level and antituberculous drug therapy in human pulmonary tuberculosis, Ann. Biochem., 23 (1963), 305

Serum properdin levels of some pulmonary tuberculous patients have been estimated. The effects of conventional combined therapy of INH with PAS (Ca salt) and that of INH and streptomycin sulphate have been correlated with the serum properdin level and the liver function of tuberculous subjects. A combined INH and streptomycin sulphate therapy was found to be superior to INH and PAS conjugation for the betterment of liver function as it raises the serum properdin level of tuberculous patients. The conventional classification of the patients (condition in stages of disease) has got no relation with the properdin level.

139. SEN, RAMANUJ & MAJUMDAR, A. C. (Central Drug Research Institute, Lucknow): Some observations in relation to the properdin system: Part II — Studies on the behaviour of some components of guinea-pig serum complement in relation to their preservation for the purpose of its use in properdin assay, Ann. Biochem., 23 (1963), 271

The effects of preservation of guinea-pig serum complement on some known essential components of complement have been studied. Freeze-drying (-20°C.) has been found to have a deleterious effect on the third component of the complement (C₃), thereby hindering haemolysis and assay of properdin. Guinea-pig serum preserved in equal volume of $10 \times VSB$ (Ca²⁺) buffer is best suited for studying its efficacy in a haemolytic system. For evaluation of C'H₅₀ and C'IH₅₀ values of guineapig serum which are used for the assay of properdin, the best preservative was found to be $10 \times VSB$ without Ca²⁺ and Mg²⁺ ions. A new serum factor has been suggested which is essential to affix complement with inulin and properdin. It is different from the presently recognized components of the complement which comprise the haemolytic system. This factor is best preserved in $10 \times VSB$ having no divalent cations (Ca²⁺ and/or Mg²⁺).

140. SRIVASTAVA, G. N., ROY, A. K., CHAKRAVARTI, R. N. & ZAIDI, S. H. (Central Drug Research Institute, Lucknow): Induction of blood hypercoagulability and thrombosis, *Indian J. med. Res.*, **51** (1963), 661

Three systemic factors, arterial wall damage (DHT), dietary fats (butter) and acute haemodynamic change (adrenaline), have been investigated for producing blood hypercoagulability and arterial thrombosis. Butter and DHT feeding caused significant shortening of plasma prothrombin time and retardation of plasma fibrinolytic activity. Adrenaline did not alter the prothrombin time, but tended to increase the plasma fibrinolysis. Coronary thrombosis was produced as a result of the combined effects of all the three systemic factors. DHT administration produced a rise of serum cholesterol and lipid phosphate, but the other factors had no effect on these parameters.

616.5 Dermatology

141. THYAGARAJAN, T. R., SRIVASTAVA, O. P. & VORA, V. C. (Central Drug Research Institute, Lucknow): Some cytological observations on the effect of griseofulvin on dermatophytes, *Naturwissenschaften*, **50** (1963), 524

The effect of griseofulvin on five ringworm fungi has been investigated. Cytological changes seen in the growing regions of the fungi appear to be similar in certain respects to those reported for colchicine in higher organisms. The abnormalities observed in the process of nuclear division and in nuclei suggest the possibility of a disturbance in the synthesis of nucleic acid affecting the general cell mechanism. Since the older mycelia are not affected by griseofulvin, it is possible that these cells may reinfect the tissues when the antibiotic treatment is discontinued.

62 ENGINEERING

621.317 Instruments & Data Handling System

142. BALAKRISHNA, S. & SRINATHKUMAR, S. (National Aeronautical Laboratory, Bangalore): Pressure transducers using the linear differential transformer, *Tech. Note No. TN-SE-3-63* (National Aeronautical Laboratory, Bangalore), 1963

A pressure transducer is described which uses a linear variable differential transformer to sense the displacement at the centre of a diaphragm subjected to the pressure being measured. Design details of the transducer are given including complete specifications for the differential transformer and the electronic circuit used for indication. The diaphragm of the transducer is changed to get different full-scale pressure ranges. The accuracy of the transducer in all ranges is better than ± 1 per cent.

143. SRINIVASAN, R. (National Aeronautical Laboratory, Bangalore): Development of a ramp type digital voltmeter, *Tech. Note No. TN-SE-4-63* (National Aeronautical Laboratory, Bangalore), 1963

A ramp type digital voltmeter has been designed and constructed in the laboratory, which can measure voltages from 0 to 10 V. at the input with an accuracy of 1 per cent (full scale). The output is visually displayed in decimal notation, the time taken for conversion being 1 sec. or less. The main design and performance features of the digital voltmeter are discussed.

621.375:621.38 Amplifiers

144. NAGABHUSHANA, S. & KRISHNAN, A. (National Aeronautical Laboratory, Bangalore): Drift reduction in d.c. amplifiers, *Electron. Engng*, 35 (1963), 614

The paper describes a very simple method of heater voltage stabilization using a thermistor with negative temperature coefficient of resistance and a lamp of appropriate characteristics. The drift reduction factor as compared to an a.c. heated tube (1 per cent servoregulated) is about 3-6 in most cases.

621.38 Electronics

145. HASHMI, S. Z. R. (Hyderabad Science Society, Hyderabad): A transistorized system for instantaneous measurement of varying or fixed frequencies, *Indian J. pure appl. Phys.*, 1 (1963), 340

A transistorized digital frequency determination system developed using a simpler technique is described and circuit details of various units, employing readily available components, are given. Values of fixed frequencies or instantaneous values of varying frequencies in the range 5-200 kc/s. can be determined in a minimum period of 512 µsec. The accuracy increases as the magnitude of the known timing interval is increased (up to 5120 µsec.). The range of frequency can be easily extended to the megacycle region by using fast switching transistors.

146. MEHENDRU, P. C. & PARSHAD, R. (Electronics Division, National Physical Laboratory, New Delhi): An observation in maximizing the output of a crystal detector in microwave measurements, *Indian J. pure appl. Phys.*, 1 (1963), 271

The signal output power of a crystal detector in a microwave detector-mount under matched load conditions has been found to depend upon its spatial position in the mount. This observation suggests that by proper adjustment of the position of the detector the signal strength can be improved by about 3 db.

621.38:681.828 Electronic Devices

147. BALAIN, K. S. (Central Electronics Engineering Research Institute, Pilam): Fabrication of fused silicon diode, J. Instn Telecomm. Engrs, 9 (1963), 209

Fabrication of a commercial type of fused silicon diode from an n-type material of resistivity 10 ohmcm. is described. The design is such that it will give about 150 ma. at 1 V. and will have a high breakdown voltage and high rectification ratio. For p-type doping of n-type silicon, results of several alloys are discussed. The complete details of fabricating the diode, i.e. slicing, etching, alloying and of testing the diode characteristics, are presented.

148. BALAIN, K. S. (Central Electronics Engineering Research Institute, Pilani): Fabrication of a germanium computer diode, J. Instn Telecomm. Engrs, 9 (1963), 249

A small area, high-frequency germanium junction type diode has been fabricated and tested. The starting material is N-type of resistivity 0-1 ohm-cm. The typical diode fabricated gives a current of 150 ma. at C-6 V. in the forward direction. The breakdown voltage is in the range of 25 V. Tests show that the diode rectifies well up to a frequency of 70 Mc.

621.51 Air Compressor

149. MURTHY, M. L. R., MADAPPA, C. T., KALYANARAMAN, V. & ACHARYA, Y. V. G. (National Aeronautical Laboratory, Bangalore): The unitary compressor-dryer system of the wind tunnel centre of the National Aeronautical Laboratory, *Tech. Note No. TN-AE-19-63* (National Aeronautical Laboratory, Bangalore), 1963

The essential design features of the NAL unitary compressor-dryer system have been described. Two centrifugal compressors driven by slip ring induction motors serve to supply 20,000 cu. ft of free air at 160 p.s.i.g. A dual-type air dryer of sufficient capacity ensures continuous supply of dry compressed air for the aerodynamic facilities. A water treatment and cooling plant handles the circulating water necessary for cooling the compressor-dryer equipment. A 5000 kW. substation supplies power to the compressor motors and other installations at the centre. The equipment and connected maintenance shops and stores are housed in one building.

621.548 Wind Power

150. RAMANATHAN, R. & VISWANATH, S. (National Aeronautical Laboratory, Bangalore): A study of the hourly wind speeds at Jodhpur from the point of view of wind power utilization, *Tech. Note No. TN-WP-29-63* (National Aeronautical Laboratory, Bangalore), 1963

The hourly wind speeds for 1958-60 at Jodhpur (Rajasthan) have been analysed to assess the wind power potentiality of the site. The annual mean wind speed at Jodhpur is 9 km.p.h. The estimated annual energy output of a wind-driven machine having a cut-in speed of 8 km.p.h., swept area 30 sq. m. and overall power coefficient 12 per cent is 789 kWh. The average quantity of water that a WP-2 windmill of overall power coefficient 12 per cent and swept area 23.6 sq. m. can pump works out to 23,000 kl. a year or 14,000 gal. per day.

151. SIVARAMAN, K. R. & VENKITESHWARAN, S. P. (National Aeronautical Laboratory, Bangalore): Utilization of wind power for irrigation of crops in India with special reference to the distribution of wind and rainfall, *Tech. Note No. TN-WP*-30-63 (National Aeronautical Laboratory, Bangalore), 1963

The use of water-pumping windmills for irrigation of crops has been examined vis-*à*-vis the distribution of wind and rainfall in various parts. The monthly quantities of water that can be pumped by a WP-2 windmill at 16 places in India have been compared; the comparison of the water pumped against the monthly rainfall at these places shows that at most of the places under study, the water pumped is maximum when the rainfall is minimum. The trials with a 6 kW₅, 220 V. d.c. Allgaier wind electric generator at an agricultural farm at Porbandar for pumping water for irrigation show that the cost of pumping water is less than half that by a 10 h.p. diesel engine.

