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Indian Journal of Biochemistry

We had announced earlier that the *Annals of Biochemistry & Experimental Medicine*, which was being published so far by the Indian Institute for Biochemistry & Experimental Medicine, Calcutta, will henceforth be published as a Quarterly by the Publications & Information Directorate, Council of Scientific & Industrial Research, Hillside Road, New Delhi 12. It has now been decided by the Council of Scientific & Industrial Research that the *Annals of Biochemistry & Experimental Medicine* will be published under the title *Indian Journal of Biochemistry* (formerly *Annals of Biochemistry & Experimental Medicine*).

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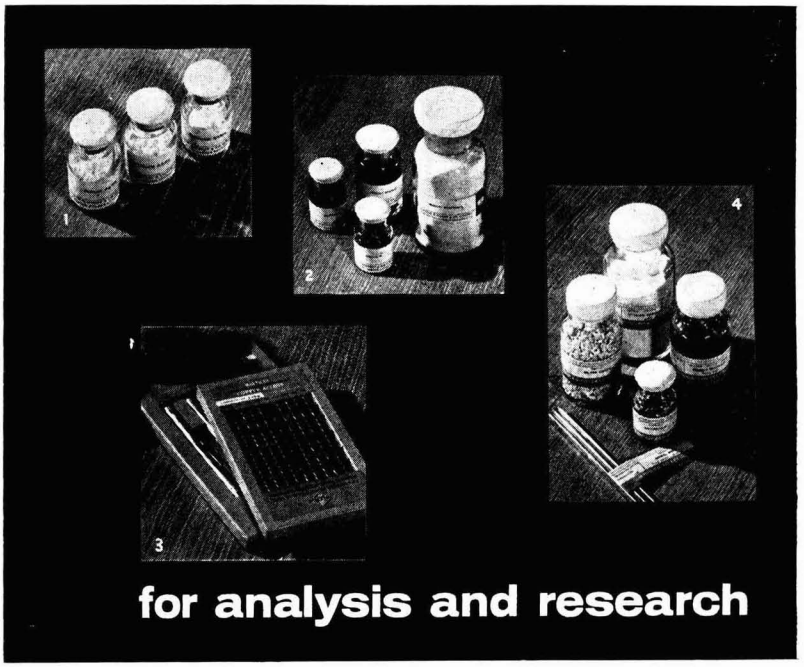

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INDEX TO ADVERTISERS

Current Topics

Research on Problems Posed by High Altitudes

THAT life and work at high altitudes pose a host of problems peculiar to the environment became evident during the military operations on the Himalayan borders, and the recent Seminar on Problems of Internal Combustion Engines at High Altitudes, organized during March by the Research & Development Organization, Ministry of Defence, amply demonstrated the complexity and magnitude of the problems requiring study and solution. The problems encountered at high altitudes are the direct result of rarefied atmosphere and sub-zero temperatures met with in these regions, coupled with difficult and inhospitable terrain which makes transportation and communication difficult. The problems do not merely concern a single area but with a large number of related areas involving many facets closely interlinked with one another. Food, nutrition and water supply, clothing, housing, sanitation, transportation and communication, fuel and power, and other ancillaries, which are intimately concerned with the normal life and work of human beings, all pose problems at high altitudes.

Though considerable research data on many of these problems, with special reference to extreme cold conditions prevailing in the Arctic and Antarctic regions, are available, yet the conditions obtaining in the mountainous terrains at high altitudes are different and are due mainly to reduced air density and extreme ambient temperatures. The problems are new in the sense that not much attention was paid to them in the past in India. Though every effort has to be made to find interim solutions to the more urgent of these problems, the whole subject of high altitude research has to be tackled on a more systematic and long-range basis to achieve a better understanding of the basic aspects of the subject and obtain worthwhile results.

The way some of the problems of internal combustion engines have been attacked and solutions found shows that the necessary talent and skill are available in the country to tackle the diverse problems of high altitude research. Problems of acclimatization of personnel in high altitudes, their food, nutrition and clothing, load carrying capacity, etc., have received attention in the laboratories of defence establishments and other research organizations, but much remains to be done. For example, we still know very little about the types of dwellings that would be most suitable in these areas, and which could be constructed with ease and expeditiously. The problems of providing adequate supplies of fuel and power, which are of primary importance, have to be given top priority. Not much is also known of the pathology of diseases met with in these regions and their therapy. Efforts must be made to develop easy means of transportation and communication, and this means development not only of lightweight prime movers but also of durable equipment and utility appliances. More data have to be collected on the meteorological and other conditions which profoundly affect the living conditions of people staying in these areas.

A long-range planned programme of work is called for to tackle these problems on an adequate scale, and this can be achieved only by greater collaboration between the defence research establishments, the universities and other research organizations. There is need for a more rational use of scientific and technical talent wherever it is available. Research effort on the problems of high altitude should be intensified and expanded in non-defence research establishments which should be encouraged to take up work in these areas. As it is not always possible to carry out work under field conditions, adequate assistance and facilities must be provided to research institutions to set up laboratories where conditions obtaining at high altitudes can be simulated and studies carried out. In other countries, such as USA, such farming out of defence research problems has yielded good results, and this practice could be followed to an increasing extent in India also.

The primary need is to identify the problems needing attention and symposia like the present one on internal combustion engines will go a long way in helping to achieve this end and also indicate possible lines of attack. The Research & Development Organization would do well to organize symposia in other areas of high altitude research so that a clear overall picture emerges as to what the problems are and how to tackle them.

Science Citation Index

RESEARCH scientists are finding it increasingly difficult to keep themselves informed of the progress made even in their own narrow fields of interest on account of the formidable amount of literature published in various languages. Further, not all the published work in their fields is readily available to them. In the indexing systems currently followed by abstracting and bibliographic periodicals indexes are semantically oriented; the so-called meaning is based on the use of words which are not always unambiguous and may lend themselves to different interpretations, especially when the user is not fully conversant with the decoding system of a particular index. Normally, in conventional indexes, 3-5 subject headings are selected which attempt to describe the ' most important ' topics in the source paper. Each such document is treated essentially as an independent unit and is unconnected with the

past literature on the subject, in search of which efforts have to be made elsewhere. Moreover, the conventional index is static in nature and becomes obsolete as the nomenclature of science changes. Another drawback of the conventional system is the encoding by the indexer and decoding by the user who must make himself conversant with the system followed. This becomes cumbersome when a researcher wishes to depart from his field and consult the index in another field of work following a different coding procedure. The selective nature of conventional indexes often omits articles reporting negative results. The commonly used indexing systems provide indexes which lead the user to the document and not the page or paragraph containing the information desired. The publication of *Science Citation Index* (*SCI*) as a quarterly from April 1964 by the Institute for Scientific Information (ISI), Philadelphia, is a new and interesting experiment designed not only to overcome the above difficulties of the research scientist but also to help him in many ways. *SCI* is claimed to provide a variety of features beyond the scope and power of conventional indexing systems. It lists the reference (cited) author and his work, and with it groups together all source (citing) authors and papers, who have referred to the same work since its publication. Each of the author's cited works, accompanied by its citation authors, is arranged chronologically. The index continues to add new works of an author and/or new citation listings to his previously recorded papers. The results of this process are claimed to provide a comprehensive, interdisciplinary, elastic index which is always up to date.

The advantages claimed for the new indexing system are: it brings the research worker forward in time to the most recent published work referring to a particular paper as well takes him back in time and additional material is compiled either by consulting bibliographies appearing in the various citing works or earlier papers of the same author listed in *SCI*; seemingly unrelated material is pulled together, cutting across the disciplinary lines implied by the journal title; older but still currently important information and more recent information are put together. A scientist can find out which scientists are citing his works, using his methods, modifying them and criticizing them.

SCI is claimed to provide answers to a large number of vital questions facing a research scientist: whether (i) a review on the subject has been published, (ii) a concept has been applied, (iii) a chemical has been tested for biological activity and/or clinical evaluation, (iv) a new synthesis has been evolved for a compound, (v) a paper has been abstracted in an abstracting periodical, and (vi) reference has been made to the full paper in the case of a preliminary communication. It is estimated that by the end of 1964 two million citations from 30,000 different publications originating from 30 countries will be indexed.

The ISI should be congratulated for their continuing efforts in developing new methods to keep the research worker informed of up-to-date research information. The success of this attempt will be watched with interest. A user survey of *SCI* may lead to fresh approaches in dealing with the important problem of keeping the research worker posted with as complete and up-to-date information in his field as possible.

Kalinga Prize for 1963

SHRI JAGJIT SINGH, Director of Traffic Transport, Ministry of Railways, Government of India, has been awarded the Kalinga Prize for 1963 for the popularization of science, especially for his efforts to improve the understanding of the fundamental theories of cosmology, relativity and space-time and astrophysics. Shri Jagjit Singh is the first Asian to receive this distinguished international award.

Shri Jagjit Singh

A keen student of mathematics, Shri Jagjit Singh took to popular science writing in 1950 with a series of articles in the *National Herald*, a daily newspaper from Lucknow. His widely read book, *Mathematical Ideas, Their Nature and Daily Use*, was published in 1959 and was followed in 1961 by *Great Ideas* and *Theories of Cosmology*. His other popular science writings include *Mathematics Today* and *Relativity and Cosmological Revolution*, which have been serialized in the *Illustrated Weekly of India*.

The award of the Kalinga Prize to Shri Jagjit Singh will be widely welcomed, and it should serve to provide the much-needed impetus to programmes concerned with popularization of science in the country, and also encourage scientists and non-scientists to take to popular science writing.

Dr P. Nilakantan — Obituary

WE record with regret the death of Dr P. Nilakantan, Director, National Aeronautical Laboratory, Bangalore, on 18 April 1964 at Coimbatore, after a brief illness.

Born in Nagercoil, near Cape Comorin, on 19 April 1910, Parameshwara Nilakantan had a distinguished academic career. After graduating from the Madras University, he proceeded to the Banaras Hindu University, where he obtained the M.Sc. (Physics) degree, topping the list of successful candidates and winning the Chancellor's Gold Medal. In 1935, Dr Nilakantan joined the Indian Institute of Science, Bangalore, and during his six years' stay at the Institute (1935-41), he published 21 research papers and notes on magnetism and X-rays, some independently and others in collaboration with Prof. C. V. Raman. In 1940, he was awarded the degree of Doctor of Science in Physics by the Madras University for his thesis 'Studies in crystal magnetism'.

Dr Nilakantan entered the field of aeronautics when he joined the California Institute of Technology, where he worked on the Cooperative Wind Tunnel Project as a research engineer. After obtaining his M.S. in Aeronautical Engineering from the California Institute of Technology, he served the Hughes' Aircraft Corporation, California, as a senior aerodynamicist and later as Chief of the Vibration and Flutter Analysis Division. Returning to India in 1944, he joined the Aeronautics Department of the Indian Institute of Science as Senior Lecturer in Aerodynamics. He later joined the Civil Aviation Department, Government of India, and was responsible for organizing the Technical Centre of the Civil Aviation Department. Among the notable achievements of the Centre under the direction of Dr Nilakantan, mention may be made of the design and construction of gliders from indigenous timber, plywood and other materials, and development of techniques for scientific investigation of accidents. Dr Nilakantan was associated with aircraft design and development activity at the Hindustan Aircraft Ltd, Bangalore, and was responsible for all the ground work on type certification procedures and testing methods.

Dr P. Nilakantan

In 1952, Dr Nilakantan was invited to take charge of the Wind Power Project of the Council of Scientific & Industrial Research and became the Chairman of the Wind Power Subcommittee. A large-scale wind power survey of the country was carried out under his direction and two types of windmills, specially suited to Indian conditions, were designed.

As Director, Technical Development and Production (Air), Ministry of Defence (1954-59), Dr Nilakantan set up the Aeronautical Development Establishment in Bangalore for working on aeronautical equipment and weapon systems. In June 1959, Dr Nilakantan was appointed the first Director of the National Aeronautical Laboratory, Bangalore. He prepared a comprehensive plan for aeronautical research in the laboratory and organized a number of design groups to work on the integrated wind tunnel centre complex, primarily aimed at providing modern and comprehensive aerodynamic research and test facilities in the transonic-supersonic range. Detailed engineering investigations were also carried out for utilizing indigenous materials and capacity to set up a large-scale unitary storage system to supply air to the wind tunnels.

Dr Nilakantan was the first Indian representative at the Commonwealth Aeronautical Advisory Research Council (CAARC) and did the initial work relating to India's collaboration in Commonwealth aeronautical research. He was the executive delegate for India to the CAARC till 1960. He was responsible for setting up the Aeronautical Society of India which he served first as its Honorary Secretary and later in 1961 as its President. Dr Nilakantan was a Fellow of the American Institute of Aeronautics and Astronautics, and a member of numerous scientific, technical and academic committees.

Problems of Internal Combustion Engines at High Altitudes

MOHAN LAL KHANNA
National Physical Laboratory, New Delhi 12

A SEMINAR on Problems of Internal Combustion (IC) Engines at High Altitudes, organized by the Research & Development Organization of the Ministry of Defence, was held in New Delhi on 16 and 17 March 1964. Welcoming the delegates, Dr S. Bhagavantam, Scientific Adviser to the Ministry of Defence, said that the performance of equipment used by the armed forces for their normal defence tasks at altitudes above 12,000 ft lacked in the desired efficiency on account of the extreme conditions of temperature and pressure encountered there. The problem became more acute with equipment using IC engines as prime movers, which had been designed for optimum operation in the plains and in some cases up to 8000 ft only. In other countries the difficulties experienced were either due to high altitudes or sub-zero temperatures. However, the technical problems faced by working the IC engines above 12,000 ft and ambient temperatures of $-40°$F. and below were loss of power, difficulty of cold starting, freezing of fuels and unsatisfactory lubrication. It, therefore, became necessary to solve these problems by pooling the knowledge and experience of eminent scientists and engineers in the country.

Inaugurating the seminar Shri Y. B. Chavan, Union Minister for Defence, stressed the need for developing indigenous equipment suitable for use under these extreme conditions.

With the rapid progress of research in the country it was considered necessary to establish an active Indian section of the International Combustion Institute so as to encourage studies in the field of combustion. This seminar also coincided with the inauguration of this Indian section by Prof. M. S. Thacker, Member, Planning Commission, who agreed to serve as its first chairman. Prof. N. P. W. Moore, Indian Institute of Technology, New Delhi, would be its first secretary. With a vote of thanks by Brig. N. B. Grant, Director of Engineering and chief organizer of the seminar, the opening session came to a close.

In his introductory talk in the preliminary general session of the seminar, Maj.-Gen. B. D. Kapur, Chief Controller of Research and Development, briefly reviewed the " defence problems of high altitude and sub-zero temperature in general ". He emphasized that these problems were unique and new to this country and had to be tackled as a task of national importance. In order to classify these problems in their correct technical perspective, he asked the participants to suggest solutions for certain urgent problems, which could be implemented without further experimentation and to recommend line of action for further research.

' Efforts made by Council of Scientific & Industrial Research (CSIR) in respect of defence problems at high altitudes ' were highlighted by Lt-Gen. Sir H. Williams (CSIR, New Delhi). Decompression chamber for studying the effect of altitude on the performance of an IC engine in the laboratory at the Central Mechanical Engineering Research Institute (CMERI), Durgapur, the behaviour of fuels and lubricants at sub-zero temperatures at the Indian Institute of Petroleum (IIP), Dehra Dun, the structure of different types of steels at the National Metallurgical Laboratory (NML), Jamshedpur, the lead-acid and the nickel-cadmium batteries at the Central Electrochemical Research Institute (CECRI), Karaikudi, the effect of wind velocity and snow weight on the behaviour of different types of hutments at the Central Building Research Institute (CBRI), Roorkee, etc., were some of the examples cited so as to indicate the different fields in which CSIR laboratories are actively engaged.

Prof. N. P. W. Moore, Indian Institute of Technology, New Delhi, in his paper on the effect of high altitude on combustion reported that the literature available on the subject is very rich and could be advantageously applied to find solutions to the problems being discussed at the seminar. With the help of graphs he explained that with the decrease in pressure the quenching distance increases and the minimum energy required to initiate flame in the charge also increases. Ultimately a region is reached where the charge cannot be burnt on account of the high energy required. He dealt at length with the new field of combustion research being followed at the present moment in USA, UK, etc., in spherical vessels provided with a large number of ports and burning premixed fuel and air. He also stated that diesel combustion was extremely complicated and showed with the help of a diagram as to how with the change of temperature and pressure, keeping the compression ratio (CR) constant, one passes from the region of ignition to ' no combustion region '. Its practical utility lay when designing new diesel engines for use at high altitudes.

The seminar conducted its deliberations in the following four technical sessions: (1) Immediate remedial measures of power loss; (2) Immediate remedial measures at cold starting; (3) Immediate remedial measures about fuel and lubricants; and (4) Long-term research on new engines and superchargers.

Power Loss and Measures to Overcome It

The first technical session on ' Immediate remedial measures of power loss ' was presided over by Maj.-Gen. S. P. Vohra, Director, EME, Army Headquarters. Introducing the subject, he said that the problem of power loss was encountered for the first time when operating automotive equipment in terrains at a height of *c.* 8000 ft during 1948-49.

At an altitude of 1000 ft, the power loss in the output of the vehicle engine is nearly 3 per cent. When operating at 14,000 ft and above, the problem becomes very acute on account of incomplete combustion of fuel with less of available oxygen, rapid wearing out of engine parts and reduced power output. The reduction of jet size, increase in CR and use of fuel with high octane number are of very little use. Remedial measures suggested for some of these problems can be implemented without further experimentation, while long-range measures could be followed up with research. He indicated that superchargers for use with engines below 40 h.p. are not available, while those for engines above 40 h.p. are designed to match engine of particular h.p., make and type and, therefore, their availability for each engine is not certain. Under the existing circumstances, it is necessary to develop lightweight engines in the ranges 1-15 and 16-40 h.p., with weight/power ratio of 2/3 of the existing conventional engines and silent to operate. It is necessary to evolve designs of standard superchargers suitable for engines in the above h.p. ranges and those for 40-100, 101-200 and 201-300 h.p. ranges. The problems faced are unique in the sense that the simultaneous effect of high altitude and sub-zero temperature on the performance of IC engines has never so far been encountered in another terrain throughout the world. Solutions to these problems have to be found by pooling the efforts of researchers in this field. Discussing 'Compensating loss of power at high altitude for stationary diesel engines below 40 h.p.', T. R. Sarkari (IIT, Bombay) did not consider it feasible to compensate the power loss by the conventional methods of supercharging on account of insufficient power gained and an appreciable increase in weight/power ratio of the engine together with the supercharger. The limitations imposed on supercharging by the conventional methods were calculated with the help of equations. In view of the urgent necessity to operate these engines to full capacity at these high altitudes, it was suggested that the restoration of power loss could be secured by enriching the atmospheric air with oxygen during its intake to the engine. The arrangement for the supply of oxygen from the oxygen bottles was discussed. 'Altitude and other correction factors for output and consumption of IC engines at atmospheric conditions' were estimated by K. S. Shah (University of Baroda, Baroda) with the help of different formulae for power output and fuel consumption for given atmospheric conditions based on the engine performance at mean sea level or any other reference condition. Their practicability for naturally aspirated engines, both Otto and Diesel, was discussed. Of the two methods considered to regain 'Loss of power at high altitudes' by S. K. Bansal and B. K. Sharma (Ghaziabad Engineering Co., New Delhi), supercharging was better than the use of higher compression ratios as the latter suffered from the disadvantages of higher cylinder temperatures, of increase in mean pressure leading to increase of maximum pressure of combustion and of the use of fuels of higher octane number. The piston cylinder type, positive rotary blower, such as Roots and vane type and centrifugal type of superchargers were briefly discussed. In their paper on 'Supercharging of IC engines', G. R. Damodaran and G. Shanmugam showed that the power loss in diesel engine is less than that in a gasoline engine due to altitude effect. The increased quantity of air consumed on account of supercharging as compared to a naturally aspirated engine burns more fuel thereby increasing the power output. The extra power generated does not affect the peak pressure and temperature. Exhaust operated supercharger is preferred over the engine driven one. However, the mechanically driven supercharger is recommended for use with smaller h.p. engines and the turbocharger for higher h.p. engines.

Before introducing the three papers on the different aspects of the problems being discussed in the seminar, J. R. Thiery, French expert working presently at IIP, Dehra Dun, remarked that the extent of troubles experienced with the performance of IC engines related to the engine designs, fuels, lubricants, etc., and the mutual interferences of one parameter with others have to be taken together for assessing the overall performance, though literature available deals with the variation of a single parameter on engine performance. R. A. Rao and B. A. Chitnavis discussed 'Some possible remedial measures for counteracting the problem of power loss of IC engines at high altitudes'. In typical cases of possible temperature limits and at an altitude between 12,000 and 18,000 ft estimated power losses of SI and CI vehicle engines have been tabulated. The remedial measures suggested have been classified into three groups based on time factor, as immediately applicable, medium range and long range. The first category does not involve serious design modifications. One such measure is to enrich the intake air with ready supply of oxygen to the power plants. However, it only serves to boost up power when needed and should not be considered for regular use. Use of fuels for augmenting power and reducing specific air consumption and further charging with oxygen bearing additives, of suitable spark timing, of increasing CR and of using altitude compensator carburettors contribute to help regain power loss. With CI engines, use of suitable injection timing and factors to reduce the ignition delay as with the use of high cetane fuels equally contribute to counteract power loss. By suitably altering the intake and exhaust systems of the existing vehicle power plants, it may be possible, at the expense of some other factors, to increase its volumetric efficiency, which directly translates it into power increase.

Some of the medium range measures are: making provision for two power plants feeding on to the same output shaft, the use of an engine more powerful than necessary for normal service, and provision of a low speed gear in the gear-box to provide extremely high torques. However, the most important measure would be the designing of a suitable supercharging system for the existing power plants. Turbocharging appears to be best suited for automotive engines and stationary engines undergoing wide variations of load. In order to maintain constant inlet manifold pressure or density, suitable

pressure or density censors be provided together with suitable controls and regulators. For improving the acceleration characteristics of turbocharged engines, it is suggested to provide a mechanical device for its rotor acting through an over-running clutch brought into operation during starting, idling and very light loads.

For long-range measures, 2-stroke, rotary type gas turbine, free piston turbine combination types of power plants are suggested. Though the last mentioned seems to meet most of the requirements, yet considerable amount of development work is required. Mention was also made of fuel cells, stirling cycle power source with direct electrical drives for the vehicles.

In his paper ' Medium size diesel engines for high altitude low temperature service ', D. D. Suryawanshi (Kirloskar Oil Engines Ltd, Kirkee) dealt with the actual performance of Kirloskar RA3 air-cooled diesel engine of 17 h.p. With the laboratory facilities provided by the French Government, the bench tests conducted with this engine revealed that the CR should be raised from 17 : 1 to 23 : 1 when operating at altitudes above 7000 ft. The CR increase, brought about by piston change, compensated for the low atmospheric pressure as well as temperature resulting in proper fuel combustion. It has been suggested that power loss in engines developing more than 40 h.p. could be compensated by supercharging, while the CR be increased in engines with h.p. below 40. In order to overcome the problems of cold starting, measures suggested are a retarding device in the fuel pump, an extra carburettor or a ' start pilot ' unit, an electric heater installed in the inlet manifold and run by the engine battery, engine canopy insulated with glass wool for use during the shut-down period and the use of 32 V. high ampere battery instead of 24 V. battery. The use of electric immersion heaters for heating sump oil is to be avoided on account of increased oil sludging and of the formation of vapour lock. When operating at 16,500 ft in midwinter the h.p. of the original engine was reduced to 11. Service trials conducted so far with the modified engine are very encouraging. This indigenous engine could be manufactured and delivered without much difficulty.

In the discussion that followed it was clearly brought out that simply carrying of oxygen bottles and its mixing with intake air of the IC engine is not the solution of the power loss. Certain modifications in the engine cylinder or the combustion system will have to be made so that the movement of air and fuel in the cylinder is adjusted to bring about efficient and effective combustion. Selection of superchargers, especially turbochargers, should be made such that it properly matches with the engine whose efficiency is not affected when worked in combination with each other. The existing engine should be replaced by another commercially available engine of higher output. Though raising of the CR up to a limit can somewhat compensate for power loss, yet the benefits recurred are limited and poor. Summing up the session, the chairman remarked that immediate ready solution of the problems has not emerged as a result of the papers and discussion, but the various aspects of the problems are better understood by the participants than before.

Cold Starting of IC Engines

The second technical session relating to ' Immediate remedial measures of cold starting ' was presided over by G. S. Chowdhri, Deputy Director, Central Mechanical Engineering Research Institute, Durgapur. Introducing the subject he remarked that we should take advantage of the work already done in other countries, especially of Dr Austin and others on the cold starting of diesel and petrol engines. Factors, such as combustion chamber design, piston rings, engine valves, cranking speed, previous cycle, leakages, condition of battery, etc., effect cold starting. The existing devices such as start pilot, swing fire equipment and glow plugs fail when operating at temperatures below −10°C. New devices, suitable for temperatures up to −40°C., should be developed and be capable of working off the engine. The overall criterion should be easy and quick starting from the point of view of the driver of the vehicle.

In his paper on ' Cold starting and operating problems of IC engines and their solution ', K. S. Shah (MS University of Baroda, Baroda) discussed the different measures for cold starting of IC engines and recommended the adoption of one or more of these for modifying the service engines. Measures suggested were addition of pour-point depressants, such as ' Santopour ' and ' Acryloids ', to lubricants or its dilution with 5 per cent alcohol, doping of diesel fuel with ethyl nitrate, isoamyl nitrate or acetonate peroxide, addition of ether or alcohol to petrol, use of petrol with Reid vapour pressure below 0·5 kg./cm.^{2} and with octane number less than 50 as a starting fuel for diesel engines, use of double spark plugs or a multiple sparking plug at low temperatures, lagging of fuel pipes and preheating of filters, use of starting aids like CAV ' thermostat ' increased injection pressure, supply of richer air-fuel mixture, stratification of charge, use of one battery for ignition and another for cranking and making provision for an arrangement to prevent the slipping of starter motor bendix drive until sustained firing is achieved.

Suggestions made by K. D. S. R. Somayajulu, J. C. Miles and R. C. Mokadam (IIT, Kharagpur) in their paper for overcoming problems of cold starting of IC engines were the provision of a long leverage cranking handle for easy exertion effort by two men, provision for depressing the intake and exhaust valve to relieve compression as a starting aid, enclosure of engine, battery and fuel by an adiabatic blanket for the combined mass to act as a heat accumulator, use of high volatile, low ignition temperature fuel capsules, such as diethyl ether, use of a pilot heater to heat lubricant, oil sump in conjunction with adiabatic blanket and the use of nickel-cadmium battery in place of the lead-acid battery. N. N. Narayan Rao (MIT, Madras) enumerated the methods used by the US army for cold starting of their vehicular engines in the temperature range −32° to −54°C. These involve the use of special fuels, oils and other fluids,

injection of diethyl ether in the intake manifold, preheating of engine, use of dry type air cleaners and provision of winter front for shearing ice. B. S. Murthy and D. S. Ranganath (Birla Institute of Technology, Ranchi) suggested the use of bi-fuel arrangement as an answer to cold starting of diesel engines under the conditions existing at high altitudes. Bi-fuel arrangement involves the use of glow plugs, air intake heaters, cartridge saturated with sodium nitrate or slow burning cordite cartridge, momentary increase of CR by the addition of a little lubricating oil into the air inlet valve, late opening of inlet valve to raise air temperature and of priming aids. Regular fuel is ignited by the use of dual fuel arrangement, wherein a second fuel of low self-ignition temperature and high volatility is introduced into the induction manifold suitably through a secondary fuel system till the primary fuel starts burning properly. Ether is considered most suitable. Preliminary trials conducted with a design for ether-air mixture unit for starting a diesel engine at −40°F. and 12,000 ft altitude have yielded encouraging results

The effect of low temperature and pressure on combustion was discussed by S. Guruswamy (Central Mining Research Station, Dhanbad). He concluded that the lowering of temperature and pressure of intake air in IC engines would produce adverse effects and the problems could be overcome by enriching the oxygen content of air, by injection of N_2O gas in the combustion zone and by the addition of suitable oxygen-containing materials to the fuel.

According to G. C. Joshi and A. G. Menon [DRL (Materials), Kanpur], cold starting trouble is intricate in the case of diesel engines and depends on mechanical factors such as cranking. But it is not so acute with gasoline engines using MT Gasoline Sub-zero down to −25°F. Same is the case with diesel engines operating on Diesel Fuel Sub-zero. Both these engine fuels and a cold starting fuel for severe cold climate were developed in the laboratory. It is felt that with the actuating device fitted to the engine, easy starting at −40°F. and above at high altitudes with these fuels is possible. However, the choice of proper lubricants, the use of auxiliary heating devices and other mechanical and thermal aids are necessary for facilitating cranking without which cold starting becomes almost impossible. According to P. L. Ballancy (Delhi Polytechnic, Delhi), the problems of cold starting can be solved successfully by resorting to bi-fuel combustion process. This is supported by the results of other workers and of his own experiments conducted on a CFR engine coupled to an electric dynamometer. These studies have revealed the oxidation of auxiliary fuel during compression stroke, initiation of primary fuel combustion, higher peak pressures with lower rates of pressure rise and power boost up to 15 per cent. However, this work needs further examination to arrive at a concrete solution to the problem. H. V. Udupa (CECRI, Karaikudi) and D. V. Virkar (College of Military Engineering, Poona) discussed in two different papers the performance of the lead-acid batteries, which is adversely affected by sub-zero temperatures due to increase in viscosity of the electrolyte, lowering in coefficient of diffusion, increase in electrical resistivity of electrolyte and freezing of the electrolyte. Though development efforts have not produced batteries with acceptable service levels at −40°F., yet suggestions to improve its performance are: thinning down the plates, incorporating barium sulphate in the negative plates to prevent polarization, and coalescing of spongy lead, warming up and retaining of heat arrangement. However, the use of nickel-cadmium and zinc-silver oxide batteries has also been recommended as an immediate solution of the problem.

Summing up, the session chairman remarked that there was no substitute for heat and keeping engines, batteries and ancillary equipment warm by wrapping in an insulation blanket or electric heater element with an automatic switch or by burning stoves, etc., does help in cold starting of engines. A combination of various available starting aids would help to ease the situation. The use of two batteries of higher capacity and the arrangement for keeping them warm and fully charged were recommended.

Fuels and Lubricants

Dr J. N. Nanda, Director, DRL (Materials), Kanpur, presided over the third technical session on 'Immediate remedial measures about fuels and lubricants'. A. D. Tuteja and K. S. Anand (IIP, Dehra Dun) discussed the fuel problems at high altitudes and sub-zero temperatures. To maintain the volatility of the gasoline to the highest possible level is desired as its reduction affects the starting and acceleration characteristics. Practical suggestions to reduce vapour lock and to improve fuel system design were given. The use of an additive in the fuel helps to prevent the ice crystal formation in the gasoline as well as diesel fuel. The octane requirement of the engine goes down when operating at high altitudes and with low temperatures. It, therefore, necessitates no change in octane rating of the fuel unless for increasing the power output; CR is increased or supercharging is introduced when it should be adjusted according to requirements. In order to bridge the wide gap between the volatility characteristics of the fuel for cold starting and for avoidance of vapour lock, the use of starting fluid and the maintenance of permissible highest volatility are recommended. In the case of the diesel engine, the usual diesel fuel with cetane number increased to 60 fails to operate below −15°F. For effective starting at −50°F. and above, the use of starting fluid, diethyl ether, is advised with careful handling. Starting too cold an engine with ether may damage it and, therefore, heating of the engine block as well as the coolant before starting is absolutely necessary. For proper operation, proper flow characteristics of the fuel should be maintained. The same could be achieved by undercutting the fuel in refining to remove the heavier fractions or the use of superior kerosene. The immediate remedial measure would be to dilute the fuel with kerosene or aviation turbine fuel (ATF). A. G. Menon and J. N. Nanda [DRL (Materials), Kanpur] reported that the factors

affecting the fuel performance in SI engines at high altitudes are atmospheric pressure, temperature, humidity, solar radiation intensity and the terrain. Motor Gasoline 80 Octane Sub-zero was developed in the laboratory to cater for operation of engines under these conditions (−15° to −40°F.). It has now been introduced in service after its indigenous production was established. The diesel fuels for engines at high altitude were discussed by G. C. Joshi and A. G. Menon [DRL (Materials), Kanpur]. By blending diesel fuel and ATF, sub-zero grade fuel for operation from 0° to −40°F. and winter grade fuel for operation from 0° to −50°F. were developed in the laboratory. The cetane number of the blends prepared were higher than that of HSD used for blending. Their indigenous production has been established and these two grades have been introduced. The use of isoamyl nitrate in low concentrations improves the cetane number of the stock.