621.694 Ejectors

152. SURENDRAIAH, M. & RAO, D. M. (National Aeronautical Laboratory, Bangalore): Performance of a two-dimensional centre-jet ejector, *Tech. Note No. TN-AE-18-63* (National Aeronautical Laboratory, Bangalore), 1963

The results of exploratory experiments carried out to determine the performance of a two-dimensional centre-jet ejector are presented. With a fixed sonic primary jet, a range of area ratios, primary and secondary flow pressure ratios and mixing lengths were investigated. The present results lead to a tentative conclusion that this type of ejector is potentially more efficient than a wall-jet type.

624.13 Soil Mechanics

153. ANAND, H. N. & MAKOL, R. L. (Central Building Research Institute, Roorkee): Comparison of triaxial compression test and field plate loading test for bearing capacity of solids, *Mat. Res. & Stand.*, 3 (1963), 201

The stress-strain relationships obtained from the field plate loading test and laboratory undrained triaxial compression tests have been compared. A correlation has been found to exist between the degrees of saturation and the ratio of stress from field to laboratory tests. Clays have been shown to behave as elastic materials under saturated conditions.

154. DEB, A. K. & SUBHASH CHANDRA (Central Building Research Institute, Roorkee): Remedial measures for the prevention of recurrent cracking in small buildings founded on black cotton soil, *Indian Concr. J.*, (1963), 190

cotton soil, Indian Concr. J., (1963), 190 A simple method proposed for the prevention of recurrent cracking in small buildings founded on black cotton soil is directed at keeping the moisture content in the soil immediately under and around the building as constant as possible so as to minimize ground movements. Vertical sand drains connected by surface channels are placed about 6 ft on centres all around the affected building, waste water from the building being allowed to flow into them. A lime concrete form laid on a polythene membrane may be added between the walls of the building and the sand drains to retard loss of moisture by evaporation as much as possible.

155. DINESH MOHAN, JAIN, G. R. S. & VIRENDRA KUMAR (Central Building Research Institute, Roorkee): Load bearing capacity of piles, *Geotechnique*, 13 (1963), 76

An approach is presented to the prediction of the bearing capacity of piles in advance of piling operations by the use of static cone penetration tests. The study has been carried out on cast in situ driven concrete piles. The distribution of skin friction and point resistance at various loads was determined by measuring strains with wire resistance strain gauges. The values of total skin friction and point bearing were also determined independently at different loads by adopting a cyclic load test technique. Pull out tests were made to determine the frictional resistance under pulling, and the values obtained under pushing during the load test. The coefficients of earth pressure were also determined from the friction values obtained during the load tests and were found to decrease from a value equivalent to the passive earth pressure state at the top to a lower value at the bottom. The data available on the frictional resistance of piles revealed that in soils of average stiffness (cone penetration values of 10-100 kg./sq. cm.) the value of unit skin friction of a pile is roughly 2 per cent of the average cone penetration resistance along the pile length.

156. MAZUMDAR, B. C. & BANERJEE, K. P. (Central Road Research Institute, New Delhi): Use of silty soil as a filler in bituminous concrete, *Indian Roads Congr.*, 27 (1963), 403

Details of experiments carried out to find out the potentialities of the use of silty soil as a mineral filler in the hot-mix bituminous concrete are presented. It has been found that silty soils with PI value in the region of 14 can be successfully used as a filler.

157. NATARAJAN, T. K. & PALIT, R. M. (Central Road Research Institute, New Delhi): Thixotropy in soil mechanics, J. Indian nat. Soc. Soil Mech., 2 (1963), 199

Thixotropy has been shown to be of general occurrence in Indian soils. The influence of various factors, viz. moisture, temperature, rate of strain, strain at failure, compressibility, dispersing agents, etc., on thixotropy has been studied. Some practical applications of thixotropy have been mentioned. 158. NARAHARI, D. R. & AMAR SINGH (Central Building Research Institute, Roorkee): Surcharge effect in load tests, J. Indian nat. Soc. Mech. Found. Engng, 2 (1963), 78

Model load tests on sand have been conducted to determine the effect of the size of pit in a load test. The results show that the peak load, the deformation at peak load and the load deformation characteristics are all a function of the size of pit.

159. RAMACHANDRAN, V. S., KACKER, K. P. & RAO, H. A. B. (Central Building Research Institute, Roorkee): Determination of liquid limit of soils by dye adsorption, *Soil Sci.*, 95 (1963), 414

The usual method of determination of liquid limit is time consuming. Liquid limit of a soil varies linearly with the clay mineral content. Since the amount of dye adsorption varies linearly with the clay mineral content, it provides a quick method for the determination of liquid limit.

62: 523.72 Solar Radiations

160. CHOUDHURY, N. K. D. (Central Building Research Institute, Roorkee): Solar radiations at New Delhi, Solar Energy, 7 (1963), 44

The salient characteristics of solar radiation reaching New Delhi have been studied. The hourly intensities during summer and winter, of direct, diffuse and total radiations and the variations in the derived transmission coefficients indicate the nature of atmospheric pollution. When the atmosphere is cloud and dust free an approximately linear relation is observed between direct and diffuse transmission coefficient. On cloudy days also certain relationships between the two components of radiations exist. The relationships obtained for New Delhi are in close agreement with those derived by Lieu and Jordan. Their procedure is thus extended to tropical countries.

62:532 Fluid Mechanics

- 161. KUBAIR, VENUGOPAL & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Secondary flow in helical coils, Indian J. Technol., 1 (1963), 333 The intensity of circulation of fluids in coiled pipes has been shown to be a function of curvature ratio (the ratio of inner diameter of the tube to the mean diameter of the helical coil) and the ratio of length to diameter (L/D) of the coil. The diametrical pressure drop which determines the rate of vortex flow in coiled pipes increases with the curvature ratio and falls with increase in L/D ratio. Diametrical pressure drop data obtained for two helical coils of different curvature ratios have been found to agree within 9 per cent with the equation for pipe bends reported by D. L. Yarnell and T. A. Ngler [Proc. Amer. Soc. civ. Engrs, 60 (1934), 792]. The use of coiled pipes as flow meters is also indicated with limitations.
- 162. KUBAIR, VENUGOPAL & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Pressure drop and heat

transfer in spiral tube coils, Indian J. Technol., 1 (1963), 336

A critical analysis has been made of pressure drop and heat transfer in spiral tube coils. Correlations have been derived between friction factor and curvature ratio under different conditions of flow and compared with known data. It has been shown that equations similar to McAdam's equation $[N_{Nu} =$ $\{1+3.54(D_i|D_c)\}N_{Re}^{nN}P_r^{n}\}$, where N_{Nu} is Nusselt number; N_{Pr} , Prandtl number; D_i/D_c , curvature ratio; and N_{Re} , Reynolds number, may hold good for the determination of heat transfer coefficient in spiral tube coils.

163. NANDA, R. S. & SHARMA, V. P. (Department of Mathematics, Indian Institute of Technology, Kharagpur): Free convection laminar boundary layers in oscillatory flow, J. Fluid Mech., 15 (1963), 419

The effect of harmonic oscillations in the magnitude of the surface temperature on the free-convection laminar velocity and temperature boundary layers on a flat plate has been analysed. Low- and highfrequency solutions have been developed separately. The results obtained are in striking contrast to the corresponding results for forced-convection flows.

624:691 Building Materials

- 164. REHSI, S. S. & GARG, S. K. (Central Building Research Institute, Roorkee): Evaluation of Indian fly ashes, *Indian Concr. J.*, (1963), 211 The results of investigations on samples of fly ash obtained from Bokaro, Durgapur, Kanpur and Madras to assess their suitability for use as pozzolana, as admixture or as fine aggregate in mortar and concrete are presented. All the fly ashes were found suitable for use as pozzolana replacing 20-25 per cent of cement, while none was suitable for use as admixture. The fly ashes can also be advantageously used to replace sand in mortars and concretes, thereby saving substantial quantities of cement.
- 165. SHIRSALKAR, M. M. & KAPSE, G. W. (Central Building Research Institute, Roorkee): Heat insulating and sound absorbing slabs from mineral wool, Res. & Ind., 8 (1963), 198

Slabs with good heat insulating and sound absorbing properties have been prepared from mineral wool bonded with polyvinyl resin and phenol-formaldehyde resin adhesives at the Central Building Research Institute, Roorkee. These slabs are found to be suitable for thermal insulation purposes and for use as ceiling tiles.

66 TECHNOLOGY

66.0 Chemical Technology

166. IBRAHIM, S. H. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Design of a pilot plant reactor for the manufacture of ethylene oxide from ethanol, Indian J. Technol., 1 (1963), 267 The data obtained from a benchscale unit for the production, in a single step, of ethylene oxide from ethanol have been employed for the design of a fluidized vapour phase catalytic reactor. The optimum design specifications and other operating conditions recommended for a pilot reactor are: contact period, 1.0 sec.; number of tubes, 30; diameter of tube (D), 3.0 in.; length of the bed (L), 25 in.; L/D ratio, 9.0; diameter of the outer shell, 30 in.; total height, 55 in.; and weight of the catalyst/tube, 4.5 lb.

167. IBRAHIM, S. H. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Ethylene oxide from ethanol in a single step, *Indian J. Technol.*, 1 (1963), 261

Using activated bauxite and reduced silver as catalyst and barium peroxide as promoter and oxides of nitrogen as additional oxidizing medium, it is possible to obtain ethylene oxide from ethanol in 21 per cent yield in a single step. Carbon dioxide, ethylene and acetaldehyde account for the rest of the alcohol consumed. The optimum operating conditions for the reaction are: temperature, $265-80^{\circ}$ C.; space velocity, 1800^{-hr} ; bed height, 7.5 in.; alcohol-air mole ratio, 10: 100; and catalyst particle size, -60+100 mesh.