'Development of suitable lubricants and hydraulic fluids for low temperature operation of IC engines' was discussed by M. C. Verma, J. R. Narang and A. G. Menon [DRL (Materials), Kanpur]. Experimental data on the pour point and viscosities of lubricating oils and hydraulic brake fluids, the low temperature torques and apparent viscosities of greases were obtained in the laboratory. In order to get the correct viscosity, the methods followed were either to blend two oils or to dilute the available oil with a volatile liquid available in the vehicle. The latter method was very convenient and is followed in other countries. A multipurpose grease for use in the temperature range −50° to 120°F. has been introduced into service.

Dealing with the problems of lubrication of IC engines operating at high altitude and low temperatures, P. K. Goel and R. K. Gupta (IIP, Dehra Dun) considered the friction reducing property and its detergency to be the most important functions of an efficient lubricants. For this, lubricants must possess exceptional viscosity-temperature characteristics or VI to be 160. Such products can be produced but their availability and high cost preclude them from use. Some of the suggestions made to overcome the difficulties of lubrication at high altitudes are: temporary dilution of lubricating oil with petrol, ATF, etc., the use of inertia and pneumatic starters, draining of crankcase oil after stop and heating it before putting it back in the crankcase, quick heating system for coolant to be used for heating crankcase oil, battery and other engine parts, etc. The use of oiliness additives and solid lubricants in lubricant may help to reduce the resistance at the cylinder walls. The detergency of the oil is affected by the introduction of condensed moisture either during its storage or during its operation in the crankcase. In addition to good detergent characteristics of oil itself, frequent oil renewal and sump oil operation at 90°C. are recommended.

During the discussion mention was made of the use of HD multi-grade engine oils meeting MIL-L-2104B, the use of lubricants and fuels used during the British expedition to South Pole [Pratt, D. L., Christie, G. M., Coxon, E. F. & Lodwick, J. R., *J. Inst. Petrol.*, **45** (1959), 19], the effect of cold weather on petroleum products used in the vehicle engine [*Lubrication*, **19** (1964), 33-44], and equivalents of fuels and lubricants used in Russia. Summing up the proceedings of the session, the chairman observed that work done in other countries and mentioned in the literature should provide necessary guidance for future work in this country. The simultaneous effect of altitude and low temperatures was new and unique in the sense that it had not been experienced elsewhere. While indigenous production of lubricants and fuels had been achieved, the development of all types of additives was to be undertaken in the country.

Long-term Research on New IC Engines and Superchargers

The fourth session on 'Long-term research on new engines and superchargers' was presided over by Maj.-Gen. Harkirat Singh, Engineer-in-Chief, Army Headquarters, New Delhi. Introducing the subject, he remarked that the vehicle has to move in the mountainous terrains and, therefore, the modifications could not be effected from mile to mile but should be simple, robust, easily transportable and in keeping with the requirements. The suggested remedies could form the future course of research work to be pursued by the R. & D. Organization of the Ministry of Defence, Government of India, the national and university laboratories and the various industries in the country. The development of an engine capable of satisfactory operation between the ambient temperature range of −40° and 110°F. and altitude range of 2000 and 18,000 ft was required. Its maintenance should be simple and the engine need not be shut down very often for repairs.

Describing the experience gained and measures taken when operating diesel engines at high altitudes, R. Kloss (Koein-Deutz, Protos Engineering Co. Ltd, Bombay) observed that the Deutz engines in Cologne had proved that air-cooled diesel engines were the ideal source of power for military purposes. The problems to be overcome were its starting behaviour and power output. The experimentally determined power loss was less than that calculated with the usual methods based on constant air conditions. The experimental arrangement for simulating conditions of altitude were described. How far the power loss could be compensated by the use of an exhaust gas turbocharger or a mechanical Helical gear supercharger was explained. As regards starting troubles he explained the brief assistance from the starter, self-acceleration of the engine, positive ignition during the initial stage of starting and the influence of oil viscosity on the starting torque. The use of the Eberspaecher hot air blower for preheating the engine to start at extremely low temperatures was described.

The use of free piston devices for high altitude and sub-zero temperature service was advocated by N. S. Nandeeswaraiya (College of Military Engineering, Kirkee). The free piston engines have the advantages of simplicity, ease of cold starting, fuel economy, lightness, vibration-free operation and 18 per cent loss of power output at 20,000 ft.

These engines had been developed in foreign countries and had been successfully used for power generation, pumping stations, etc., but lot of more work has to be done before it is a commercial success. M. L. Khanna and G. C. Garg (NPL, New Delhi) discussed the use of superchargers with CI engines. The eight different methods of supercharging were described. The present trend is to use exhaust gas supercharging because of increased specific power output, reduced specific fuel consumption, reduced cost, increased reliability and cheaper operation. The recent studies of Chatterton and Wallace on the combination of CI and gas turbine engines have indicated it to be advantageous for traction purposes from the point of view of operational efficiency as well as of mechanical simplicity.

T. R. Jagadeesan (College of Engineering, Guindy) discussed two results of an investigation on the use of superchargers for low h.p. diesel engines. Supercharging increases the mean effective pressure by an increase in the inlet manifold pressure and could be achieved by compressors driven either independently, mechanically by an engine or by an exhaust gas turbocharger. However, the engine driven centrifugal compressor is best suited for low h.p. engine on account of good part load performance characteristics. N. N. Narayan Rao (Madras Institute of Technology, Madras) examined the matching of a supercharger to a series of engines. There is a maximum and a minimum limit of air flow handled by an engine. Since this entire mass of air is to be handled by the supercharger, the air requirement could, thus, be plotted on the compressor characteristic by two matching lines. When the same supercharger is used with a range of similar engines, it follows that the gear ratio between engine and supercharger should be altered. The possibility of developing lightweight engines was examined by N. S. Murthy and Darshan Lal (IIT, Kharagpur). Reduction in weight could be achieved by the use of light materials, like aluminium alloys wherever possible and of precision casting technique with minimum sections. 'Design considerations for lightweight IC engines for high altitude operation' were discussed by K. S. Shah (MS University of Baroda, Baroda). Supercharging the engine would restore the power output and solve cold starting problems. The Roots blower is ideal for the purpose. Heating of both fuel and lubricant is necessary and for efficient combustion multiple-spark plugs should be provided.

T. V. Lakshman Rao (Osmania University, Hyderabad) examined an analytical method for selection and matching of a turbosupercharger to a CI engine. The supercharger is put in to increase the air breathing capacity of the engine by increasing the inlet manifold pressure. Type of service, performance required, type of control system, ambient conditions, engine characteristics, etc., are some of the considerations to be taken into account for correct matching. For analytical matching, the supercharger-engine combination should be taken as a two-stage compressor with widely different operating characteristics. The air flow requirements of the engine and that of the supercharger are plotted against boost and their meeting point gives the matching conditions. Matching of components has also to be studied in detail. For example, in the case of turbosupercharged engines, matching of turbine and engine, turbine and compressor, nozzle and turbine and turbocharger unit to the engine has to be taken into account. In his paper on 'The materials of construction of diesel engines at low temperatures' A. N. Oak (Kirloskar Oil Engines Ltd, Poona) observed that materials exhibited different properties under low temperature conditions, which should be carefully considered. For example, steel shows brittle fracture under conditions of low temperature, triaxial stresses and high rate of impact loading. Thermal stresses, residual stresses, composition and manufacture also influence brittle failure sensitivity. S. V. Sastry (Kirloskar Oil Engines Ltd, Poona) considered some aspects of high altitude simulator design. The altitude simulator being designed will simulate altitude conditions in the range of 8000 and 15,000 ft and temperatures of $-25°$ to $+25°$C. These conditions in the chamber, to be used for evaluating the engine performance, are obtained by expanding cool dry compressed air over two turbines. The first phase of the project consists of trying out the turbines and the production of low temperatures using the available air mass flows. The next phase will be to incorporate modifications to the cycle envisaged to ensure design conditions. 'Design parameters for superchargers used for altitude correction of the output of automotive engines' were discussed by S. J. Shah (MS University of Baroda, Baroda). Its capacity, power requirement and control system to be employed should be taken into account while selecting a supercharger. For use with a petrol engine, it should be mounted before the carburettor. Adjustments to fuel flow and spark-timing shoud be made. Similar adjustments are also necessary for diesel engines. The limit of supercharging in petrol engines is 1·3 kg./cm.^{2}, when fuel of octane number 75 is used and after cooling is not resorted to. For diesel engines, thermal loading limits the pressure to 1·5 kg./cm.^{2}, which can be raised to 2·4 kg./cm.^{2}, if overlap is increased to 120° and effective cooling of cylinder walls is adopted. Considering supercharging possibilities, K. D. S. R. Somayajulu and J. C. Miles (IIT, Kharagpur) said that there is a possibility of compressing air separately in one or more 'boost cylinders' and of delivering it to the other power cylinders of an engine at appropriate times for further compression. Calculations show that a given 3-cylinder engine would develop 33 per cent more power if one of the three cylinders is used as a boost cylinder than if all the three are used as power cylinders. A V-4 engine with one boost cylinder would increase power output by 66 per cent. Such a system would have the additional advantages of simplified lubrication and cooling systems, altitude supercharge control, efficient compression and good torque characteristics. R. S. Chaudhri [R. & D. Establishment (Engrs), Poona] reviewed the military characteristics of IC engines in the lower output range for use at high altitudes. These special requirements are not met by any of

the commercially available engines in the country. To meet these requirements indigenous development of a family of petrol engines consisting of three series covering engines of 1, 2, 4, 8, 16 and 32 h.p. has been suggested. Arrangement for easy starting under extremely low temperatures and of suppression of noise should be provided in these engines, whose weight/power ratio may be reduced by the use of lightweight materials.

Papers were followed by considerable discussion when useful suggestions were made by individuals, research and industrial organizations and personnel of the armed forces. On behalf of the Indian Engine Manufacturers' Association, Shri S. L. Kirloskar offered the utilization of the facilities available in the industry by individuals and research organizations interested in the development of suitable engines meeting the needs of the army. Messrs Greaves Cotton & Co. Ltd announced the development of self-starters for cold starting. An intimate contact between the army, research centres and the industry was stressed for the future. Summing up the session proceedings, the chairman remarked that he noticed a keen interest evinced by the participants in understanding the problems presently faced by the Indian army and by making useful suggestions. Concluding the seminar Maj.-Gen. B. D. Kapur observed that the seminar had been a great success and had served a very useful purpose in understanding different viewpoints. It was intended to publish in full the text of the papers of the various sessions together with the complete discussions that followed.

The seminar succeeded to a very great measure in coordinating the effort of the defence scientist who presented the problems to the designer in the correct perspective, and the industrialist who produces the goods according to the blue prints of the design and in an overall speedy execution of this task.

International Symposium on Lipid Transport

J. GANGULY

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THE International Symposium on Lipid Transport was organized by the Vanderbilt University School of Medicine, Nashville (Tenn.), USA, and was held on 10 and 11 October 1963. In all, 12 speakers were invited to present papers, one each from Canada, Sweden, England, Israel and India, and the rest from USA. The symposium was attended by nearly 500 scientists, most of whom were from the USA.

The symposium was divided into four sessions spread over two days, each day having one session in the morning and another in the afternoon. The respective sessions were as follows: *Intestinal absorption of lipids*: Chairman, Prof. A. C. Frazer (Birmingham, UK); *Regulation of plasma lipids*: Chairman, Prof. D. B. Zilversmit (Memphis, Tenn.); *Lipid transport in adipose tissue*: Chairman, Prof. V. P. Dole (New York); and *Lipid transport in the liver*: Chairman, Prof. R. J. Havel (San Francisco, Calif.).

Prof. B. Borgstrom (Sweden) described his work on the presence of 2-monoglyceride in the micellar state in the lumen of the small intestine at the time of fat absorption. Extensive data were presented describing the optimum physico-chemical conditions necessary for the production of the micellar 2-monoglyceride in the intestine. Apparently, the products formed during the course of lypolysis give rise to mixed monoglyceride-fatty acid-bile salt micelle. The micellar 2-monoglyceride then readily enters the mucosal cell.

Dr J. Ganguly (India) presented the most recent work at the Indian Institute of Science, Bangalore, on the mechanism of absorption of cholesterol and vitamin A. Ingested cholesterol esters are first de-esterified, when the cholesterol forms a micelle in the intestine. The micellar sterol then rapidly displaces the cholesterol molecules of the lipoproteins of the membranous structures, like the cell membrane and the endoplasmic reticulum of the mucosal cells and thereby enters the cell. The sterols, thus displaced, are re-esterified with unsaturated fatty acids at the point where they leave the cell and enter the lymph. The fed vitamin A esters, on the other hand, are de-esterified in the lumen, the free alcohol then crosses the cell membrane and is re-esterified inside the mucosal cell, whereupon the ester is automatically released into the cytoplasm. Vitamin A palmitate is specifically removed from the mucosa and is deposited in the Kupffer cells of the liver. Apparently, both these fat-soluble compounds are thrown out of fat solution and are absorbed at the molecular level by totally different mechanisms.

Prof. S. L. Palay (Boston) produced excellent electron micrographs that distinctly showed the existence of micro-microvilli around each microvillus. But these slides did not appear to convince the audience about his claims that fat is absorbed by a process of pinocytosis.

Prof. J. L. Oncley (Ann Arbor, Michigan) reviewed in detail the composition of various plasma

lipo-proteins and their role in transport and metabolism of lipids. Almost all of the plasma lipids are firmly bound to proteins and most of the lipid components of plasma lipo-proteins are in rapid and dynamic equilibrium with one another and with the various tissues. Photographs of the models of plasma lipo-proteins showed spherical shapes for the lipo-protein complex, with a layer of polar peptide and phospholipid residues surrounding a core of non-polar lipids and non-polar peptide residues.

Prof. D. J. Hanahan (Seattle, Washington) discussed the uptake of palmitic acid-1-C^{14} and linoleic acid-1-C^{14} in the triglycerides and phospholipids of liver, plasma and erythrocytes of adult rats. Apparently, the sphingomyelins of the liver and plasma, as well as of the erythrocytes, showed no uptake, while the phosphatidyl choline of both liver and plasma had the highest specific activity. The fatty acids of liver triglycerides seem to be specifically positioned while, in contrast, those of plasma triglycerides are probably randomly distributed.

Prof. J. F. Danielli (Buffalo, New York) discussed several models of cell membrane and the possible mechanisms of transport across biological membranes.

Prof. G. F. Cahill, Jr, (Boston) developed the thesis that lipid metabolism in adipose tissues is to a great extent controlled by hormones. Thus, while incorporation and lipogenesis are mainly regulated by insulin activity, lipid mobilization depends upon many hormonal factors, in addition to the availability of glucose. The most interesting point in this connection is the presence of sympathetic innervation that locally produces epinephrine, which in turn accelerates lipolysis of the adipose tissues.

Prof. B. Shapiro (Israel) discussed the mechanism of synthesis of triglycerides in adipose tissues. The fatty acids attached to the plasma albumin are removed by the adipose tissue particles, after which they are esterified with either α-glycerophosphate or diglyceride. The fatty acid moiety of the triglyceride, thus formed, undergoes a rapid redistribution on the endogenous glycerol compounds, which can be demonstrated by the rapid exchange of the glycerol moiety of these triglycerides. The glyceride glycerol of adipose tissue can originate from pyruvate as well as from glucose and glycogen.

Prof. H. Sheldon (Canada) produced excellent electron micrographs and autoradiographic data on the adipose tissue from fasted rats which were re-fed. These techniques enabled him to localize an isotope with a resolution to 0·1 μ and to follow the *in vitro* incorporation of labelled fatty acids into the triglycerides by the adipose tissues of the epididymal fat pads. This work has shown that about 90 per cent of the labelled fatty acids is rapidly incorporated into the triglycerides.

Dr D. S. Robinson (Oxford) reviewed the literature on the uptake and release of those lipids, triglycerides and free fatty acids (FFA), which are of importance to the body tissues as sources of metabolic energy. During absorption, fatty acids enter the blood from the thoracic duct as triglycerides in the chylomicra. A portion of this triglyceride goes to the liver, where it is rapidly hydrolysed. A considerable portion of the fatty acid, thus released, is reconverted to triglycerides and returned to the blood stream in the low density lipo-proteins to be distributed to extrahepatic tissues. Thus the low density lipo-proteins assume great significance for transporting triglycerides from the liver to the extrahepatic tissues. This hypothesis has been supported by recent work, where it has been shown that the accumulation of triglycerides in the liver, as caused by hepatotoxic agents, may be accounted for by a block in the hepatic lipo-protein formation.

According to Prof. H. A. Eder (New York) almost all lipids that are transported from the liver are in the form of lipo-proteins. The formation in the liver, and release into plasma, of these lipo-proteins can be regulated by several factors, like (i) the availability of suitable proteins, (ii) the availability of the lipids, (iii) combination of proteins and lipids, and (iv) the release of complete lipo-proteins. He was able to demonstrate that the protein can be obtained by *de novo* synthesis in the liver, because inhibition of *de novo* protein synthesis led to a decrease in the release of lipids.

Prof. D. W. Fawcett (Boston) reviewed with the help of electron micrographs the normal histological organization of the liver.

The symposium successfully brought out the facts that (1) the lipo-proteins play an indispensable role in the organization of the ultrastructure of all biological membranes and in the transport and metabolism of lipids, and (2) that the adipose tissues are probably metabolically more active than most other tissues. But the most significant development appears to be in the field of fat absorption, which has eluded many investigators for nearly a century, during which time several theories were put forward and rejected. The luminar phase of absorption is seemingly much better understood now, in that it appears certain that the lipase hydrolyses the triglycerides to 2-monoglyceride, which then appears in the micellar state and enters the cell. But how exactly the 2-monoglyceride becomes the triglyceride inside the mucosal cell is not clear yet. Perhaps the next few years will witness some interesting pictures of the cellular phase of absorption.

The entire proceedings will shortly be published by Charles Thomas as *Lipid transport.*

The Application of Modern Technical Practices in the Iron & Steel Industry to Developing Countries

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AN inter-regional Symposium on the Application of Modern Technical Practices in the Iron and Steel Industry to Developing Countries, sponsored by six UN specialized agencies, viz. Centre for Industrial Development, Economic Commission for Europe, Economic Commission for Africa and the Far East, Economic Commission for Latin America, and the Bureau for Technical Assistance Operations, was inaugurated in Prague on 11 November 1963 by Mr Josef Khajei, Minister of Metallurgical and Ore Mining Industry of the Czechoslovakian Government. Representatives from over 75 countries participated in the symposium. India was represented by Dr B. R. Nijhawan (National Metallurgical Laboratory, Jamshedpur), Mr B. S. Krishnamachar (Indian Standards Institution, New Delhi) and Dr M. N. Dastur (M. N. Dastur & Co., Calcutta). The technical sessions in Prague lasted a week and were followed by visits to iron and steel plants and centres of metallurgical interest in the UK, Federal Republic of Germany, France, Italy, Poland and Czechoslovakia. The symposium came to an end at Geneva after a two-day concluding technical session.

The symposium served to focus attention on the conditions under which iron and steel industries had grown in the advanced countries and which may advantageously be applied in the case of developing countries. The advances made by the iron and steel industry during the last decade were highlighted, with special emphasis on technical and economic criteria for establishing iron and steel industry in the developing countries. The symposium elaborated, in particular, on the preparation and beneficiation of raw materials for the iron and steel industry, based on latest research and operational data available from plants successfully operating today.

The main subjects discussed at 15 technical sessions at Prague were: (1) Current position of raw materials for the iron and steel industry, and the status of the industry in different regions of the world; (2) Problems facing the steel industry and their solution in the light of modern practices in the iron and steel industry; and (3) Factors specific to iron and steel industry in the developing countries.

The main problems facing the developing nations were summarized as follows: insufficient or inadequate reserves of raw materials, especially coking coal; limited transportation facilities; varying economic structure and shortage of technical manpower; need for a broad product mix in plants of a relatively small capacity; and difficulty in establishing the initial capacity levels in the face of a fast expanding market. The symposium brought home the realization that no country, advanced or developing, could afford to develop its iron and steel industry without the application of 'applied research', whose 'content' must be indigenous. It was pointed out that while heavy and light equipment could perhaps be advantageously imported, mere import of 'research technology' would hardly achieve the ends.

A paper entitled 'Growth pattern of iron and steel industry in India's economic development', giving an outline of the progressive development of iron and steel industry in India during the successive five-year plans, was presented by Dr B. R. Nijhawan. The researches carried out at the National Metallurgical Laboratory, Jamshedpur, and elsewhere were highlighted. Reference was also made to the projected growth pattern of the iron and steel industry, including the production of alloy, tool, special and stainless steels. The urgent need for setting up small plants for foundry iron production in different parts of the country, based on regional raw materials and also of ferroalloy industry in India for producing specialized range of ferroalloys with exceedingly low impurity content, needed for the production of alloy, tool, special and stainless steels was stressed. Comprehensive pilot plant trials and other studies carried out at the National Metallurgical Laboratory, Jamshedpur, during the past several years have been largely concerned with the formulation of optimum beneficiation treatments of indigenous raw materials, their agglomeration and sintering, reducibility, etc., and the work has led to a better appreciation of the importance of utilizing indigenous raw materials for the successful development of iron and steel industry and also for developing processing techniques specially suited for them.

Dr M. N. Dastur's paper dealing with small steel plants and their role in the economy of the developing countries was well received for its advocacy of small plants and their highly favourable potential in developing countries. The paper made an excellent appraisal of the relative economics of small plants and integrated steel complexes. Mr B. S. Krishnamachar presented a paper on steel standards and standardization.

A problem peculiar to India and some other developing countries is that while possessing large deposits of high grade iron ore, they are faced with serious shortage of coking coal. Among the solutions suggested for the problem were: the use of low temperature coke made from non-coking coals for iron-making; reduction in coke consumption by using higher hot-blast temperatures; and the use of self-fluxing sinters and pre-reduced iron pellets. The use of charcoal for iron smelting was cited based on current practice at Wundwvuie in Western Australia and at Bhadravati in India.

Several papers discussed modifications in the original 'top blown' oxygen converter. Other

modifications discussed concern the rotation of the vessel in the Kaldo and Rotor processes, and injection of powdered lime, either directly or with the oxygen stream, and side-blown basic lined converter steel-making. These developments in pneumatic steel-making methods are of special significance to developing countries in view of their low capital cost and the feasibility of small iron and steel plants.

Increased adoption of mechanized ore mining had led to increased output of ore fines. It is, therefore, becoming increasingly important to develop processes capable of utilizing ore fines, flue dust, coke breeze, limestone fines, etc. Several papers dealt with agglomeration techniques, such as pelletizing, briquetting and sintering, their spheres of application, economics and relative merits. Several recently developed methods based on the use of iron ore fines and ultrafines were discussed.

The blast furnace will continue to be the basic unit for the smelting of iron ores, notwithstanding the interesting possibilities that direct reduction methods promise, if and when they are developed for successful commercial operation. The technical papers and discussions on this subject established that standard blast furnace practice is experiencing a revolution of its own which will widen its sphere of application and usefulness. Modifications in burden preparation, injection of pulverized coal and hydrocarbon in the hearth region, use of higher blast temperatures, oxygen enrichment, high top pressure and other modifications fully justify the prediction that the coke requirements to produce a ton of pig iron may one day be less than 500 kg.

It was generally agreed that small iron and steel plants would be justified in the developing countries. While planning a new plant, it is always necessary to keep in view the range of products required and, therefore, it may be worth while planning the installation of integrated plants. It was agreed that the lack of sufficient reserves of raw materials does not preclude the establishment of iron and steel industry in the developing countries. Examples of countries like Japan which wholly or partially depend on imports for their raw materials are well known. The primary factor for the creation of a steel industry is not the availability of raw materials, but the existence of a home and export market. Developing nations generally face adverse trade balances and thus cannot depend on steel imports indefinitely, although the present tendency in advanced countries is of overproduction and price reduction of finished products.

The visits of the delegates to iron and steel plants and metallurgical research centres, particularly those in the UK, were highly rewarding. Among the places visited was the Spencer Steel Works, Richard Thomas and Baldwin, one of the most modern integrated iron and steel works in the world and the 'steel pride' of Britain. It was observed that the iron and steel industry in UK was basically raw material oriented, while progressively introducing the latest automation methods, including the use of computer control to streamline production.

Space, Time & Elementary Particles*

HENRY P. STAPP†

BEING in India it is not unfitting for me to speak of transmigration. The transmigration I shall refer to is not of souls, however, but of ideas. Regardless of the destinies of souls it is the fate of ideas to be born, to die and to be born again in different guises. The topic is relevant today because ancient and cherished ideas about the nature of space, time and elementary particles are being severely challenged by current developments in elementary particle physics, and their deaths seem imminent.

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John Kenneth Galbraith, the recent American Ambassador to India, emphasized in his book, *The Affluent Society*, that events and the ideas that interpret them are capable of quite independent lives. The vested interest in basic ideas is so great that they become self-sustaining, even though in their independent lives they may lose touch with reality and become obsolete. They remain virtually impregnable to the attack of fresh ideas. The fatal blow comes, in the words of Galbraith, only when they "... fail signally to deal with some contingency to which their obsolescence has made them palpably inapplicable".

Early Concepts of Space

Inquiry into the nature of space and time can be traced in the western traditions back to Parmenides, who proved that empty space could not exist.

He argued on the following lines: (1) A thing either exists or it doesn't exist; it is either real or not real; (2) Empty space is devoid of every real thing; (3) A thing cannot be both a real thing and devoid of every real thing; (4) Hence empty space is not a real thing — it does not exist. Motion is the shifting of a thing from an occupied space into a formerly empty space. As empty space is not real, motion is not real. Parmenides concludes from these considerations that the world must be regarded as one solid lump of matter, for ever immutable and unchanging.

This view of the world has attractive features. It has undeniable simplicity. It has logical unity and compactness. It is aesthetically neat. It may appear a little at odds with experience, but it is well known, and readily demonstrated, that things are not always what they seem. Since the laws of logic are absolute, one must accept their consequence and regard the appearances as deceptive. In spite of their attractiveness, Parmenides' views were not universally accepted among the Greeks. However, they were definitely taken seriously and other thinkers had to reconcile their views with Parmenides' arguments.

The most important counter-proposal from the point of view of science was that of Democritus. He accepted Parmenides' arguments regarding the nature of the world, but proposed that there can be many worlds. These worlds, which are the solid immutable objects of Parmenides, were called atoms. They moved about in an otherwise empty space. It is interesting that even in these early beginnings the nature of particles was closely tied to the nature of space.

The beginning of modern science seemed to revive these ideas. The contributions of Dalton, Newton and others were most readily understood in terms of the idea of indestructible atoms moving in an otherwise empty space. Thus the views of Democritus, if not reborn, were at least revitalized.

Wave Concept of Light

The triumph was, however, not to endure. Even in Newton's time the strange behaviour of light was difficult to reconcile with the particle viewpoint. If light is allowed to travel from a source to a screen via two alternative paths, then the distribution of light falling on the screen is not the same as the sum of the distributions when the two paths are individually opened; the net amount falling at a point when both paths are simultaneously open for one minute is not the same as when the paths are consecutively opened for a minute. This interference between the two possible paths cannot be understood as an interference between different particles travelling along different paths, because such an effect would vanish when the source became so weak that only one particle at a time was being transmitted. But the interference effect is in fact independent of the source strength.

The interference phenomenon is easily understood if light is assumed to be a kind of wave motion, like waves upon the sea. However, a medium to transmit these waves is needed. This medium would fill space, which would then be nowhere empty.

This wave picture of light seemed unquestionably confirmed when Maxwell's theory of electromagnetic phenomena was found to automatically give a detailed quantitative description of all the known properties of light, including the interference phenomena. In Maxwell's theory, light is a wave motion. The medium transmitting this wave was called ether, and was computed to be millions of times harder than steel. Since particles such as electrons are most easily pictured as merely local irregularities in this medium, one is brought back to a view similar to that of Parmenides: space is filled with a hard solid substance — empty space does not exist.

Relativistic Concepts

This view was destroyed in its turn by the theory of relativity. When efforts to detect the motion of the earth relative to the ether failed, Einstein suggested that the laws of nature were such as to make the detection of motion relative to the ether impossible in principle. This idea was validated in many areas. But to say that the state of motion of the ether is undetectable in principle comes close to saying that the motion of ether is meaningless. In any case, it was not a useful idea, and it withered.

The theory of relativity did not, however, lead back to the notion of empty space as a simple ' void '. In the first place, space became partially interchangeable with time. Formerly the two ideas were quite distinct; time referred to an ordering of events, space referred to their location. But in relativity two events that one man regards as simultaneous, hence separated only in space, will be regarded as separated in both space and time, in another man's view. Neither viewpoint can be regarded as preferred, in so far as physics can tell. Thus the distinction between ' before ' and ' after ' becomes enmeshed with ' here ' and ' there ', and a more general concept of space-time separation emerges.

Because the instant of time now has, in relativity theory, only a local significance, one can no longer think of the history of the universe as a whole as gradually unfolding; this requires a preferred definition of ' now '. Rather the whole history of the universe is laid out like a map and the idea that the past and future are separated by what is ' happening now ' is just a matter of limited perspective; Parmenides' distrust in appearances was borne out.

In general relativity there is a still further departure from the conception of empty space as a simple void. For there empty space has non-uniform properties. Space is basically a framework supporting a system of distances. In general relativity distance relationships vary from point to point, even in empty spaces. Thus empty space, while devoid of all matter, is not devoid of every real thing; relationships regarding distances, while not matter, are none the less real. This distinction provides for an alternative not considered by Parmenides, and hence a way out of his dilemma: empty space is devoid of all substance, but is not devoid of every real thing.

Quantum Mechanical Ideas

A somewhat similar but independent solution is provided by quantum mechanics. In quantum mechanics, a particle is represented by a function defined at every point in space-time. Thus space is completely filled. Yet the function represents only a probability that some event will occur. Now a probability is not a substance, and the wave function cannot be considered to represent a substance, because it is subject to sudden changes in the far reaches of the universe due to changes in available information. Yet in quantum mechanics there is, besides mental events, nothing but the wave function.

As the wave function is defined throughout space, and there is nothing else in space, and the wave function represents nothing that can be considered a substance, we have a space completely filled with something but completely devoid of substances; space is completely filled but totally void.

Particle and Field Concepts

As the concept of space developed through these various stages, the picture of the elementary particle in that space was correspondingly changed. For Democritus each particle was a hard solid indestructible object. They interacted with one another by collisions, like billiard balls. In Newtonian mechanics, particles could interact at a distance, without coming into actual contact. Thus it was not necessary to ascribe to them any finite size; they could be confined to points. Instead of size the important property of a Newtonian particle was its mass; each particle has a unique well-defined mass. Since mass was measured by weight, the mass could be considered a measure of the 'amount of matter' carried by the particle. Mass was a concept independent of the spatial properties of position and size.

For Maxwell it was not clear whether a particle was confined to a point or not. If it was a point particle then the theory implied that its mass was infinite, unless there was some unknown compensating factor.

But in relativity theory it seemed that particles must be confined to points, for if extended in space then they must be extended also in time. This led to awkwardness, if not actual inconsistency.

In both Maxwell's theory and relativity theory there were, in addition to particles, also fields. Whereas particles were localized, fields were defined over all space. Thus nature was represented as a compromise between Parmenides and Democritus.

This compromise was unified by the quantum theory in which a particle is represented by a wave function, which like a field is defined over all space. This function is associated with the event of 'finding the particle' at the various points in space. Because the probability of finding the particle simultaneously at two different points is zero, one can conclude that the wave function refers to the 'centre' of the particle. As there are (in standard treatments) no extra parameters corresponding to other parts of the particle, one has, in effect, a point particle, which is described, however, by a wave function defined over all the space.

Quantum Field Theory

A minor miracle occurs when the (same) quantum principles are applied to fields. If the fields are non-interacting, then the quantum principles imply that each field can be associated with a function that is the wave function of a particle. Thus the distinction between particles and fields disappears; both are aspects of a single entity, at least for the non-interacting case. The two classical concepts merge into a single quantum concept.

This elegant result is obtained for the case of non-interacting particles — for an idealized world in which every particle moves for ever in a straight line. One possible way to extend the theory to more realistic cases is to add a contact interaction between the point particles. This procedure has had some remarkable successes, and also some serious difficulties. The difficulties seem due basically to the necessarily singular nature of the contact interaction between point particles; the interaction has to be infinitely large to give any effect at all, and this infinity, when compounded, leads to difficulties. One difficulty is that the observable quantities are not defined in terms of the original quantities in a properly mathematical way; the theory is apparently not mathematically consistent.