168. IBRAHIM, S. H. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Thermodynamic and economic feasibility of manufacture of ethylene oxide from ethanol, *Indian J. Technol.*, 1 (1963), 302

The thermodynamic and economic feasibility of the manufacture of ethylene oxide from ethanol in a single step has been investigated. For a small package plant the process developed is more economical than the conventional ethylene oxidation and chlorhydrin processes. Since the maximum yield of ethylene oxide obtained in the new process is 21 per cent, the process has been shown to be economically sound only when the selling price of ethylene oxide is at least Rs 2400 per ton.

169. SARMA, B. (National Chemical Laboratory, Poona): Quantitative separation of niobium from titanium, iron, etc., from fluoride solutions, *Indian J. Technol.*, 1 (1963), 331

Niobium precipitates quantitatively as a flocculent mass when its fluoride solution is boiled with boric acid. If pyrogallol is added before the addition of boric acid, impurities other than tantalum form soluble pyrogallol complexes and remain in solution.

66.048 Evaporators

 170. NARSIMHAN, G. (National Chemical Laboratory, Poona): On the transient behaviour of multiple effect evaporators, *Trans. Indian Inst. chem.* Engrs, 19 (1962), 98

The transient behaviour of multiple effect evaporators has been analysed mathematically and equations derived for the prediction of time dependent concentration in each effect of the multiple effect system. A problem has been worked out for illustrating the necessity for allowing a certain amount of time to lapse before conditions stabilize in a multiple effect system.

661.185 Surface Active Agents

171. GUPTA, S. L. & SHARMA, S. K. (Chemistry Department, Birla Science College, Pilani): Tensammetric studies of alcohols with reference to their structural influence on surface activity, *Kolloidzschr. Z. Polym.*, 190 (1963), 40

Tensammetric studies of various aliphatic alcohols have been carried out with a view to seeing if this technique can be used to assess the structural influence on surface activity. From the study of the homologous series of aliphatic alcohols, it is seen that the surface activity increases with increase in chain length of the alcohols. With lower members of the series the desorption peak is not sharp. There is no regular shift of peak potential from methanol to amyl alcohol. For the same alcohol the surface activity increases if the carbon atoms are in a straight chain but decreases if they are branched. Primary alcohols are more surface active than secondary and secondary are more surface active than tertiary alcohols. The peak potential is more negative for normal alcohol than that of tertiary alcohols. Saturated alcohols are more surface active than unsaturated ones having the same number of carbon atoms. The peak potential is also more negative with saturated than with unsaturated alcohols. Monohydric alcohols are more surface active than trihydric alcohols having the same number of carbon atoms as in monohydric and dihydric alcohols and in this case the peak potential is more negative with trihydric than with monohydric alcohol.

172. SETHI, S. C., SUBBA RAO, B. C., KULKARNI, (Miss) S. B. & KATTI, S. S. (National Chemical Laboratory, Poona): Studies in the cashewnut shell liquid: Part II — Anionic surface active agents from cardanol, tetrahydrocardanol and their derivatives, Indian J. Technol., 1 (1963), 348

Cardanol, tetrahydrocardanol and their ethers have been sulphonated under different conditions and neutralized with various bases to give surface active agents with a wide variety of applications. Sodium ethoxycardanolsulphate has been found to be a good wetting agent and lime soap dispersant. Sodium methoxy- and ethoxytetrahydrocardanol sulphonates are very good detergents and their solutions have low surface tension and interfacial tension values. Their wetting property improves with rise in temperature, thereby making them ideal surfactants for high temperature work. Triethanolamine tetrahydrocardanol sulphonate has been found to be a good emulsifier for oil-water and water-oil systems.

662.73 Waste Utilization

173. BORDOLOI, D. N., SAIKIA, T. C., RAO, P. R. & GANGULY, D. (Regional Research Laboratory, Jorhat): Alcohol from sawdust, Res. & Ind., 8 (1963), 225

Fermentation of wood hydrolysates containing glucose, mannose, galactose, maltose and xylose using a mixture of Saccharomyces ceravisiae, S. ellipsoideus and Fusarium lini has been found to yield about 48 per cent of alcohol on the weight of sugars calculated as glucose. Used individually, none of the organisms yields more than 35 per cent alcohol.

174. GEORGE, J. & SHIRSALKAR, M. M. (Central Building Research Institute, Roorkee): Particle boards from coconut husk, *Res. & Ind.*, 8 (1963), 129

Particle boards of attractive appearance, good strength and satisfactory resistance to decay and fire have been prepared from the unretted husk of mature coconuts. The proportion of synthetic resin binder required for their preparation is only 0.5 per cent compared to 6-10 per cent required in the conventional manufacturing process. The cost of production of 1 sq. m. of board of density 6 kg./cm.³ and 1.9 cm. thickness is estimated to be Rs 3.11 as against the wholesale price of Rs 8.3-10.5 in UK. The boards may find potential application for partitions, ceilings and cheap roofings for buildings.

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662.74 Coal Technology

175. DAS GUPTA, N. N., CHATTERJEE, N. N. & BHOWMIC, B. B. (Central Fuel Research Institute, Jealgora): A rapid method for the determination of ash in coal and coke, *FRI News*, 12 (1962), 95

A rapid method has been suggested for determination of ash in coal and coke for quick quality control work. The effects of the following variables were studied: (i) size of boat, (ii) amount of sample, (iii) rate of passing air or oxygen, (iv) amount of mineral matter in the sample, (v) furnace temperature, (vi) position of boat in the tube, and (vii) use of air or oxygen. A method has been recommended, considering the various factors stated, in which a test can be carried out in 8 min. only.

176. DAS GUPTA, N. N., GHOSAL, A., CHATTERJEE, N. N. & MENON, M. V. P. (Central Fuel Research Institute, Jealgora): On the sampling of coke, J. Min. Met. Fuels, 11 (1963), 15

From a preliminary study on the sampling of run-ofoven (pilot plant) coke, it has been found that a gross sample of not less than 50 lb. suffices for its proximate analysis. The ash content of different size fractions of coke shows small variation while wider variation is observed in their moisture and volatile matter contents.

177. DAS GUPTA, N. N. & TARAFDAR, T. C. (Central Fuel Research Institute, Jealgora): Oxidation of coals on laboratory storage, *Indian J. appl. Chem.*, 25 (1962), 24

The results of studies on the deterioration of the caking, swelling and plastic properties of coals on storage in air and under water are presented.

178. HAQUE, R., SHARMA, S. K., DAS GUPTA, N. N. & LAHIRI, A. (Central Fuel Research Institute, Jealgora): Thickness of plastic layer of coals: Influence of rank, oxidation and additives on the maximum thickness of the plastic layer of coal, *Indian J. Technol.*, 1 (1963), 322

The influence of various factors, such as rank of coal, the extent to which coal is oxidized, addition of inerts and pitch on the thickness of the plastic layer in coals has been investigated using a standard Sapozhnikov apparatus. The maximum thickness of the plastic layer has been found to be related to the rank of the coal represented by its carbon and hydrogen content and the heat of wetting, indicating that the maximum thickness of the plastic layer may be used as an additional parameter for classifying coals in respect of their coking properties. The thickness of the plastic layer increases with increase in the load on the charge, the increase being more in the case of medium to weakly coking coals. The addition of coke breeze or non-coking coals and oxidation of the coals lower the thickness of the plastic layer, but the addition of hard pitch increases it.

179. LAHIRI, A. (Central Fuel Research Institute, Jealgora): Gas quenching of semi-coke from LTC plant, Res. & Ind., 8 (1963), 35

Circulation of carbonization gas instead of steam for quenching semi-coke in a prototype LTC plant at the Central Fuel Research Institute, Jealgora, has been found to confer specific advantages, namely increased throughput of coal, higher yield of coke and tar and lower yield of liquor per ton of coal carbonized. There is no deterioration in the quality of coke, tar and gas. The adverse effect of steam on the refractory is also eliminated. Results with a low rank high volatile Raniganj coal using the gas circulation technique show that the throughput can be increased by at least 60 per cent and the coke yield by 4.5 per cent on dry coal. The modifications made in one of the two retorts of the LTC plant at the institute for gas circulation and details of operational control are presented.

180. NANDI, H. C., CHOWDHURY, S. B., IYENGAR, M. S. & LAHIRI, A. (Central Fuel Research Institute, Jealgora): Sapoznikov process for obtaining reactive domestic fuel and metallurgical coke from Indian weakly and non-caking coals, J. Inst. Fuel, 36 (1963), 118

Moulded shapes have been obtained from Indian coals by the Sapoznikov process consisting of flash heating the fine coals (-25 BSS) in a fluidized bed to a critical temperature, extrusion and subsequent carbonization at 600° or 750°C. The shapes obtained at 600°C, are more reactive than low-temperature coke obtained by conventional methods, and can be used as domestic fuel. Those obtained at 750°C, have sufficient strength to be used as metallurgical fuel.

664 Food Technology

181. AGARWAL, P. C., PRABHAKAR, J. V., RANGANNA, S. & BHATNAGAR, H. C. (Central Food Technological Research Institute, Mysore): Pink

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discolouration in canned banana puree, Food Sci., 12 (1963), 200

Processing conditions have been standardized to overcome the onset of pink discolouration of canned pulp of ripe bananas of *Pachabale*, *Harishal* and *Yelachi* varieties. Addition of ascorbic acid (50 mg./100 g.) during pulping has been found to overcome enzymatic browning. The pulp preheated to 180° F. and then canned has been found to keep well for 6 months at room temperature.

182. CHALIHA, B. P., BARUA, A. D., GOHAIN, (Mrs) A. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Studies on the utilization of Assam lemon — Preliminary observations, *Indian Fd Pack.*, 17 (1963), 5

The high quality juice obtained from Assam lemons has been shown to be quite suitable for conversion into squash, cordial, barley water and concentrate. The oil content of the fruit is rather low. The peel and pomace is a rich source of pectin of high jelly grade. The Assam lemon, therefore, appears to be an excellent raw material for the preparation of pectin.

183. CHALIHA, B. P., BARUA, A. D., MAHANTA, D. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Studies on the utilization of Assam oranges: Part I — Recovery of peel oil and its physico-chemical composition, *Food Sci.*, 12 (1963), 240

The recovery of Assam mandarin peel oil by steam distillation and using a pipkin roller press, and the physical and chemical composition of the two oils have been studied and compared with those of Gauhati (Assam), Nagpur, Sikkim, Coorg, Italian and Brazilian mandarin and Florida tangerine oils. The oil has two absorption peaks in the ultraviolet region and two in the visible region.

184. CHALIHA, B. P., BARUA, A. D., MAHANTA, D. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Studies on the utilization of Assam oranges: Part II — Recovery and quality of pectin, Food Sci., 12 (1963), 243

In the case of Assam mandarin oranges, prior extraction of the oil by the pipkin roller press does not materially affect the quality of pectin. Drying of the peel and then pomace also does not significantly affect the recovery or the quality of pectin. The jelly grade of the pectin from the pomace is higher than that of pectin from the peel unlike in the case of Coorg mandarin orange.

185. CHALIHA, B. P., BARUA, A. D. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Assam lemon as a source of pectin: Part I — Effect of method of extraction, drying and storage of peel and pomace on the recovery and quality of pectin, *Indian Fd Pack.*, 17 (1963), 8

In the case of Assam lemons, two extractions with 0.2 per cent hydrochloric acid in the case of fresh material and three in the case of dried material

yield the maximum quantity of pectin of high quality. Drying of the peel and pomace at 55°C. does not significantly affect the recovery of the pectin. Blanching of the fresh material results in the recovery of pectin of better quality from the dried material. Rasping of the fruit for the cold extraction of peel oil prior to recovery of pectin does not materially affect the yield or the quality of the pectin. The pectin has a high jelly grade of 250-275. It contains D-galacturonic acid, D-galactose, L-arabinose and D-xylose just like any other citrus pectin.

186. CHALIHA, B. P., BARUA, A. D. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Assam lemon as a source of pectin: Part II — The effect of storage of dried peel and pomace on the recovery and quality of pectin and stability of the pectin during storage, *Indian Fd Pack.*, 17 (1963), 4

The dried peel and pomace of Assam lemon can be stored at room temperature (75-85°F.) without any significant effect on the recovery and quality on pectin. The dried material should be stored under conditions that will avoid the absorption of moisture during storage. The pectin from the fresh as well as dried material can be stored in airtight containers without appreciable degradation in quality.

187. KADKOL, S. B. & LAHIRY, N. L. (Central Food Technological Research Institute, Mysore): Strained baby foods from meat, *Indian Fd Pack.*, 17 (2) (1963), 5

A method for the preparation of baby food from meat and meat and vegetables has been standardized. The proximate, mineral and vitamin compositions of the laboratory samples have been determined. The PER of the product containing only meat did not significantly differ from that containing meat and carrot.

188. KERAWALA, D. N. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part I — Effect of addition of glucose on texture and of processing temperature on retention of ascorbic acid and carotene in mango toffee, *Food Sci.*, 12 (1963), 221

Addition of 2 per cent glucose by weight of the ingredients yields a finished product (toffee) with a golden yellow colour and free from stickiness. The recipe has been standardized on the basis of these trials. Proximate analysis of the product reveals that it is a rich source of calcium, phosphorus and β -carotene and poor in ascorbic acid due to considerable losses of this vitamin (59 per cent) which occur during cooking. The loss of β -carotene during cooking is negligible (1.7 per cent).

189. KERAWALA, D. N. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part II — Physicochemical changes in mango toffee during storage, Food Sci., 12 (1963), 223

The loss of moisture in mango toffees stored for 130 days at 6°C. and room temperature (23-28°C.)

is negligible but slightly greater at 37°C. The toffees, however, acquire a hard texture. Toffee pieces with an initial moisture content of 8.5 per cent or above tend to become mouldy after storage for four months, particularly at room temperature. Storage temperature does not seem to influence the migration of fat in the toffee from the central to the peripheral region. There is considerable loss of added ascorbic acid both during cooking and storage. Rapid deterioration of surface colour occurs during the initial period of storage largely as a result of oxidative changes in the mango carotenoids. The extent of deterioration of colour inside the body of the toffee pieces and the stability of β -carotene are related to the temperature of storage.

190. NARASINGH, K. L., DALAL, V. B. & SRIVASTAVA, H. C. (Central Food Technological Research Institute, Mysore): Effect of fungicidal wax emulsion on the storage behaviour of green limes, *Food Sci.*, 12 (1963), 197

Green limes can be stored for 12-13 days with minimum of wastage, shrivelling and deterioration in quality, if coated (within 24 hr after harvest) with wax emulsion containing 9-12 per cent solids and 0.4 per cent of the fungicide flit 406.

191. ROY CHOUDHURI, R. N., JOSEPH, A. A., KANTHA JOSEPH, NARAYANA RAO, M., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Chemical composition of some varieties of potato, Food Sci., 12 (1963), 249

Three different varieties of potato, President, Up-todate and Great Scot, grown in India have been analysed for the proximate principles, minerals and vitamins. The protein content of the different varieties of potato varies from 1.8 to 2.3 per cent on fresh weight basis, the protein content being the highest in Great Scot variety. The calcium, phosphorus and iron contents of the three varieties of potato vary from 6.2 to 6.6 mg., 33.7 to 37.0 mg. and 1.3 to 1.7 mg. on fresh weight basis. The different varieties of potato were found to be fair sources of vitamin C (14.3-14.9 mg./100 g. fresh weight).

192. ROY CHOUDHURI, R. N., JOSEPH, A. A., KANTHA JOSEPH, NARAYANA RAO, M., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Preparation and chemical composition of potato flour from some varieties of potato, *Food Sci.*, 12 (1963), 251

Potato flours' prepared from President, Up-to-date and Great Scot varieties of potato grown in India have been analysed for the proximate principles, minerals and vitamins. The protein, calcium and vitamin C contents of the different samples of potato flour per 100 g. were 7.1-9.2 g., 25.4-28.5 mg. and 36.9-38.0 mg. respectively. Potato flour packed in polythene bags and stored in sealed tin containers at 37° C. for 6 months was found organoleptically acceptable, the losses of vitamin C as a result of storage being 25-30 per cent. 193. SIDDAPPA, G. S. & KERAWALA, D. N. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part III — Effect of incorporation of antioxidant on the development of rancidity and stability of carotene in mango toffee, *Food Sci.*, 12 (1963), 228

Mango toffee, prepared with or without the addition of antioxidants, does not show any appreciable increase in the peroxide value or the Kries' index up to nearly 3 months' storage at 37°C. There is, however, a small but definite increase in the acid number. The toffee is quite acceptable in taste and flavour. Among the antioxidants tried, only ascorbic acid appeared to have a slight beneficial effect in regard to non-enzymatic browning of the product. Any initial beneficial effect of packing the product in nitrogen gas was nullified when the storage period was increased from 55 to 105 days. Among the added antioxidants, a combination of BHA and BHT (1:1) with an initial ascorbic acid content of c. 32 mg./100 g. of the product gives maximum retention of B-carotene as well as total carotenoids. The protective action of BHT alone or ascorbic acid alone is practically the same, but less than that of ascorbic acid. Next in order of effectiveness are BHA, Tenox II and NDGA closely following one another. BHA and BHT have good ' carry-through ' property, surviving the processing conditions. The processing conditions, the addition of antioxidant and the temperature of storage (6°, 25-28° and 37°C.) do not have any noticeable effect on the nature and characteristics of the original carotenoids of mango pulp used in the preparation of the toffee.

194. SIDDAPPA, G. S. & KERAWALA, D. N. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part IV — Packaging requirements of mango toffee in relation to moisture equilibrium, *Food Sci.*, 12 (1963), 233

The initial, critical and danger points for mango toffee are 8.2, 13.4 and 10.2 per cent of equilibrium moisture content (EMC) respectively. The product stores well when the relative humidity of the storage atmosphere is up to c.56 per cent. At 0-11 per cent relative humidity, however, it hardens considerably and is not quite acceptable. The overall quality of the product is best at 64-68 per cent relative humidity. The product is not thus hygroscopic in the real sense, and does not, therefore, require any stringent packaging conditions in regard to moisture pick up.

195. SIDDAPPA, G. S. & KERAWALA, D. N. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part V — Effect of incorporation of fungistatic agents on the storage behaviour of mango toffee, *Food Sci.*, 12 (1963), 235

Cellophane and aluminium foil wrappers slow down the pick up of moisture by mango toffee during storage and thereby delay considerably the onset of mould attack under adverse humidity conditions. Aluminium foil is more effective than cellophane in this respect. Potassium sorbate is more potent than sodium propionate as a fungistatic agent in mango toffee, in the loose or in the wrapped conditions. In the case of loose toffee, however, sodium propionate is not quite effective against mould attack.