A related problem is the unobservability of fields. The theory is built upon the concept of a field, which is a mathematical object defined at every point of space and time. In Maxwell's theory, a field represents a quantity whose value at any point of space and time can be experimentally determined. But Maxwell's theory does not correspond to reality because of quantum effects. Yet when the quantum effects are introduced one finds that fields in small space-time regions are not observable; if one tries to measure such a quantity the effect of the space-time constraint is such as to cause the apparatus to disintegrate, due to the phenomena of particle creation, which is inherent in a relativistic quantum theory. Thus, one is left in the position of having built a theory to explain measurements of a quantity which the theory then shows impossible to measure.

The quantities that can be related to experience are probabilities associated with the presence or absence of particles. The defining characteristic of a particle is its mass. In the case of no interaction there was a close connection between fields and particles. The subsequent introduction of the interaction destroyed this connection; particles correspond to eigenstates and field corresponds to nothing — they are certain abstract entities. Stated in this way the possibility suggests itself that may be a wrong move was made at the passage to the interacting case, namely that one should have stuck with the particles rather than going off with the fields.

S-Matrix Theory

The theory associated with the 'particle alternative' is called S-matrix theory. The S-matrix is essentially the collection of all quantities referring to the particles. These constitute only an infinitely small subset of the quantities appearing in the field theory approach.

In the past few years it has been convincingly demonstrated, if not actually proved, that one can deduce all the results concerning the S-matrix that were formerly obtained from field theory directly from considerations involving only the S-matrix itself. That is, the very strong requirements imposed in the field theory upon the connection between the field theoretic quantities and the S-matrix, and between the various field theoretic quantities themselves can be ignored; one can deal solely with relationships among the S-matrix quantities themselves. The calculations are in fact greatly simplified because none of the difficulties associated with the apparent inconsistencies of field theory arise. That is, the results come out in automatically renormalized form without the use of special techniques for avoiding divergences. Moreover, the new methods seem much more powerful than the old; they are being pursued with success in the area of strong interactions, where field theory had been completely ineffectual. Also the S-matrix approach seems to provide for a calculation of masses and coupling constants. This was outside the realm of conventional field theory.

In view of these impressive achievements let us adopt the view that the S-matrix or particle alternative is right and that the field alternative is wrong, and inquire as to the impact of this on the concepts of space and time.

In S-matrix theory the basic variable is not the space-time coordinate x but is rather the momentum-energy variable k. The relationship between these two resides in the fact that two systems differing from each other by a translation by an amount x are represented by functions which differ by a phase factor $\exp(ikx)$. In field theory where states corresponding to all values of k are allowed, one can find a superposition of these that has the property of being orthogonal to a translation of itself by any finite amount. One can, therefore, build up a system of orthogonal states, with one for each space-time point. These can be identified with the physical situation where the particle is at the corresponding point.

The basic difference between S-matrix theory and field theory is that in S-matrix the value of k is restricted by the mass shell constraint, $k^2 = m^2$. The notion that there should be something corresponding to this particle but with a non-physical value of the mass is rejected; an eigenvector is associated with its eigenvalue, not with a continuum of non-eigenvalues. A consequence of the mass constraint is that the construction of the space-time continuum from momentum space can no longer be carried out. In this sense space-time does not exist; there is no framework of points corresponding to the possible positions of the particles. Space-time is not, then, a framework of possible positions of a particle. It is rather a framework of possible translations of a particle. Thus, the notion of a particle's being at a point is lost; one can speak only of the shifting of a particle by a certain amount.

This sounds a little like the old idea of relativity of position—only relative position can be defined. Certainly this idea is at least contained. But we are referring to a situation where all particles but one are fixed, and hence can serve as a reference. Even then the space-time coordinates do not define a set of possible positions of the particle but a set of possible translations of it.

How does the argument of Parmenides fare now? Previously we got around his assertion that empty space was devoid of every real thing by noting that it could be just devoid of every material thing, yet not devoid of every real thing. This circumvention was a consequence essentially of a better understanding of the possible kinds of things; space was essentially, as before, a system of possible positions. In the S-matrix view, space is a set of possible translations. The concept of empty space simply does not arise. There are translations and other translations but no idea of emptiness.

Although from today's perspective Parmenides' conclusions are erroneous, his rejection of the naive concept of space as a simple void seems supported. But one would dare say that the last word has now been said.

Study of the Upper Atmosphere at the Thumba Equatorial Rocket Launching Station Using Sodium Cloud Technique

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ON 21 November 1963 the first research rocket carrying a sodium vapour payload was launched from the Thumba Equatorial Rocket Launching Station (TERLS) established by the Indian National Committee for Space Research (INCOSPAR). The scientific objective is the study of the upper atmosphere. The project is a modest start of space research on the Indian soil with the help of sounding rockets. The atmosphere of the earth between 40 and 300 km. is extensively studied by sounding rockets. This is because the atmosphere above 40 km. is too thin to sustain a research vehicle like balloon, while still not thin enough up to about 300 km. to allow a satellite to continue long in orbit. Among different techniques used with the sounding rockets, release of sodium vapour clouds between heights 70 and 200 km. for the study of the dynamics of the atmosphere in this region has now become a well-established technique.

Release of sodium vapour in the upper atmosphere as a tracer element was first suggested by Bates[1] and was successfully tried for the first time by Edwards *et al.*[2]. Since then several similar studies[3-16] have been made at a number of places on the earth, and the information about wind velocities, wind shears, turbulence, temperature and density of the upper atmosphere in the altitude region between 70 and 200 km. has been deduced from observations of the sodium vapour clouds. However, all such previous studies were carried out at latitudes higher than 30° in both the hemispheres and no data about the upper atmosphere were available near the equator, till the first launching from TERLS in November 1963. The first three successful rocket launchings, which were supported by the NASA, the CNES and the INCOSPAR, have revealed interesting results.

Instrumentation

Rocket payload — The sodium vapour rocket payload is a pyrotechnic device and requires careful handling during its preparation, storage and use. The payload consists of a strong metal cylinder tightly packed (*c.* 1000 p.s.i.) with a mixture of thermite and small sodium metal pellets, an electrical squib to ignite the thermite, and an electronic device for igniting the squib at a predetermined time after the rocket is launched. The heat of the burning thermite which generates a temperature of about 1000°C. vaporizes the sodium, and the vapour is dispersed in the atmosphere through the vent holes in the metal cylinder wall, along the rocket trajectory. Sometimes, along with sodium, other metals like potassium and lithium are also mixed as tracer elements in the vapour payloads. The sketch of the sodium vaporizer used at TERLS is shown in Fig. 1. The payloads used during the three rocket launchings from TERLS were packed with a mixture of 1·4 kg. of sodium, 0·4 kg. of potassium and 6 kg. of thermite. On the top of the above mixture a small layer of thermite was placed, and above this another small layer of high grade starter thermite was packed; the latter was in contact with two thermal squibs.

The electronic timer was a solid state device consisting of a calibrated RC circuit controlled transistor, which allows enough current to flow through the thermal squib at the desired time and is attached to the top of the vaporizer. The circuit was powered by an 18 V. nickel-cadmium cell, which was freshly charged just before the rocket launch for reliable operation. Two separate timing circuits controlling two independent squibs were used to insure against any malfunction. The battery power was kept off when the rocket was on the ground, and the acceleration at the time of rocket launch initiated a gravity switch, which put on the power to the electronic timer.

The payloads used in the launchings so far made were kindly supplied by the Centre National D'Etudes Spatiales (CNES) of France under a collaboration agreement, and it has been proposed to use in future experiments payloads which will be fabricated in India with the help of the Defence Research Laboratories, Government of India.

Photographic equipment — All the scientific information about the dynamics of the upper atmosphere is derived from the high speed aerial photographs taken and other optical observations of the vapour trail. For the Indian programme Kodak type K-24 cameras supplied by the National Aeronautics & Space Administration (NASA) of the USA were used. The Kodak type K-24 is an aerial reconnaissance camera, with a fixed focus,

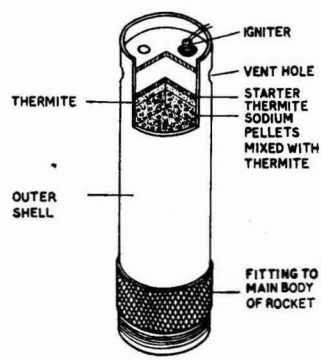

Fig. 1 — Sketch of the sodium vaporizer used at the TERLS

178 mm., f/2·5 Aero Ektar lens, and a removable automatic, electrically operated film magazine. It accepts 5½ in. wide film, and gives a large-size sharp picture of 5 in. square format. An arrangement is made in the camera to put fiducial marks on each picture frame so that it will be possible to define the position of each photographic frame with respect to the camera body.

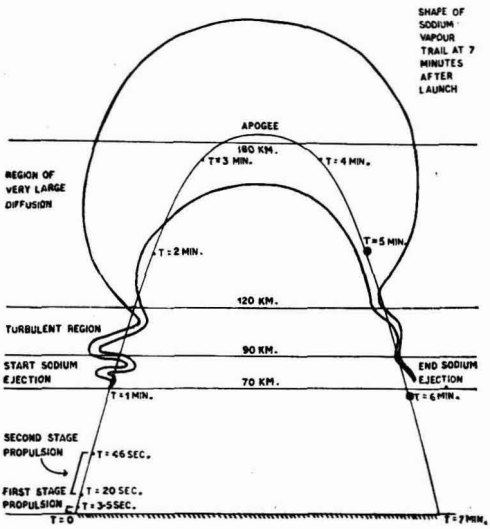

Fig. 2 — Schematic diagram showing the rocket trajectory, sequence of operations and formation of the sodium vapour cloud

Experimental Technique

The sodium vapour released in the high atmosphere glows brilliantly because of the fluorescent scattering of the sunlight at 5890 and 5896 A. The experiment was performed during morning or evening twilight at a time when the atmosphere below *c.* 40 km. altitude is in the earth's shadow and, therefore, the background sky light is dim. Under such background light conditions the trail appears as a very conspicuous bright object, visible at distances up to about 500 km. if the sky is clear. From the average performance characteristics of the rocket used as a vehicle it is the usual practice to adjust the timings so that the vapour ejection starts at an altitude of *c.* 70 km. and continues at least up to somewhere beyond the apogee of the rocket trajectory. For the payload used in the Indian launchings, the squib ignition timer and the burning time of the vaporizer were adjusted so that the ejection started at an altitude of *c.* 100 km. on the upward leg of the trajectory, and continued till the rocket reached about the same height on the downward leg. Fig. 2 shows schematically the sequence of operations, and the formation of the sodium vapour trail in a typical experiment. The trail outline is the approximate shape of the projection of the sodium vapour discharge from the rocket on a vertical plane parallel to the rocket trajectory 7 min. after the rocket launch. In Fig. 3, the actual photographs of the trail taken from Palayamkottai on 21 November 1963 are shown.

Observations

Determination of atmospheric winds — Atmospheric wind structure is measured by recording the positions of the sodium cloud with time against those of

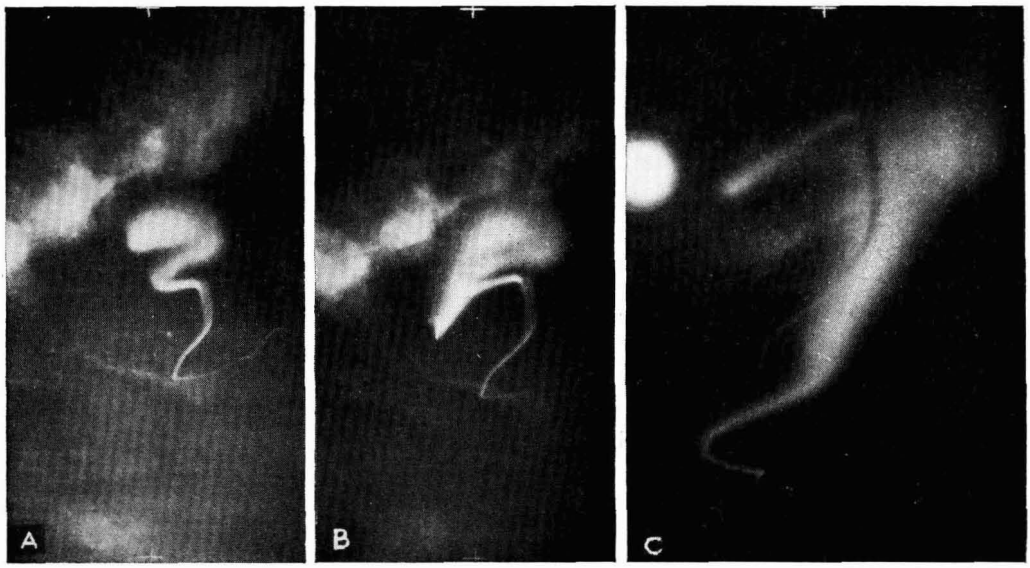

Fig. 3 — Sodium cloud pictures taken from Palayamkottai on 21 November 1963 [Time of taking of the photographs after the launching of the rocket: A, 195 sec.; B, 255 sec.; and C, 555 sec.]

known stars. This is accomplished from time coincident photographs of the sodium trail taken in succession from at least two photographic stations situated at a known distance apart — the exposure sequence and exposure times being predetermined. Camera directions are determined accurately from the positions of the known stars which form the background of the vapour trail photographs. Then with the help of standard triangulation techniques[17-20] the space coordinates of the points on the trail are obtained at each instant. From evaluated displacements of the identifiable points in a known interval of time the wind velocity vectors at different heights can then be determined.

For triangulation, theoretically two camera stations are enough. However, it is advisable to operate more than two stations. Clear cloudless and haze-free sky conditions are absolutely necessary for obtaining usable photographs. Weather changes sometimes occur unexpectedly and if more than two camera stations are operated one need not give up a scheduled rocket launching as long as clear conditions are available at least at two stations. It is also common practice to operate more than one camera at each station to overcome failures which may develop at the last moment. During the November 1963 and January 1964 launchings from TERLS, four camera stations, with two cameras at each station, were operated. The geographic locations of the camera stations are indicated in Fig. 4. Knowledge of the latitude and longitude of the camera stations correct to about one-tenth of a minute of arc is absolutely necessary for accurate triangulation. The distance of the camera station from the expected rocket trajectory has to be sufficiently large so that large pictures of the whole trail are obtained. At the same time the distance of the camera station from the rocket trajectory should not be very large, i.e. the distance should be

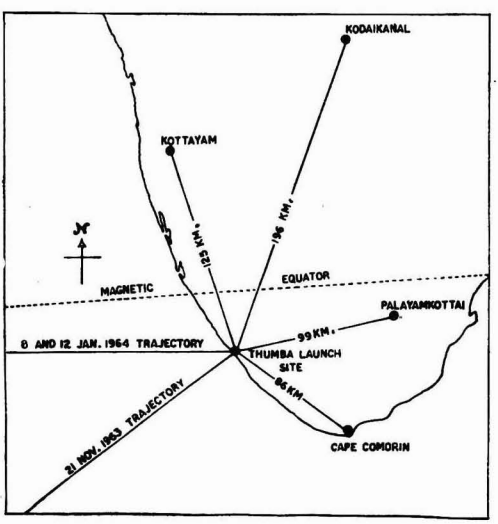

Fig. 4 — Geographic locations of the rocket launch site and the camera stations

such that the angle subtended by the bottom-most point of the trail is at an elevation of at least 15° from the horizon since at angles of elevation less than 15° haze and absorption in the atmosphere reduce the apparent trail brightness.

Good and reliable communication facility between the camera stations and the rocket launching station is absolutely necessary, so that the camera stations can continuously report the visibility conditions to the launching site as often as possible. For time coincident photography and for determination of the camera axis from star positions in the photographs, the exposures are to be given at precisely prefixed times from the instant of the launching of the rocket. Hence transmission of correct time signal to the camera site from the headquarters is also very important. Very reliable telephone communication was arranged by the Indian Posts & Telegraphs Department during the time of the three sodium vapour payload launchings from TERLS. The India Meteorological Department also played an important role by forecasting weather and visibility conditions at the camera stations.

Turbulence measurements — These measurements are made by taking pictures of the turbulent region of the trail with fast cameras having very long focus. Prof. J. E. Blamont of France, who is a collaborator for the Indian sodium vapour payload rocket experiments, took observations for turbulence measurements during January 1964 launchings with a long focus camera specially designed for this purpose.