196. SIDDAPPA, G. S. & KERAWALA, D. N. (Central Food Technological Research Institute, Mysore): Studies on fruit toffees: Part VI — Effect of substitution of skim milk powder with Bengal gram or groundnut flour, *Food Sci.*, 12 (1963), 238

It has been shown that Bengal gram flour, groundnut flour and groundnut protein isolate can be employed as possible substitutes for skim milk powder in the preparation of mango toffee. The product with Bengal gram flour has bright attractive yellow colour and good tasté. The colour is stable during storage. The toffee with groundnut protein has a mild acidic taste and the characteristic groundnut taste and flavour. The use of groundnut flour as such makes the product 'oily' and the set is not quite satisfactory. There is scope for preparing fruit toffees of high nutritive value and good acceptability employing protein-rich materials.

197. SOWBHAGYA, C. M., MAYURA, K., NAIR, K. G., SASTRY, L. V. L. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Estimation of benzoic acid in the presence of vanillin in synthetic syrups, J. Ass. off. agric. Chem., Wash., 46 (1963), 767

In preserved synthetic syrups, vanillin, added as a flavouring agent, interferes in the standard titrimetric estimation of benzoic acid. By combining the AOAC titrimetric method and a modified colorimetric method using thiobarbituric acid reagent which forms a yellow colour with vanillin, a method has been standardized for eliminating the interference of vanillin in the estimation of benzoic acid. Vanillin is estimated by the colorimetric method and the amount of standard alkali required to neutralize it is calculated. This titre is deducted from the total titre for benzoic acid and vanillin in the sample, as obtained by adopting the standard AOAC titrimetric method, thus obtaining the titre for benzoic acid alone. Extensive data have confirmed the applicability of the procedure.

664.5 Spices

198. HABEEBUNNISA, PUSHPA, M. C. & SRIVASTAVA, H. C. (Central Food Technological Research Institute, Mysore): Studies on the effect of protective coating on the refrigerated and common storage of Bell peppers, *Food Sci.*, 12 (1963), 192

From studies on he storage of freshly harvested capsicums under different refrigerated conditions, the temperature range 52-55°F. and relative humidity range 85-90 per cent have been found to be the optimum conditions for their storage; under these conditions they can be stored for 19 days. Untreated fruits stored at different refrigerated temperatures showed wastage mainly due to shrivelling. Fruits coated with carnauba, 3 and 6 per cent wax emulsion, and stored at different temperatures (75-90°, 62-66° and 47-50°F.) show that protective coating enhances the storage period at all these temperatures. In the treated fruits the percentage of shrivelling and decay was reduced and the fruits showed better lustre and looked fresh. The treated fruits showed reduced rates of respiration with better retention of ascorbic acid.

665.3 Fats & Oils

199. KAPUR, O. P., SRINIVASAN, M., KALBAG, S. S. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Detection of adulteration of ghee with vanaspati: Part III—Production of turmeric extract (curcumin) as a colouring agent, *Indian J. Technol.*, 1 (1963), 292

The results of large-scale trials on the use of turmeric extract as a colouring agent for vanaspati are presented. Details of the method for preparation of turmeric extract from turmeric tuber and colouring trials with a one-ton lot of vanaspati using concentrated alcoholic extract of turmeric are described. Consumer acceptability trials with the coloured product indicate that it is preferred to samples coloured with *ratanjot* extract or chlorophyll. The coloured product shows satisfactory storage behaviour, there being no significant decrease in colour value or increase in peroxide value after 3 months' storage. Turmeric colour does not interfere with the Baudouin test. The cost of colouring vanaspati with turmeric extract works out to c. 1 nP. per kg.

200. SEN, D. P., DANI, N. P., SRIPATHY, N. V., VISVESWARIAH, K., LAHIRY, N. L. & VERNEKAR, V. S. (Central Food Technological Research Institute, Mysore): Refining of crude commercial sardine oil, *Food Sci.*, 12 (1963), 189

A simple and cheap procedure for alkali refining of commercial sardine oil, employing comparatively low temperature (60-65°C.) and fairly high concentrations of alkali (15 per cent) with slow stirring is reported. The refined oil is light brown and has the following characteristics: free fatty acids (per cent oleic acid), 0.5; sap. val., 201.8; iod. val., 173.6; unsapon. matter, 1.23 per cent; moisture and volatile matter, 0.4 per cent; $n_D^{30^\circ}$, 1.476; and sp. gr. (30°C.), 0.92.

201. SHRIPATHI RAO, H., NARASIMHAM, P., CHARI, K. S. & AGGARWAL, J. S. (Regional Research Laboratory, Hyderabad): Hydrogenation of castor oil: Part II — Pilot plant studies, *Indian J. Technol.*, 1 (1963), 320

The hydrogenation of castor oil has been studied on a pilot plant scale (25 kg. lots) using Raney nickel catalyst. A satisfactory white flaky product (iodine value, 3.8; hydroxyl value, 154.7; acid value, 2.7; and melting point, 85.0° C.), comparable to imported samples, is obtained on hydrogenating the oil at 150°C. and under 10 kg./sq. cm. pressure for 5 hr using 2 per cent catalyst on the weight of oil. Repeated reuse of the catalyst (up to 17 cycles) after replenishment with 25 per cent fresh catalyst gives results comparable to those obtained with the fresh catalyst. The approximate cost of production of hydrogenated castor oil works out to Rs 1.91 per kg. in a 5 tonnes capacity plant and Rs 1.86 per kg. in a 10 tonnes capacity plant.

666.1 Glass & Ceramics

202. CHOWRASHI, PROKASH KUMAR & SACHCHIDA-NANDA KUMAR (Central Glass & Ceramic Research Institute, Calcutta): A note on the Indian standard method for testing alkalinity of glass, *Trans. Indian ceram. Soc.*, 21 (1962), 102

The Indian standard method for testing alkalinity of glass has been modified to improve its accuracy and rapidity. Ten commercial glasses having widely different chemical durabilities were tested for alkalinity and the extracted amounts of alkalies were estimated flame photometrically as well as by titration. The results obtained by the two methods show that the extracted glass constituents other than the alkalies did not have any effect on the titre value. The same samples were also tested according to the DIN method as proposed by the International Standards Organization and the ratio of the titre values as obtained by the IS and DIN methods was found to be 0.55.

203. GUPTA, PRANAB KUMAR & SACHCHIDANANDA KUMAR (Central Glass & Ceramic Research Institute, Calcutta): Glasses in the systems PbO-B₂O₃-SO₃ and ZnO-B₂O₃-SO₃, Trans. Indian ceram. Soc., 21 (1962), 91
In the systems PbO-B₂O₃-SO₃ and ZnO-B₂O₃-SO₃

In the systems PbO-B₂O₃-SO₃ and ZnO-B₂O₃-SO₃ clear and stable glasses containing up to about 20 mole per cent SO₃ have been obtained. Unlike the borate glasses, thin films of sulphate-containing glasses show selective infrared transmission around 12. Compared to the corresponding borate glasses, thermal expansion is higher. DC resistivity, dielectric constant and softening temperature do not change significantly by replacing B₂O₃ with SO₃. Addition of SO₃ improves resistance of lead glasses to water attack, but deteriorates zinc glasses. Some of the glasses did not show any visible change after they were kept exposed to atmosphere for about a year.

666.94 Cement & Concrete

204. CHATTERJI, A. K. & RAWAT, R. S. (Central Building Research Institute, Roorkee): Absorption of cement by asbestos fibres, *Nature, Lond.*, 198 (1963), 750

Evidence is presented to show that besides being physically held, cement may be chemisorbed by the asbestos fibres and that the strength of a.c. products may be influenced by the amount of cement chemisorbed. The necessary conditions for chemisorption of cement by the fibres are indicated and explanations for the low absorption of high alumina cement by these fibres and accelerated setting of cement in the presence of chrysotile fibres are given.

205. GOKHALE, Y. C. (Central Road Research Institute, New Delhi): Using micaceous sands for cement mortars, Indian Concr. J., 37 (1963), 298

River sands in the Kathmandu Valley, Nepal, contain as high as 10-12 per cent of mica particles, causing a 50 per cent decrease in the strength of mortars and concretes made with them. Investigations on cement mortars using micaceous sands indicate that the addition of lime putty improves considerably their strength and workability. For each mortar mix, however, there is an optimum quantity of lime putty which gives maximum compressive strength. Maximum compressive strength is obtained when the 'water-binder' ratio is minimum, the term binder indicating the quantity of both cement and lime in the mix.

667.6 Paints & Varnishes

206. JAMIL, M. ZAFAR, SAXENA, E. R. & DATAR, D. S. (Regional Research Laboratory, Hyderabad): Effect of butyl titanate on sol-gel-sol transformations in titania paints, *Indian J. Technol.*, 1 (1963), 308

Butyl titanate accelerates sol-gel and gel-sol transformations in titania-linseed oil paints. The magnitude of these changes depends upon the period of mixing and the amount of butyl titanate added; the changes are more pronounced with rutile paint than with anatase paint. Butyl titanate hydrolyses and the titanium hydroxide formed stabilizes titania sols. The transformation of the sol to gel on standing is presumably due to immobilization of linseed oil polymolecules caused by their interlinking with pigment particles through weakly dissociating butyl titanate molecules. On disturbing the system, these links are broken and the system regains its mobility. Addition of 0.5 per cent butyl titanate initiates these transformations and causes the development of thixotropic properties in titania paints.

207. LODH, S. B. & RAO, P. R. (Regional Research Laboratory, Jorhat): CNSL furfural based surface coating from rice bran oil, *Paintindia*, 13 (5) (1963), 19

A stoving enamel has been prepared by heating a mixture of anhydrous aluminium chloride-treated rice bran oil and furfural cashewnut shell liquor resin at $130-40^{\circ}$ C. for 0.5 hr. The coatings dry up at 150°C. within c. 0.5 hr on glass surfaces and within 1 hr on metal surfaces. The baked films are resistant to water, alkali or acids and also to organic solvents like chloroform, alcohol and ether.

208. LODH, S. B. & RAO, P. R. (Regional Research Laboratory, Jorhat): Examination of reeds as raw materials for furfural production, J. Instn Chem. (India), 35 (1963), 48

Studies on four different varieties of reeds, viz. Saccharum munja Roxb., S. procerum Roxb., Phragmites karka Trin. and Neyrandia reynandiana (Kunth) Keng. syn. N. madagascariensis var. zollingeri Hk. f. in FBI, which occur abundantly in different parts of India, especially in Assam, have shown that they are good sources for the production of furfural. The yield of furfural is found to be 5.6, 5.13, 6.97 and 5.4 per cent (on dry weight of the material) respectively.

 209. SINGH, S. M. (Central Building Research Institute, Roorkee): Effect of extenders on the shrinkage cracking of cement paint film, *Paintindia*, 13 (1963), 30
 A systematic evaluation of indigenous cement

A systematic evaluation of indigenous cement paints has revealed that they lose decorative value in 10-15 months. The most serious defects observed were map-cracking and discolouration due to dirt retention and lime blooming. Ten cement paint formulations incorporating the extenders lime, sand, asbestos and diatomaceous earth were exposed for material weathering. After 18 months, it was found that lime addition was effective in reducing map-cracking up to 12-15 months. Sand and asbestos did not bring about any reduction in mapcracking. On the other hand, they encouraged dirt retention. Formulations containing the lowest proportion of extenders gave the best performance.

668.317 Gelatine

210. KRISHNAN, D. R. & BARAT, S. K. (Central Leather Research Institute, Madras): Studies on the preparation of glue and gelatine from Indian cattle bones, Leath. Sci., 10 (1963), 335 Extraction of green bones under pressure without any pretreatment yielded a poor quality glue. Liming helped to remove sinews and marrows which when extracted after usual deliming yielded good quality gelatine. The bones after cleaning did not yield any glue and prolonged liming alone was of no avail. It was only through acid pretreatment that a good yield of quality gelatine was obtained. Liming after acid treatment was found to give a better quality gelatine which was also more transparent than that obtained through acid treatment alone. However, liming of ossein cuts the yield to a considerable extent.

668.44 Resins

211. CHAUDHURI, S. B., BARUAH, J. N. & RAO, P. R. (Regional Research Laboratory, Jorhat): Rice bran oil modified alkyd resins, *Paintindia*, 13 (3) (1963), 21

Alkyd resins have been prepared from rice bran oil by the fatty acid process. The alkyd resins thus prepared have been found to yield satisfactory types of surface coating films both on glass and tin plates. The alkyd resins have also been found to be capable of being formulated into satisfactory types of enamels.

212. GOVINDAN, K. P. & KRISHNASWAMY, N. (National Chemical Laboratory, Poona): Preparation and properties of cation-exchange resins from polystyrene sulphonic acid and formaldehyde, *Indian J. Technol.*, 1 (1963), 297 A cation-exchange resin with high exchange capacity (9-12 kgr. CaCO₃/cu. ft) and high degree of swelling has been prepared from commercial polystyrene by treatment with sulphuric acid and formalin.

The possibility of obtaining resins with varying degrees of swelling and capacities by suitably adjusting the curing conditions is indicated.

669.051 Ore Processing

KARTHA, K. N. (National Metallurgical Laboratory, Jamshedpur): An X-ray study of the reaction of calcium oxide and calcium chloride in the decomposition of monazite, NML Tech. J., 5 (2) (1963), 4

X-ray study of monazite heated by itself, with calcium oxide and calcium chloride singly as well as in combination has confirmed the earlier finding from chemical investigations that heating with calcium oxide alone decomposes the monazite very little, whereas heating with a mixture of calcium oxide and calcium chloride decomposes the monazite which can be leached by acid and separated as calcium phosphate, rare oxides and other compounds. The results further indicate that the rare earths are also likely to get decomposed, which may facilitate the separation of the individual rare earths by the same technique.

214. SARMA, B. & GUPTA, J. (National Chemical Laboratory, Poona): Preparation of pure oxides of niobium and tantalum from Indian columbite and tantalite, *Indian J. Technol.*, 1 (1963), 311

A promising solvent extraction procedure, employing cyclohexanone or methyl n-propyl ketone, has been developed for the preparation of niobium and tantalum oxides of more than 99.9 per cent purity from Indian columbite. The procedure involves the opening of the mineral by alkali fusion followed by washing and leaching with hydrochloric acid to obtain a mixture of hydrous oxides of niobium and tantalum. The air-dried oxides are dissolved in 40 per cent hydrofluoric acid in the cold and necessary amount of hydrochloric acid added to adjust the acidity of the solution which is then subjected to solvent extraction, when tantalum goes into the organic phase and niobium remains in the aqueous phase. The oxides are precipitated with ammonia and ignited. Good separations with respect to yield and purity of oxides are achieved by maintaining the acidity of the solutions at 0.5N and the solute concentration (wt/vol.) at c. 10 per cent in the case of cyclohexanone and 20 per cent in the case of methyl *n*-propyl ketone.

669.1 Iron & Steel

215. LAHIRI, A. K., BANERJEE, N. G. & BANERJEE, T. (National Metallurgical Laboratory, Jamshedpur): Dissolution of steel and absorption of hydrogen by steel during acid pickling in presence of inhibitor, NML Tech. J., 5 (1963), 33

The effect of urea, thiourea and di-o-tolyl thiourea inhibitors on metal dissolution and hydrogen pick up by the metal during pickling in sulphuric acid has been investigated. The effect of addition of the inhibitors on hydrogen pick up by the metal during pickling was determined using modified vacuum heating technique for the determination of hydrogen. Of the three inhibitors studied, urea was found to have poor inhibitive properties. Both thiourea, and di-o-tolyl possess excellent inhibitive properties, the latter being more efficient than the former. The thiourea group of inhibitor showed reduction in total hydrogen pick up by the metal with increase in inhibitor concentration. The hydrogen pick upweight loss ratio was found to increase with increase in concentration of the inhibitor.

66:541.121 Equilibrium Studies

216. KHADILKAR, H. P. & NARSIMHAN, G. (National Chemical Laboratory, Poona): Isobaric binary vapour-liquid equilibria for the system toluene-4-methyl-2-pentanol, *Indian J. Technol.*, 1 (1963), 299

Isobaric vapour-liquid equilibrium data for toluene-4-methyl-2-pentanol system have been determined at 710 mm. Hg total pressure. The data show good agreement with those estimated on the basis of Wohl's 3-suffix equation. The limiting values of the correction factor for the activity coefficient have been found to be 0.98 and 1.03. The activity coefficients for the system can be more accurately predicted on the basis of Margules constants than Van Laar constants.

66:615.777 Insecticides

217. BHIDE, S. P., NARAYAN RAO, K. V. & KULKARNI, S. B. (National Chemical Laboratory, Poona): Preparation of water dispersible DDT: Contact angle and sedimentation rate and volume measurements, *Indian J. Technol.*, 1 (1963), 305

The suitability of a number of commercial surface active agents for preparing stable dispersions of DDT in water has been evaluated by measuring the contact angle, sedimentation rate and surface tension of DDT-surfactant systems. Non-ionic type of surfactants, such as Lissapol NX and Triton X-100, have been found to be more suitable than ionic surfactants. The incorporation of clays in the formulation has, in general, an adverse effect on the effectiveness of the surfactants in improving the suspensibility of DDT.

218. CHINCHOLE, P. R., SHUKLA, R. N., KULKARNI, S. B., GHARPUREY, M. K. & BISWAS, A. B. (National Chemical Laboratory, Poona): Preparation of water dispersible DDT: Suspensibility, stability and particle size distribution of melt-ground paste, *Indian J. Technol.*, 1 (1963), 277

Water dispersible DDT formulations of different compositions have been prepared in the form of meltground oil-bound pastes and their suspensibilities determined before and after storage at different temperatures. The data enable the selection of suitable compositions with satisfactory suspensibility and storage stability. The particle size distribution of the paste formulations has been determined and the relative covering power of these and a commercial wettable powder compared. The covering power of the paste, which contains thin and long needleshaped particles, is at least 2.5 times that of the wettable powder which mainly consists of spherical particles. The increased and effective coverage provided by the pastes, especially over rough surfaces, is due to the presence of larger sized particles in them than in the wettable powder.

66:620.193 Corrosion

219. NAGANATHAN, K., ANNAMALAI, P. L., SUBRA-MANYAN, N. & RAJAGOPALAN, K. S. (Central Electrochemical Research Institute, Karaikudi): Passivating treatment after acid pickling of structural steel, *Paintindia*, 13 (1963), 133

A passivating treatment for mild steel based on a single stage phosphoric chromic acid wash has been assessed by field exposure studies at Mandapam Camp, in comparison with the Footner's process. It is concluded that the phosphoric chromic acid wash would give adequate protection under most conditions during the interval between pickling and painting.

220. ROY, K., SARKAR, M. & CHATTERJEE, B. (Department of Chemistry & Metallurgy, B.E. College, Howrah): Sacrificial anodes for protection against underground and subsoil corrosion, *Indian J. appl. Chem.*, 26 (1963), 33

The use of magnesium, aluminium and zinc as sacrificial anodes for cathodic protection of cast iron and mild steel against soil corrosion under laboratory conditions has been investigated. The degree of protection achieved with both zinc and aluminium anodes has, in general, been found to be appreciably more for mild steel compared to cast iron.