Diffusion measurements — Diffusivity in the high atmosphere is determined by measuring the rate of sodium trail expansion at different heights. The same photographs, from which wind velocities are determined, are used for this study. The vapour, when released, is at a higher temperature than the air and has a higher pressure. It undergoes a quick initial expansion, and reaches ambient conditions in a short time of the order of 1 min. After this initial spurt in expansion, the expansion takes place by diffusive processes. The usual practice for the evaluation of the coefficient of diffusion is to measure the trail diameters at different heights and express their changes as functions of time, and compare these expressions with analytical expressions predicted on theoretical grounds involving the coefficient of diffusion.

Temperature measurements — The temperature of different regions of the trail, situated at different heights, could be derived by measuring the Doppler broadening of the resonance lines emitted by the vapour trail. As the vapour trail reaches ambient conditions quickly, the temperature determination by this method gives the atmospheric temperature at different heights directly.

One method[8] is based on measuring the linewidths of sodium D lines by Fabry-Perot interferometer. This method, though simple, does not yield very accurate temperature measurements. A more accurate method has been developed by Blamont *et al.*[21], in which they compare the directly observed intensity I_0 of the light emitted from a point in the cloud, with the intensity I_1 from the same point but observed after passing through a sodium vapour absorption cell of known optical thickness, and kept

at a known constant temperature. The ratio $R = I_1/I_0$ is a function of the ratio of the cloud temperature and of the absorbing vapour temperature.

For temperature measurements it is necessary that an optically thin cloud should be observed. On the other hand, for good photographic records of wind velocity determinations, the clouds should be bright; a large amount of sodium is used to make the cloud optically very thick. For temperature measurements, therefore, another vapour like potassium is introduced in a smaller quantity which gives an optically thinner cloud for temperature determinations. This technique was made use of during the rocket launchings from TERLS in January 1964.

Results of all these measurements will be published in due course.

Scientific Objectives and Future Programme

The rocket range at Thumba is situated about 8° north of the geographic equator and almost on the magnetic equator. The sodium vapour experiments conducted from this range are the first such investigations near the equator. Very little is known at present about the wind system above an altitude of 80 km. of the atmosphere, and at the moment no data are available for the neutral equatorial atmosphere at these heights. Thus the results coming out of these experiments will be of great significance.

Large variations of the magnetic field are observed by a ground-based magnetogram near the magnetic equator. These variations are attributed to an intense ribbon of current called the equatorial electroject, flowing along the magnetic equator at a height of about 120 km. in the E region of the ionosphere. The equatorial ionosphere, including this equatorial electrojet current, is yet insufficiently understood, and an extensive programme of study is being undertaken by a number of scientists from different institutions in India. A study of atmospheric parameters like temperature, turbulence, magnetic field, electron density, electron temperature, ion constitution, drift velocities of the inhomogeneities in the E region, and the drift velocity of the neutral atmosphere is included in this programme. Sodium vapour cloud experiments which form a part of this programme will provide information about the movements of the neutral atmosphere. Because of the drawback of the sodium vapour cloud technique, viz. that it can be used only during twilight hours (morning or evening), it has been proposed to undertake a programme of study of the night-time atmosphere by the release of self-luminescent clouds of other chemicals. The sodium cloud release and self-luminous cloud release experiments will be complementary to each other, and by combining the results of both sets of experiments it will be possible to study the diurnal variations of winds and tides in the upper atmosphere.

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Observations on Flying Locusts by Radar

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THE problem of locusts is one of the oldest in history and remains still one of the most baffling for agriculturists. The regions most affected by locust invasions are the northern parts of Africa and South-west Asia. North-west India suffers periodically from invasions by these insects flying across Baluchistan and Sind in West Pakistan and Afghanistan.

The important features of studies so far made on desert locusts, particularly in relation to synoptic meteorology, have been discussed in considerable detail in a recent publication[1] by the World Meteorological Organization. Double exposure photography, making use of cameras directed vertically upwards[2], and reconnaissances conducted from aircraft[3] have so far been the main sources for providing basic data for study of locust swarms in various situations. The potentialities of the use of centimetric radar for studies in this field do not appear to have been given much attention till now. The purpose of this paper is to present to the readers a few sample photographs* of locust swarms as seen on the radar, and discuss the possibilities of using radar for the study of some of the detailed characteristics of swarm formations, their flight activity leading to progressive displacement in a certain manner or tendency to concentrate over a region.

Equipment Used and Genesis of Study

The Rain & Cloud Physics Research Unit at the National Physical Laboratory, New Delhi, has in use a Japanese microwave radar (wavelength, 3·2 cm.; peak power, 250 kW.; pulse width, 1 μsec.; pulse repetition frequency, 300 per sec.; and beam width at half power points, 1°) since 1957, for studies of details relating to precipitation processes of clouds of different types within a radius of 360 km. around Delhi. The unit has had, as one of its programme of work, systematic cloud-seeding trials at Delhi during the south-west monsoon season (July-September). In this connection, use has been made of the radar set since 1961 to help in the assessment of results of cloud-seeding experiments by observing with it progressive developments of rain cells over target and control sectors on all seedable days during the period of the experiment. The radar pictures of locusts forming the basis of the present paper were obtained as a sequel to such studies during the monsoon season of 1962.

Radar Reflections from Birds and Insects

In trying to explain the phenomenon of 'angels' (radar echoes from clear sky) consideration has been given by a number of investigators to the feasibility of detecting reflections, on the radar screen, from flying birds and insects. The ability of a radar to detect the presence of birds and insects has been well demonstrated in studies made by Richardson *et al.*[4], Bonham and Blake[5] and Crawford[6]. The radars used for such observations ranged in their frequency of operation from 200 to 30,000 Mc/s. Considering that the sensitivity of the receiver in the radar set used in the present study is 89 dbm. (overall sensitivity of the set is such that it can detect rain drops of diameter about 0·33 mm. at a distance of 100 km., if present in a concentration of 10 per litre) and the wavelength on which it works is 3·2 cm., one could reasonably expect that the equipment in use would be quite suitable for obtaining reflections from birds and insects. That, in the situation under discussion, the observed radar reflections were due entirely to scattering by locust swarms was evident from the fact that these were seen visually also over the station, and that the area in question having been remarkably free from rain occurrences on those days, there was no room for confusion of some of the echoes having come from nearby rain cells.

Observations

Locust invasion — The locust swarms were seen visually over Delhi on 25 July 1962. For routine observation of development of precipitation cells over target and control sectors with reference to cloud-seeding programme of work, the radar on this day was being operated systematically, and hourly pictures on PPI (Plan Position Indicator) were being taken at various angles of elevation and at different ranges. The invading locusts were, however, not shown up very clearly on the radar on the first day due, presumably, to the fact that their concentration was not sufficiently high and also, perhaps, most of them were flying rather low on this day. During the next four successive days of their activity over and near Delhi, the swarms, however, left very clear indications of their movements on the radar as can be seen from the radar pictures included at the end of this paper.

As radar pictures of locust swarms were all to be obtained only at low elevation angles, these would naturally include reflections from ground objects also. In order to avoid any confusion that might arise on this account, reflections from ground objects only, at various elevation angles, have been photographed (this is possible on any clear weather day) and shown in Fig. 1.

The invasion by the insects followed a continuous 15-day wet period over the region, in keeping with what has been considered generally to be a feature preceding marked locust activity over an

*A few of these pictures were shown in the meeting of the WMO Inter-regional Seminar on Meteorology and Desert Locust, held at Tehran during November-December 1963, by the delegate from the India Meteorological Department.

area, namely that these arrive and breed in association with exceptional rains[7]. A temporary break in monsoon conditions then followed, and nearly dry weather prevailed over the area on the four days when locusts in large numbers were seen both visually and also on the radar screen. With the return of normal monsoon over the area, the locust activity began to decrease again.

Area affected by swarms, their size and shape — The total area affected by locust swarms on a day, as shown by the radar, varied from a few hundred to a few thousand square kilometres, the area occupied by an individual swarm ranging from below a square kilometre to a few hundred square kilometres. The number of individual organized swarms on anyone occasion ranged from a few tens to, perhaps, a few hundreds, the distance between two neighbouring swarms varying from less than a kilometre to a few kilometres. The maximum length over which a swarm stretched was found to be about 100 km., the minimum in some cases falling below a kilometre.

The swarms were seen to assume different shapes, such as thin lines, arcs of circles, loops, long extended chains, etc.

Mode of approach and flight behaviour of swarms — After the major primary swarm of locusts reached west of Delhi on 26 July 1962, as indicated at M in Fig. 2A, innumerable other swarms were seen approaching the station. Further series of pictures taken on 100 km. range (Figs. 3A-D) as well as those on 50 km. range (Figs. 2A-D) indicated that the insects assembled gregariously in the form of bands and that most of these ultimately amalgamated with the major swarm, while the latter, as a whole, tended to move towards the station in a south-easterly direction. By the next morning, i.e. at 1040 hrs IST on 27 July 1962, another major swarm was seen located by the radar towards north-west of Delhi, as at N in Fig. 4A. As the radar was not in operation during night hours, it could not be ascertained definitely whether this second major swarm was the result of amalgamation of a number of smaller insect bands, which were seen to approach station on the previous evening, or formed by combinations of fresh bands of locusts which gained their entry into the area later. In any case, radar pictures taken subsequently did not reveal pouring in of any further fresh major swarm into the area, subsequent to the appearance of the two major swarms mentioned above, namely one towards west and south (M in Fig. 4A), and another towards north-west (N in Fig. 4A). These two major swarms continued to be the predominant features during the series of events photographed on the radar till the insects disappeared completely from the scene.

At the initial stages of their flight into Delhi area, the swarms of insects approaching station in banded forms appeared to move at times at a fairly high speed, covering a distance of about 40 km. in $2\frac{1}{2}$ hr, but once they reached Delhi and neighbourhood their movement slowed down, as they apparently chose to settle down over the place to enjoy the rich harvest of green fields and leafy trees in the locality. Indeed, it is seen that the first major swarm, after reaching south of Delhi, did not undergo any appreciable displacement during the next three days. This will be evident from the day-to-day positions of the swarm, as shown by the radar pictures in Figs. 5A-D. The fine structure details of the swarm, indicating how the insects arranged themselves in the form of long wavy bands, are well brought out by Fig. 6B. The average speed with which some of the individual swarms moved during the next three days of their activity over the area was between 4 and 6 km./hr.

From pictures taken at different elevation angles (these pictures have not been included in the paper) it was observed that the locust swarms at places extended up to a height of 1·5 km. in the vertical. It was further found that this maximum height usually came down towards the evening. That the vertical extent of the cloud of the locust swarms often reached a height of about 1·5 km. will be seen from pictures taken on the REI (Range Elevation Indicator — the vertical and horizontal extents of swarms are depicted on equal scales on this display). These pictures are shown in Figs. 6C and 6D.

The general direction of movement of locust swarms on these days was towards east, conforming to the traditional down wind movement commonly associated with these insects (winds at 1 km. level were from west to east on all the days of locust activity). However, an examination of hourly radar pictures taken successively at different elevations showed that on one and the same day the insects flying at different heights sometimes moved in different directions. Also, from pictures taken at the same elevation in course of the day it was seen that all the swarms over the region did not always move in the same direction. At times, even different portions of the same swarm appeared to move in different directions.

The peculiar shapes taken by the swarms at certain places (see Figs. 4A-F) are due, presumably, to antilocust operations which were reported to have been started over the area on this day. The swarms, as a result of such operations, apparently got deflected somewhat from the path originally taken and tended to spread over a wider area than that occupied previously. One interesting point brought out by radar pictures in this connection, however, is that the major swarm to the south of Delhi (M in Fig. 4A) was apparently not much affected by these antilocust operations, as it continued to remain entrenched more or less in the same locality and with the same, or even increased, density of population till the next day, i.e. 28 July 1962. The patterns obtained on 28 July 1962 are as shown in Figs. 7A-D. The activity of the swarm began to decrease somewhat on 29 July 1962, when it began to show slight displacement south-eastwards (Figs. 8A-C) until it disappeared finally from the area on 30 July 1962.

Spatial concentration of locusts — It is possible to deduce some general information about the nature of spacings between individual flying locusts on the basis of radar observations, provided the echoing cross-section of a normal locust is known and the receiving equipment in the radar is calibrated duly.

TABLE 1 — SOME CHARACTERISTIC FEATURES OF LOCUSTS AS REVEALED BY RADAR

Date	Height of flight of swarms (topmost locusts) km.		Movements of swarms in the course of the day		Wind at 1·0 km. level		Total area occupied by locusts (at the specified time) sq. km.	Maximum area occupied by a single swarm at the specified time sq. km.	Concentration of locusts No./cu. m.
	Morning	Evening	Directions in which movement was noticed	Range of speed estimated km./hr	Direction	Speed knots/hr			
26 July 1962	1·42	0·72	N, NE, E and SE	2-16	270°	13	238 (1030 hrs IST)	156 (1030 hrs IST)	$0·7 \times 10^{-1}$
27 July 1962	1·5	0·85	N, NE, E and SE	4-5	290°	10	944 (1248 hrs IST)	275 (1248 hrs IST)	$1·3 \times 10^{-1}$
28 July 1962	1·5	1·1	NW, N and E	6	290°	10	1438 (1051 hrs IST)	377 (1051 hrs IST)	—
29 July 1962	—	1·1	NW, N and SE	5	280°	23	412 (1400 hrs IST)	189 (1402 hrs IST)	—

N, north; E, east; NE, north-east; NW, north-west; and SE, south-east.

In the absence of any definite knowledge about echoing cross-section, an attempt could be made to get some idea of locust concentration in a swarm by making certain plausible assumptions in regard to the former. Keeping in view that the effective target area tends to equal the geometrical cross-section of the target itself as its upper limit when the wavelength used is small compared to the target, a value of 1 sq. cm. may be considered to be a reasonable value for the echoing cross-section of a locust (the radar cross-section of a sea gull has been estimated to be of the order of 0·01 sq. m. at frequencies in the L-band region). Assuming this value of echoing cross-section, and on the basis of two sets of measurements made of the intensity of radar echo from locust swarms, it was possible to make a rough estimate of concentration of locusts in the two swarms, one each on 26 and 27 July 1962. The concentration so deduced was found to be of the order of $0·7 \times 10^{-1}$ and $1·3 \times 10^{-1}$ respectively per cubic metre — values well within the range observed by other methods, viz. 10^{-3} to 10 per cubic metre. Some of the characteristic features of locusts as were brought out by the radar studies are mentioned in Table 1.

Disappearance of locusts — No prominent locust swarm was detected by the radar on 30 July 1962. Their virtual disappearance from the area on this day coincided with a change in the wind direction from westerly to easterly and with the setting in of a fresh spell of monsoon activity over Delhi and neighbourhood.

Conclusion

The results of this tentative study using radar, presented in this paper, bring out clearly the usefulness of radar in furnishing information of value about locust swarms, their grouping or formation characteristics, flight behaviour, etc.— information for which we have depended hitherto chiefly on reconnaissances from aircraft and also observations made by mobile ground parties. Considering that radar observations in this case happened to be made only incidentally and without any prior planning, some limitations of the data collected have been inevitable. It may reasonably be hoped that, as more experience is gained in observations of this kind and with better planning of the programme of work, it should be possible to gather more detailed and valuable information about locust life by using radar technique. The feasibility of collecting such data by observations made from one single site is an important advantage in favour of this method. Careful survey by radar of a locality liable to suffer seriously by heavy invasions by locust swarms during a certain season should be of considerable help in alerting, in time, the antilocust squads on ground and locust control aircraft to start their projected operations and carry them out effectively.

Summary

Using a high power microwave radar, observations have been made at Delhi on the movements of invading locust swarms over the area (within 50 km. around) during the locust invasion in July 1962. The study has brought out clearly the potentialities of the use of radar for tracking locust swarms and studying their flight characteristics and behaviour.