221. SUBRAMANYAN, N. & SHYAMALA, (Miss) N. (Central Electrochemical Research Institute, Karaikudi): Corrosion and electrochemical behaviour of copper-mild steel couple bielectrode system, *Indian J. Technol.*, 1 (1963), 338

Coplanar bielectrodes of copper and mild steel have been used to study the influence of area ratio on the potential and corrosion rate of the couple. The corrosion current has been found to increase with increase in the ratio of anodic to cathodic area. The geometrical distribution of the two types of areas with respect to the electrolyte has an overwhelming effect on the behaviour of the bielectrodes. The behaviour of the two metals when present close together in the bielectrode is different from that of the same two electrodes when they are separated from each other in the same solution (3 per cent sodium chloride) and connected externally.

222. SUBRAMANYAN, N., ANNAMALAI, P. L. & RAJAGOPAL, C. (Central Electrochemical Research Institute, Karaikudi): The role of meteorology in corrosion, Curr. Sci., 3 (1963), 65 From a study of the corrosion of mild steel at Mandapam Camp vis-à-vis the effects of meteorological factors, it has been found that it is not the relative humidity alone but also the salinity of the prevailing winds that is responsible for the enhanced corrosion rate during the monsoon.

66:621.3 Electrotechnology

223. KRISHNASWAMY, N. & INDUSEKHAR, V. K. (National Chemical Laboratory, Poona): Electrodialysis: Part III — Salt reduction in a nine-chambered cell, Indian J. Technol., 1 (1963), 280

The desalting efficiency of a nine-chambered electrodialysis cell using Permaplex C20 and A20 membranes for natural and synthetic brackish waters has been studied. The nature of the solution used in the concentrating chamber has been shown to affect the efficiency of the cell. Using a current source of 100 ma. and recirculating tap water in the concentrating chamber till its salt content approaches that of the feed solution, different degrees of desalting (49-94 per cent) can be achieved at varying flow rates.

224. NARASIMHAM, K. C., SUNDARARAJAN, S. & UDUPA, H. V. K. (Central Electrochemical Research Institute, Karaikudi): Effect of rotation of anode in the preparation of perchlorates, *Rocz. Chem. Ann. Soc. Chim. Polon.*, 36 (1962), 685

The effect of rotation of lead dioxide and platinum anodes in the oxidation of sodium chlorate to sodium perchlorate has been studied.

66:621.355 Accumulators

 225. MATHUR, P. B. & PAUL, N. J. (Central Electrochemical Research Institute, Karaikudi): Magnesium cell for demonstration, J. chem. Educ., 40 (1963), 43

A newly discovered cell system consisting of magnesium and copper electrodes dipped in copper sulphate solution has been described for demonstration in educational institutions. A layer of insoluble material develops at the magnesium electrode as soon as the electrode is dipped in copper sulphate solution. This layer acts as a natural separator between anode and cathode, eliminates short circuiting and so allows close packing of the electrodes in the cell. The cell system does not get polarized at any rate of drainage of current and hence it is useful for continuous heavy discharge. Compactness, non-polarizability, high ampere-hour capacity and simplicity of fabrication are some of the attractive features of the new cell system.

226. BHASKARA RAO, M. L., ANANTHARAMAN, P. N. & MATHUR, PREM BEHARI (Central Electrochemical Research Institute, Karaikudi): Production of positive plates for silver oxide-zinc batteries, I & EC Prod. Res. Develop., 2 (1963), 155

Starting from silver oxide, a method of preparing positive plates without any grid has been worked out for a silver oxide-zinc battery. The method is based on the fact that, on heating, silver oxide decomposes at a relatively low temperature to form silver which sinters to form a porous skeleton. The procedure thus eliminates one step (production of powder) in the conventional technique of production of anode plates using silver powder. The merits and demerits of the new procedure and the practical aspects of production are presented.

66:622.367 Talcs

227. GHOUSE, K. M., RAMA RAO, B. & DATAR, D. S. (Regional Research Laboratory, Hyderabad): Reflectance and X-ray diffraction studies of some Indian steatites, *Indian J. Technol.*, 1 (1963), 295

Six samples of steatite obtained from different locations have been examined for their whiteness and mineralogical composition on the basis of reflectance and X-ray diffraction studies. The whiteness of the samples has been found to be in the following decreasing order: Dagotha (Rajasthan), Cuddapah (Andhra), Almora (Uttar Pradesh), Sundergarh (Orissa) and Chandapur (Rajasthan). X-ray patterns of the samples show that they are fairly pure talcs with the exception of Salem steatite which contains antigorite in appreciable amounts.

66:631.8 Fertilizers

228. MUKHERJEE, P. N., RAMCHANDRAN, L. V. & LAHIRI, A. (Central Fuel Research Institute, Jealgora): A new method of production of nitrogenous organic manure, *Chem. & Ind.*, (1963), 741

Experiments carried out on the fixation of nitrogen in coal has led to a new method for the production of nitrogenous fertilizers from coal. This fertilizer, as has been seen from the field trials, is as effective as any synthetic organic fertilizer and the method developed can also be used for nitrogen enrichment of a wide range of cellulosic substances.

66:675 Leather Technology

229. ANANTHANARAYANAN, S. & RAMASWAMY, D. (Central Leather Research Institute, Madras): Complexometric estimation of chromium in chrome liquors, *Leath. Sci.*, 10 (1963), 159

A complexometric titration procedure is proposed for the estimation of chromium in chrome liquors, prepared with organic reducing agents like sawdust, dividivi, etc. A photometric titration in the ultraviolet region is proposed for estimating micro amounts of chromium. The results indicate that the proposed method holds good with ± 1.1 per cent error. The photometric titration procedure has been found to be suitable for the estimation of chromium with greater accuracy as compared to existing micro methods.

230. ANANTHANARAYANAN, S., RAMASWAMY, D. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras): A note on estimation of ionically held sulphate groups of chrome tanned protein, *Leath. Sci.*, 10 (1963), 407 An improved method to differentiate ionically held and complexly held sulphate groups in chrome tanned protein is suggested wherein urotropine (hexamethylene tetramine) is substituted in place of pyridine in the existing method. It has been found that 4 per cent urotropine solution removes quantitatively all ionic sulphate groups of the chrome tanned protein on agitation for 4 hr.

231. BASU, B. C., RAMANATHAN, N. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras): Relationship between birefringence, watersoluble materials and shrinkage temperature of vegetable tanned leathers, *Leath. Sci.*, 10 (1963), 206

With the removal of free water solubles, there is no change in Ts and birefringence of vegetable tanned leathers. But the combined water solubles present in leather tend to lower the Ts and also the reversal or suppression of the positive birefringence of collagen. After removal of water solubles, the negative fibre turns positive and positivity is increased with increase in washing time, along with increase of Ts value. Positively birefringent vegetable tanned leathers shrink at a temperature higher than negatively birefringent ones. Probable reasons for this change are discussed.

232. BASU, B. C., RAMANATHAN, N. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras): The optical birefringence of leather fibres in relation to the physical properties of vegetable tanned leather. Leath. Sci., 10 (1963), 249

tanned leather, *Leath. Sci.*, **10** (1963), 249 Experiments have been conducted to find any possible correlation between the optical properties and physical properties of leather. Negatively birefringent leather contains less capillary and total moisture than positively birefringent leather. Negatively birefringent leather shrinks at a lower temperature in both aqueous and non-aqueous media when compared to positive one. The extent of contraction in the liquid paraffin medium in the case of the negatively birefringent leather is remarkably high in comparison to positive ones though there is not much difference in the water medium. The positively birefringent leather shows a small wear index (or resistance to abrasion), but less tensile strength and water absorption. The probable reasons for these differences are discussed.

233. CUNNINGHAM, G. E. & GHOSH, D. (Central Leather Research Institute, Madras): Studies in purified and salt modified goran liquors, *Leath. Sci.*, 10 (1963), 162

Comparative studies have been carried out with unmodified and purified goran liquors and mimosa liquors to determine the factors responsible for the high thermal stability of goran tanned leathers. The titration curves, acid and salt contents and gelatin numbers of the liquors have also been studied. Goran contains more buffering salt than mimosa liquors. Purification of goran by lead acetate precipitation followed by dialysis results in loss of a relatively greater proportion of salts of strong acids. During purification, some salt of weak acid, most probably sodium acetate, is introduced; this is removed by subsequent dialysis. The gelatin number indicates goran tannin to be inherently more astringent than mimosa tannin. Goran liquor purified by lead acetate precipitation technique was found to penetrate the pelt relatively quickly, whether the liquors were restrengthened or not. Leather tanned by purified goran was very dark and poor in substance in both the systems. The shrinkage temperature of the leather tanned with purified goran replenished with tannins was found to be almost the same as that of the leather tanned with original goran. The high thermal stability imparted to the leather appears to be an inherent property of goran tannin molecules themselves.

234. GHOSH, D. (Central Leather Research Institute, Madras): Studies on the decolouration of mangrove liquors, *Leath. Sci.*, 10 (1963), 201

Three methods have been tried for the decolouration of mangrove liquor. Both external addition of acids and salts to the tan liquor and pretreatment of pelts with the same reagents cause some precipitation of tannins, but an improvement in colour of the final leather. Excess of acids and salts in the tan liquor has been shown to adversely affect the tanning properties of the liquor, notably in regard to ease of penetration through the pelt. Treatment after tannage has been shown to be the best method among the three methods studied.

235. GHOSH, D. & BARAT, S. K. (Central Leather Research Institute, Madras): Studies on goran tannin: Part II — Isolation and identification of some of the constituents of goran tannin, *Leath. Sci.*, 10 (1963), 403

The separation of constituents of goran tannin has been effected. Most of the constituents yielded phloroglucinol and protocatechuic acid after microfusion. Some of the constituents after leucoanthocyanidin reaction yielded only cyanidin. One of the constituents was identified as catechin. None of the constituents was found to be crystalline, though they migrated as discrete spot on two-dimensional paper chromatogram. All the constituents isolated except one yielded higher shrinkage temperature when sausage casings (intestine of cow) were tanned with them.