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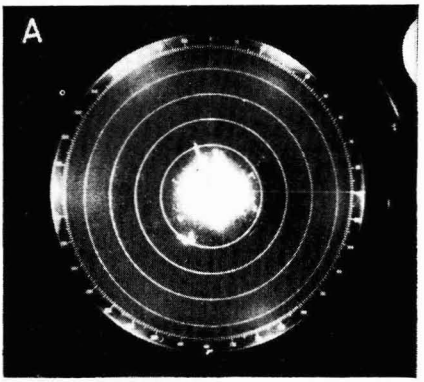

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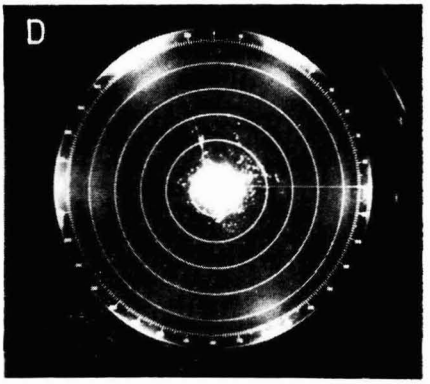

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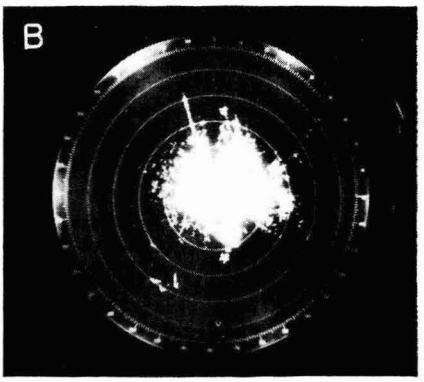

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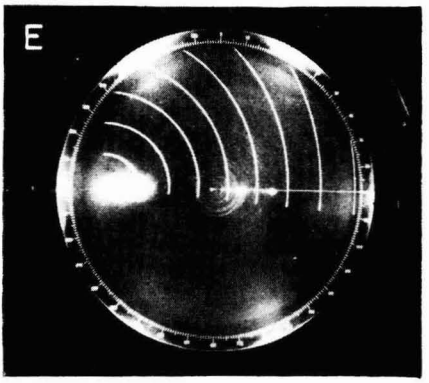

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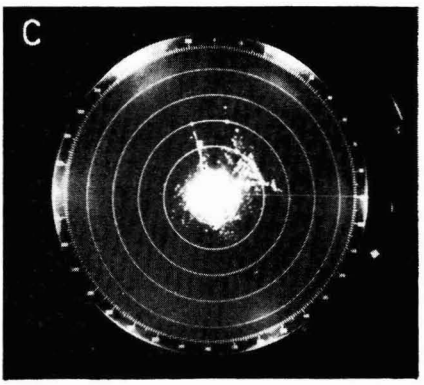

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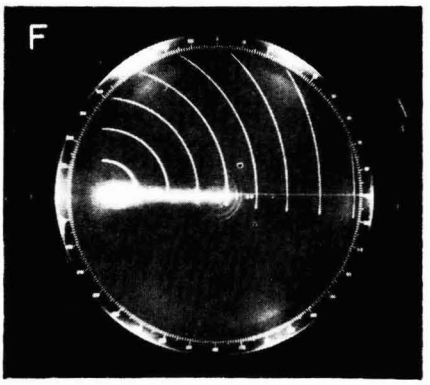


Range: 40 km.;Azimuth: 252°

Fig. 1 — Permanent echoes photographed on PPI and REI on 14 April 1964

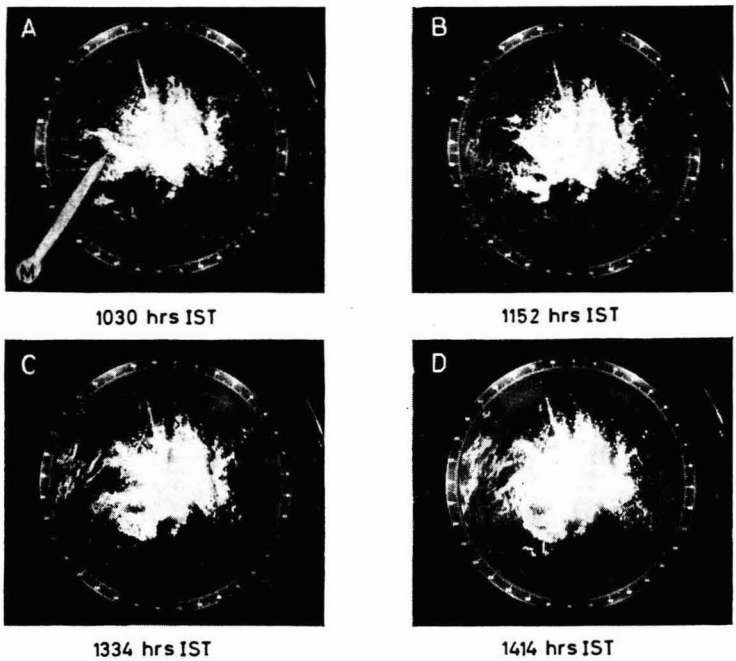


Fig. 2 — PPI pictures of locust swarms on 26 July 1962 [Elevation, 1° and range, 50 km. Range markers (not clearly visible) are 10 km. apart. Major primary swarm of locusts is indicated by M]

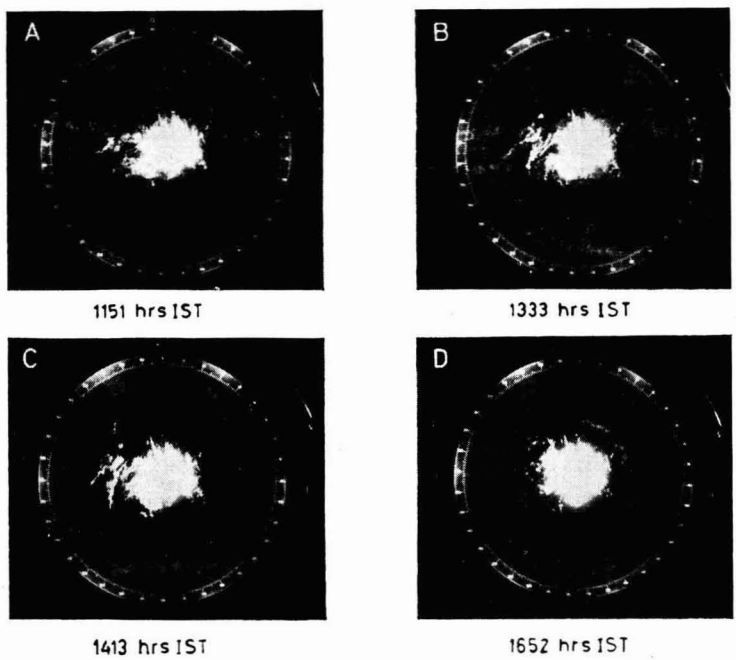


Fig. 3 — PPI pictures of locust swarms on 26 July 1962 [Elevation, 1° and range, 100 km. Range markers are 20 km. apart]

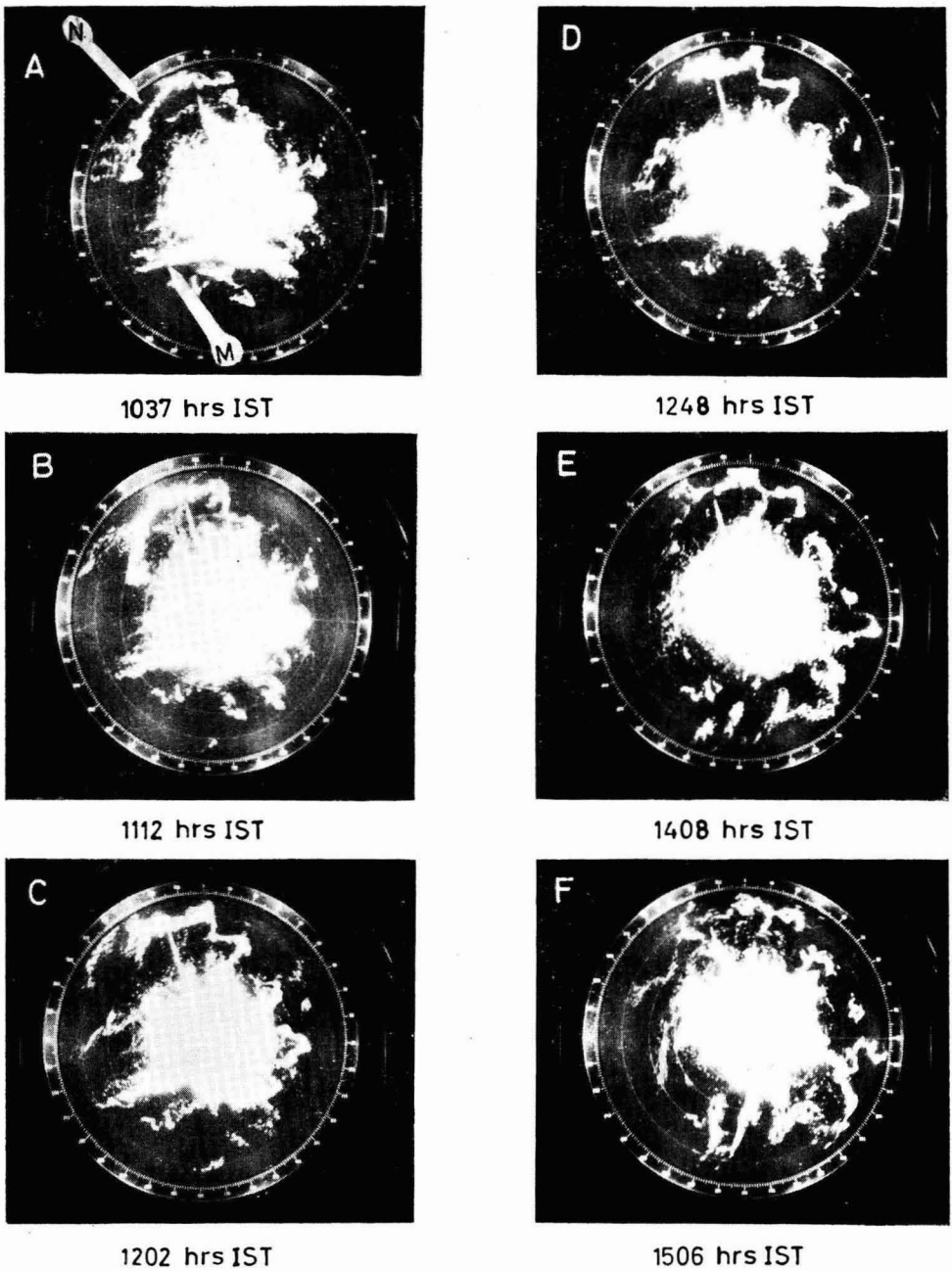


Fig. 4 — PPI pictures of locust swarms on 27 July 1962 [Elevation, 1° and range, 50 km. Range markers are 10 km. apart. The two major swarms, i.e. the one towards south and the other towards north-west, are indicated by M and N respectively]

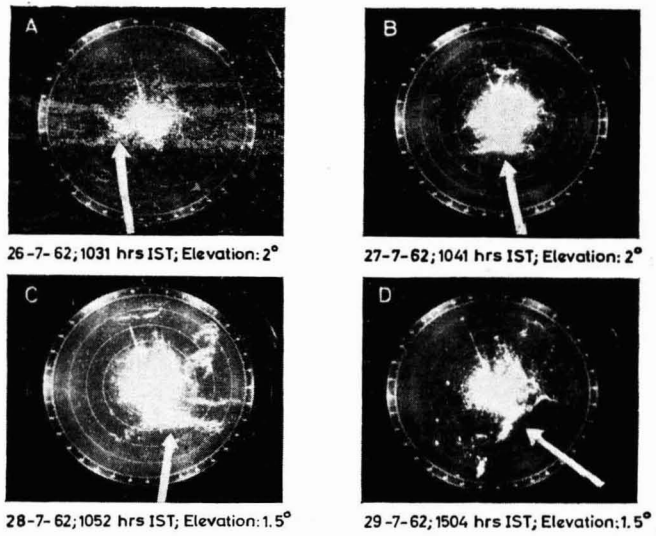


Fig. 5

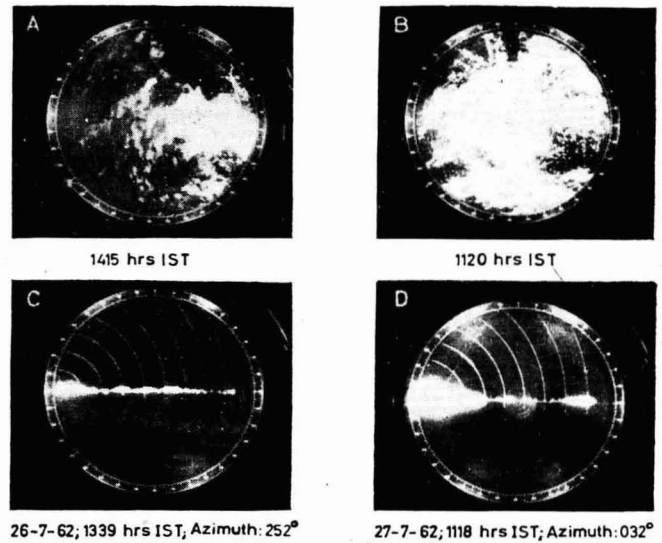


Fig. 6

Fig. 5 — PPI pictures showing the successive positions occupied by the major swarm (M) of locusts (indicated by arrow) during the four days of their activity around Delhi

Fig. 6 — Radar pictures showing the movement of the locust swarms on 26 and 27 July 1962 [A, locust swarms, in the form of bands, seen approaching the station on 26 July 1962. Picture is offcentre PPI on 20 km. range. Range markers which are 5 km. apart are not visible; B, fine structure details of the major swarm towards the south on 27 July 1962 indicating natural alignment of insects in the form of wavy bands. Picture is PPI at elevation 1·5° on 20 km. range. Range markers which are 5 km. apart are not visible; C, a section of the major locust swarm (M) on 26 July 1962 in the direction 252° as seen displayed on REI. Range markers which also serve as height markers are 5 km. apart. The swarm is seen to extend up to 40 km. in the horizontal and up to 1·5 km. at places in the vertical; and D, some smaller swarms on 27 July 1962 in the direction 032° as seen on REI. Range/height markers are 2·5 km. apart]

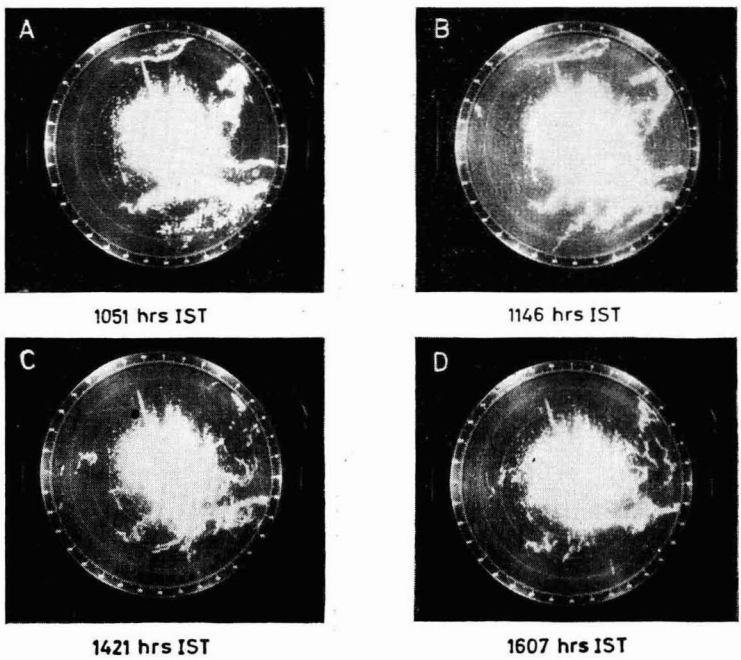


Fig. 7 — PPI pictures of locust swarms on 28 July 1962 [Elevation, 1° and range, 50 km. Range markers are 10 km. apart]

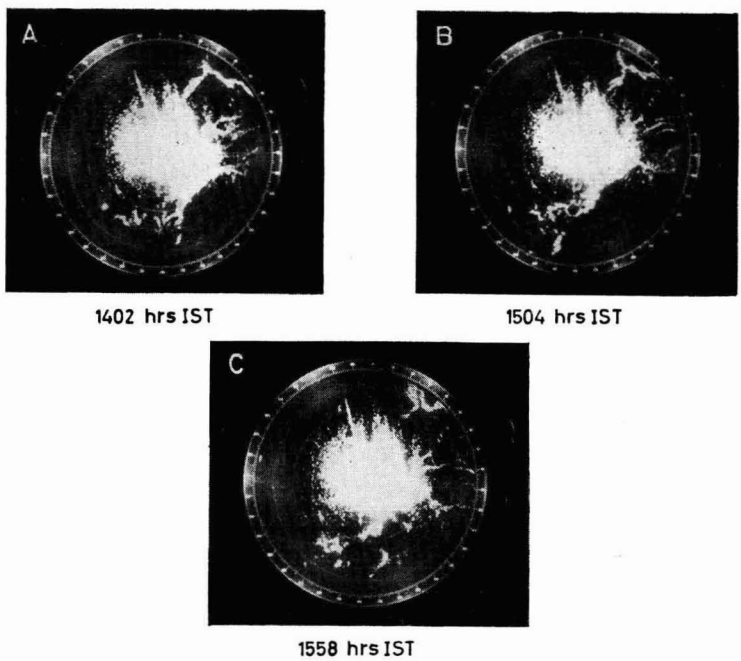


Fig. 8 — PPI pictures of locust swarms on 29 July 1962 [Elevation, 1° and range, 50 km. Range markers are 10 km. apart]

REVIEWS

BASIC MATRIX ALGEBRA AND TRANSISTOR CIRCUITS by G. Zelinger (Pergamon Press Ltd, Oxford), 1963. Pp. xv+116. Price 42*s*.