236. KEDLAYA, K. J. & SELVARANGAN, R. (Central Leather Research Institute, Madras): A note on book-binding leather, *Leath. Sci.*, 10 (1963), 263

Attempts have been made to improve the quality of myrobalan tanned leather *vis-à-vis* peroxide test. Mezei's buffer mixture has been found useful in this regard.

237. KRISHNAMURTHI, V. S. & SEN, S. N. (Central Leather Research Institute, Madras): A systematic study of fungi on tan liquors: II — Aspergilli, Bull. cent. Leath. Res. Inst., 9 (1962), 137

Aspergillus fumigatus, A. ustus, A. foetidus and A. oryzae have been isolated from vegetable tan liquors.

238. KRISHNAN, D. R. & BARAT, S. K. (Central Leather Research Institute, Madras): Glue from vegetable tanned (EI) leather wastes, *Leath. Sci.*, 10 (1963), 212

Leath. Sci., 10 (1963), 212 Attempts have been made to detan EI tanned leather wastes for the manufacture of glue using sodium hydroxide, lime, potassium thiocyanate and acetone-water mixture. Glue extracted after subjecting the stock to the above treatment has been assessed in terms of melting point and viscosity of the resultant product.

239. MADHAVAN PILLAI, K. S., KEDLAYA, K. J. & SELVARANGAN, R. (Central Leather Research Institute, Madras): Cashew seed skin as a tanning material, *Leath. Sci.*, 10 (1963), 317

Cashew seed skin has been examined as a tanning material. For extract manufacture it has been found necessary to blend it with materials like wattle or myrobalan. Leather tanned with cashewnut skin and topped with myrobalan was found to possess fairly good colour, feel and yield comparable to EI tanned leathers.

240. NATARAJAN, M., BOSE, S. M. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras): Studies on utilization of tannery hide fleshings as an animal feed, Bull. cent. Leath. Res. Inst., 9 (1962), 193

A simple method for the purification of limed fleshings for use as an animal feed has been developed. The suitability of the purified product as animal feed has been investigated by growth experiments on rats and chicken, by determination of biological value and coefficient of digestibility and by *in vitro* digestibility studies using proteolytic enzymes. In vitro protein synthesis experiments with pigeon pancreas slices have been carried out. The results obtained have shown that hide fleshings alone are not suitable for use as the sole source of protein in the animal feed, but may be used as a partial replacement of the standard proteins to the extent of 25 per cent.

241. NAYUDAMMA, Y. & KOTESWARA RAO, C. (Central Leather Research Institute, Madras): Studies on shrinkage phenomenon: Part VII — Chrome combination tannages, *Leath. Sci.*, 10 (1963), 381

Chrome sandwich tannages involving myrobalan tannin, wattle tannin, formaldehyde, immergan and syntan have been conducted and the hydrothermal stability and chrome fixation of the leathers obtained determined. The results indicate that retanning chrome tanned leather repeatedly with chrome and also retanning the same with vegetable tannins sandwiched between chrome and chrome improves the Ts of the leather.

242. RAJADURAI, S. (Central Leather Research Institute, Madras): Studies on the chemistry of *Pithecolobium dulce* tannins: Part I — Isolation of (+)-7:3': 4'-trihydroxyflavan-3,4-diol, *Leath. Sci.*, 10 (1963), 340

The amorphous material extracted by acetone from *Pithecolobium dulce* bark consists largely of 3,4,7,3',4'-pentahydroxyflavan, a compound of novel type

characterized by crystalline derivatives. Its constitution has been demonstrated by oxidation of the trimethyl ether with potassium permanganate to 2-hydroxy-4-methoxy benzoic acid and varatric acid and by the Oppenauer method to 7,3',4'-trimethoxyflavonol. It combines the properties of both leucoanthocyanidin and phlobotannin.

243. RANGANATHAN, T. S. (Central Leather Research Institute, Madras) & REED, R. (Department of Leather Industries, The University, Leeds, UK): Studies on zirconium tannage — Mechanism of the tannage: Part II, Bull. cent. Leath. Res. Inst., 9 (1962), 202

It was indicated in an earlier paper that zirconium, apart from being fixed to hide protein to some extent through the agency of amino groups, could get fixed by other means also. By studying the fixation of zirconium by lyotropically treated hide powder samples, evidence has been obtained for the physical deposition of aggregates of zirconium complexes. This has also been confirmed by electron microscope studies.

244. SANTHANAM, P. S. & BARAT, S. K. (Central Leather Research Institute, Madras): Non-volatile organic acids in myrobalans, *Leath. Sci.*, 10 (1963), 172

The non-volatile organic acids in aqueous infusion of myrobalan have been studied by the paper chromatographic technique of Hartley and Louson (i.e. with the indicator incorporated in the solvent system for the second dimension) with certain modifications. Eight non-volatile organic acids have been detected. Out of these, four are phenolic tannin acids, two phenolic non-tannin acids and the remaining two non-phenolic organic acids.

245. SANTHANAM, P. S. & BARAT, S. K. (Central Leather Research Institute, Madras): Tanning studies with purified and aged myrob infusions, *Leath. Sci.*, 10 (1963), 393

Tanning experiments carried out with purified liquors and aged liquors of myrobalans have shown that the non-tans present reinforced by the products of degradation are mainly responsible for the darkening of colour of the leather resulting from prolonged tanning with myrobalan infusion. It has also been confirmed that pyrogallol, one of the degradation products formed, is, among others, mainly responsible for the darkening of the colour.

 246. SEN, S. N. (Central Leather Research Institute, Madras): Pigmentation on chrome tanned pelt in blue by a mould of Penicillium group, *Leath.* Sci., 10 (1963), 388

Red pigmented patches on chrome tanned pelt are common phenomena and evidences so far reported showed that it is due to the growth of some species of Penicillium. From the various pigmented samples collected in the laboratory, it has been concluded that pigmentation is due to the growth of *Penicillium rubrum* Stoll and to this extent, this observation differs from the earlier reported ones. Some of the factors contributing to pigment production in addition to the mould growth have been investigated. 247. SUMATHI, S. C., RAMASWAMY, D. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras): Estimation of organic acids in chrome liquor, *Leath. Sci.*, 10 (1963), 414

A method utilizing solvent extraction is proposed for the estimation of organic acids (free and complexed) in chrome liquor. The free acid present is first extracted with a 2:1 mixture of *tert*-amyl alcohol and *n*-butanol (saturated with water). After removal of the free acid the complexed acid is released by refluxing with concentrated hydrochloric acid and this acid is again solvent extracted and estimated. The error involved in this method is less than 0-6 per cent.

248. THABARAJ, G. J., BOSE, S. M. & NAYUDAMMA, Y. (Central Leather Research Institute, Madras); Effect of pretanning operations on removal of globular proteins and collagenous constituents from hides and skins, *Leath. Sci.*, 10 (1963), 109

Albumin, globulin and mucoid have been obtained in pure form from fresh goat skin. A method employing Folin-phenol reagent for the estimation of skin albumin and globulin and a method for fractional precipitation of albumin, globulin and mucoid have been standardized. Fresh goat skins are exhaustively extracted with 10 per cent sodium chloride solution and with half-saturated lime solution: albumin, globulin and mucoid in the extracts are quantitatively estimated after fractional precipitation. Each globular protein solubilized during different pretanning operations is similarly estimated after fractional precipitation. The loss of collagen during each pretanning operation has also been estimated. Albumin, globulin and mucoid make up c. 2.6, 2.3 and 5.7 per cent respectively of dry goat skin and collagen c. 77.5 per cent. The average per cent removal of albumin, globulin, mucoid and collagen during pretanning operations was 78, 81, 59 and 1.6 respectively, the maximum removal of globular proteins occurring during liming. The other processes

may be arranged in decreasing order as bating, soaking and pickling. The maximum removal of albumin occurs during soaking and of globulin and mucoid during liming.

249. VENKATACHALAM, P. S. (Central Leather Research Institute, Madras): A note on a rapid beamhouse technique suitable for buffalo hides, *Leath. Sci.*, 10 (1963), 264

A method enabling the completion of liming buffalo kips for upper leathers in 3 hr and medium hides for sole leather in c. 18 hr using only pits is reported.

66:676.1 Pulp & Paper

250. LODH, S. B. & RAO, P. R. (Regional Research Laboratory, Jorhat): Rayon grade pulp from ekra reed, *Indian Pulp Pap.*, 17 (8) (1963), 1

Studies on the preparation of rayon grade pulp from ekra reed (*Erianthus ravennae* Beauv.), which is available in Assam in abundance, have shown that rayon grade pulp containing as high as 93 per cent alphacellulose can be obtained in a yield of c. 35 per cent on the dry weight of the reed.

251. LODH, S. B. & RAO, P. R. (Regional Research Laboratory, Jorhat): Rayon grade pulp from munja reed, Res. & Ind., 8 (1963), 33

The results of investigations on the preparation of high alpha-cellulose pulps from munja (Saccharum munja Roxb.) reed occurring abundantly in Jammu and Kashmir are presented. Pulp containing 94 per cent alpha-cellulose can be obtained in a yield of c. 33.4 per cent by prehydrolysing the reed with 1 per cent sulphuric acid under 15 p.s.i.g. pressure for 3 hr and subsequently digesting it at 165° C. for 1 hr with 20 per cent alkali. High grade pulp (alpha-cellulose content, 92 per cent) can also be prepared by initially cooking the reed with 20 per cent alkali at atmospheric pressure and then digesting it by soda process.

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