With the advent of transistors and their wide applications in the various fields of instrumentation, an electronic engineer of today is frequently confronted with the problem of analysis of transistor circuits. Almost simultaneously with the discovery of transistors it was realized that the knowledge of matrices will be helpful in such analysis and also for computing the gain of transistor amplifiers. It is, therefore, most opportune with the progress and advancement of the use of transistors that the book has been written by the author with his specialized knowledge and experience, which is evidenced by the exposition of the subject in a commendably concise form.

A thorough introduction to the subject has been made by the author in the first part of the book in which he has considered the representation of general types of four terminal networks with matrices. Besides the various types of networks he has considered the representation of coupled circuits which are extensively used in practice. In the second part of the book, the author has dealt in detail with the approach to the derivation of the parameters of transistors in all the three configurations. Treating the transistor as an active four-pole network, the author has shown how the effect of frequency on the internal parameters can be studied with the help of matrix analysis. The method has been further extended to the analysis of transistor amplifiers and cascaded coupling networks.

The third part of the book is devoted mainly to the application of matrices to the design problems in transistor amplifiers. The derivation of design equations definitely establishes the simplicity with which the matrix algebra can be applied for solving the active network problems. With the exhaustive list of references at the end of each part, the book will be of great assistance to the research worker and a useful companion for practising electronic engineer.

S. S. BANERJEE

MATHEMATICAL TECHNIQUES OF OPERATIONAL RESEARCH by L. S. Goddard (Pergamon Press Ltd, Oxford), 1963. Pp. x+230. Price 42*s*.

This book is primarily intended for the graduate mathematician contemplating a career in Operational Research (OR). It gives a brief introduction to the mathematical tools that have been used in solving various classes of problems in the field of OR. Among the topics discussed are linear programming, including transport and assignment, queueing theory, machine interference and inventory theory.

The book consists of seven chapters. Chapter I gives an introduction to some of the basic mathematical topics, namely algebra, analysis, special functions, theory of probability, differential and integral equation, with special emphasis on the theory of probability. In Chapters II and III, an account of linear programming including the special cases of transportation and assignment problems with discussions on various applications is given. The next two chapters deal mainly with the steady state properties of the single channel queue and of queues in series and parallel. The machine interference problem has been discussed in Chapter VI to illustrate the application of queueing theory to industrial problems. The last chapter deals briefly with the subject of inventory control.

The book would have been more useful if a few numerical examples had been added. However, as an introductory book, it has been written very well and the applied mathematicians interested in OR and the top management interested in the mathematics of OR will find it quite useful.

P. V. KRISHNA IYER

NONCONSERVATIVE PROBLEMS OF THE THEORY OF ELASTIC STABILITY by V. V. Bolotin; translated from the Russian by T. K. Lusher; English translation edited by G. Herrmann (Pergamon Press Ltd, Oxford), 1963. Pp. xii+324. Price 60*s*.

The stability of elastic systems has been generally investigated by the Euler's method, which is applicable when the external forces are conservative. In a large number of technological applications non-conservative systems are important. Typical examples are: (i) aerodynamic and hydrodynamic loads acting on aircraft wings or rockets; (ii) the 'follower' forces in bending and torsion; (iii) forces acting on parts of turbines and electrical machines; and (iv) loads induced in parts and linkages of automatic control systems.

All such cases lead to non-self-adjoint boundary value problems, which have not been extensively dealt with in literature. The corresponding generalized coordinates have antisymmetric matrices. The present work aims at giving approximate methods to solve such problems, with special stress on technological applications.

The first chapter gives the history of Euler's method. It is shown how in the case of 'follower' forces, like a tangential load, the Euler's method gives wrong results. The necessity of using Lagrangian form of the finite strain tensor in place of the classical strain tensor and the corresponding body-stress equation is explained. Under certain approximations the classical body-stress equation and boundary Conditions in Cartesian coordinates hold good in the Lagrangian system if the stress-tensor τ_{ij} is replaced by $\tau_{ij}[\delta_{kj}+\partial u_k/\partial x_j]$. Equations in general curvilinear coordinates have also been obtained. Some definitions of stability including that of Liapunov are given and it is shown that the classical Poincaré method may be used to solve the general problem. A number of general

results are obtained and it is shown that Euler's method only gives static instability, while the non-conservative systems can lead to both static and oscillatory types.

The second chapter deals with 'follower' forces and the problem treated include the bar, I-section and a rectangular strip. A number of numerical results are derived.

The third chapter treats rotating flexible shafts and the last chapter discusses the stability of elastic bodies in gas flow. The flutter problem for plates and shells and the piston theory are treated in detail. In all applications Galerkin's method of approximations is used. The book ends with concluding remarks and valuable suggestions for further research. The author and subject indexes are given separately.

The book should interest both scientists and technologists. The scientific treatment could be better in some parts. This is due to the stress on the applicational aspect of problems. In fact, it is suggested in the concluding remarks that instead of obtaining academic solutions further investigations should be aimed at finding out how much the actual tractions applied can be approximated by 'follower' forces.

Some misprints have crept in even in the revised, corrected and translated edition. Typical examples are the omission of Ω in exp (*it*) in equation 9 on page 10, and the wrong sign of the last term in the Christoffel symbol of the first kind given on page 41.

B. R. SETH

ADAPTIVE CONTROL SYSTEMS edited by Felix P. Caruthers & Harold Levenstein (Pergamon Press Ltd, Oxford), 1963. Pp. viii+290. Price 80s.

The book is a collection of papers read at the Symposium on Adaptive Control Systems held at Garden City, Long Island, New York, during October 1960 and sponsored by the Long Island section of the Institute of Radio Engineers and cosponsored by various other institutions and professional societies. The symposium consisted of five paper-reading sessions which were followed by a sixth session for panel discussion.

The papers entitled (1) Performance criteria in adaptive control by C. W. Sarture and J. A. Asetine, and (2) Performance indices of adaptive control systems by Y. T. Li, presented at the first session on Definition of Problems, summarize various performance criteria and emphasize and illustrate the role that performance criteria play in the design of adaptive control systems.

The following three papers presented at the second session dealing with Analytical Techniques classify and summarize some of the many techniques currently available for the analysis of non-linear systems: (1) Techniques for analysing non-linear control systems by Louis F. Kazda; (2) The art of formulating signal flow graphs by L. Braun (Jr) and W. A. Lynch; and (3) Ultrastability and the theory of lie groups by Aaron Wallace.

Majority of the papers presented at the third and fourth sessions on Adaptive System Theory deal with purely theoretical and abstract aspects of adaptive control. These include: (1) A statistical theory of adaptation by Bernard Widrow; (2) Extremum adaptation in the presence of noise and drift by R. I. Van Nice and R. A. Mathias; (3) Random optimization and multipole adaptive control by R. C. Turnblade; (4) The application of Markov chains to discrete extremum — Seeking adaptive systems by H. S. Kirschbaum; (5) Adaptive control system models of the human operator by George A. Bekey; and (6) A self-adjusting control system by R. N. Clark and E. E. Gould.

Papers read at the fifth session deal with specific applications of adaptive control. The first paper describes the simulation on a digital computer of a model — which is claimed to be more than a first step — of a human memory; the second discusses the feasibility and application in a high performance interceptor missile in the face of widely varying aerodynamic parameters; and the third describes an adaptive flight control system which is claimed to have been successfully used in the X-15 aircraft which has an environment variant of 10 : 1.

During the panel discussions, the utility and potentiality of adaptive control system were highlighted; answers to questions, such as what it is, how it can be used, and how is it different, were attempted.

The book offers a mixed fare and has something for everyone (from beginner to expert). It covers a fairly representative cross-section of the subject and consists of delightfully easy-to-read papers and also papers on abstract and abstruse subjects — a feature which is common to most of such symposia. The book is riddled with an unusually large number of typographical errors. Investment in this book may be justifiable only on account of the bibliography it contains on the subject of adaptive control systems.

L. K. WADHWA

ELECTROMAGNETIC THEORY AND ANTENNAS: Parts I & II — Proceedings of a Symposium, Copenhagen, 1962; edited by E. C. Jordan (Pergamon Press Ltd, Oxford), 1963. Pp. Part I, xxx+658; Part II, ix+659-1330. Price £ 10 10s. per set

This book is a compilation of papers presented at the Symposium on Electromagnetic Theory and Antennas held at the Technical University of Denmark during June 1962. It contains 70 full length papers and 55 summaries. This symposium was preceded by three other international symposia with similar scope at McGill University, Canada (1953), Michigan University (1955), and University of Toronto (1959). The proceedings of these symposia and this book give the progress in the electromagnetic theory and antenna during the last decade. The book is in two volumes.

The papers have been divided into five broad fields which constitute five sections of the book. Section A contains papers dealing with scattering and diffraction by particles and various types of geometries. Some of the papers deal with scattering by metal surfaces having dielectric coating, a problem very important in target cross-section studies. Diffraction problems in waveguides have also been dealt with.

Section B contains papers dealing with modern developments in hydrodynamic wave and magneto-ionic theory. The results of studies on propagation of waves and charged particles in plasma have been given. A number of papers deal with radiating sources in anisotropic media. This problem has received considerable importance now due to the need for the study of behaviour of radiating sources passing through anisotropic medium. Some of the papers deal with the propagation of waves through various ferrite geometries in waveguides. These two sections constitute one volume of the book.

Sections C, D and E constitute Part II (second volume) of the book. Section C contains a number of papers dealing with scattering of electromagnetic waves by a statistically inhomogeneous medium. Propagation through media having properties varying with space and time, propagation characteristics of optical and infrared waves, etc., are some of the other aspects covered in this section.

Section D deals with subjects like surface waves, leaky waves and their characteristics. There are a few papers on the generation of millimetre and submillimetre waves. Section E contains papers on radiating properties of antenna arrays. However, the papers cover very limited types of arrays.

The book is highly mathematical in character and most of the papers give theoretical analysis of problems. Of course, there are a few papers that deal with experimental investigations. Most of the papers are in English. A few are in French.

The book is useful primarily for those undertaking research and, to some extent, those doing post-graduate studies. It is a good book for any library, as it gives at one place a lot of the modern developments in the various aspects of electromagnetic wave propagation and radiation.

S. MISHRA

THE USE OF RADIOACTIVE ISOTOPES FOR CHECKING PRODUCTION PROCESSES by B. I. Verkhovskii; translated by H. S. H. Massey; translation edited by Rankin Kennedy (Pergamon Press Ltd, Oxford), 1963. Pp. 76. Price 21*s*.

This book published in Russian by the Academy of Sciences of the USSR (Moscow, 1959) has been translated into English by H. S. H. Massey and is one more addition to the growing number of books now available in this field. The book is divided into three chapters. The first two chapters give a basic treatment of what radioactivity is, the structure of the atom, the different types of radiations and principles of simple detecting equipment like ionization chamber, GM and scintillation counters. Chapter 3 deals with the use of radiations in instruments for checking technological process. The basic principles of the use of isotopes in various types of production and control are well known and these are briefly described. Applications like the measurements of thicknesses, non-destructive testing of flaws, measurement of density, humidity and of chemical composition, etc., are briefly given. Examples of some of the uses of these with particular reference to Soviet industries are mentioned. Written in 76 pages the book gives a simple treatment of the subject and is useful particularly to people with a general background of science.

V. K. IYA

RADIOACTIVE ISOTOPES IN INSTRUMENTATION AND CONTROL by N. N. Shumilovskii & L. V. Mel'ttser; translated by R. F. Kelleher; translation edited by P. J. Blaetus & G. A. Young (Pergamon Press Ltd, Oxford), 1964. Pp. xiv+198. Price 70*s*.

This book, being a translation from Russian, presents the various applications which radioisotopes have found in the field of process instrumentation. It covers the instruments used for the measurement of thickness and density of solids and liquids, thickness of surface layers, flow of liquids and gases, liquid levels, vacuum and composition. These instruments are based on the principle of absorption, scattering and back scattering of beta and gamma rays and on the ionization in gases caused by alpha radiation. Applications using neutron beams have been mentioned. Both relay devices and continuous measurement devices have been covered.

The authors have given particular emphasis to the 'compensating systems' in which the measured signal is intermittently compared against a standard signal. Such systems are not affected by errors due to variations in the characteristics of the measuring circuit; they are novel in instruments using radioisotopes though they appear to be widely in vogue in the USSR. The 'wedge compensation' and the 'dynamic compensation' systems are of particular interest — the former is a null-balance detection system in which the standard signal is varied by a servo-driven wedge attenuator to match the measured signal; in the latter system the standard signal is cyclically varied over the complete range of the measured signal by means of a modulating device and the value of the measured signal is obtained by noting the instant of time when the measured signal equals the modulated standard signal.

One important feature special to instruments using radioisotopes is the error due to the statistical nature of radioactivity. A substantial part of the book is devoted to the analysis of this error in the different types of instruments and the methods of optimizing the parameters such as source strength and the time constant of the measuring circuit, in order to minimize this error.

Besides giving the well-known relations pertaining to the behaviour of radioactivity in applications for measurement, the authors have given a large number of empirical relations which appear to have been obtained from extensive experiments; these are of particular use to the instrument designer. The book gives the details and characteristics of some of the standard Russian instruments, such as the densitometer, the thickness gauge, the defectoscope, the level indicator.

Almost everywhere in the book, the measuring circuit has been treated as a black-box. Though the details of measuring circuits can be found in standard text-books and journals, the inclusion of one chapter covering the measuring circuits would have made the book self-sufficient.

The book has a good number of editing and printing errors, a few of which are significant, for instance, formula III. 26 should be

$$u_{+\infty} = \Delta q/c[1+\exp(-T_{0P}/\tau)]$$

This book is a welcome addition to the limited amount of published literature available in this new field which is gaining importance day by day.

B. S. PRABHAKAR

FROM LOW-SPEED AERODYNAMICS TO ASTRONAUTICS by Theodore Von Karman (Pergamon Press Ltd, Oxford), 1963. Pp. xv+82. Price 25*s*.

The book embodies three public lectures given by the author at the Institute of Fluid Dynamics & Applied Mathematics of the University of Maryland in 1961. The purpose of these lectures is sufficient to suggest the scope and the style of the book. The author traces in an illuminating manner the growth of the subject of aerodynamics to which he himself has contributed considerably.

The book under review consists of five chapters, the first being the introductory chapter and the others dealing with Aerothermodynamics, Aerothermochemistry, Rarefied gas dynamics, and Magneto-fluid dynamics respectively. The chapters are preceded by the list of figures (in all 62) and followed by the references which the author has cited in the text. Coming from a master of the subject, the book sets in a clear manner what has been achieved and the directions the subject is taking now. Personal references have made the book interesting.

The printing and get-up are very attractive and the style clear and lucid. The reviewer welcomes the addition of this monograph as a useful study for the research workers in the field of aerodynamics who have a considerable acquaintance with the subject.

P. L. BHATNAGAR

THEORY AND FUNDAMENTAL RESEARCH IN HEAT TRANSFER edited by J. A. Clark (Pergamon Press Ltd, Oxford), 1963. Pp. ix+220. Price 70*s*.

This book contains the proceedings of a symposium sponsored by the ASME Heat Transfer Division Standing Committee on Theory & Fundamental Research in Heat Transfer and held during the 1960 winter annual meeting. The object of the symposium was to focus attention on the current status of theory and fundamental research and to indicate areas where further research was necessary. Eleven papers by invited authors are published in this book covering a wide spectrum in the field of heat transfer.

Dunkle has presented an authoritative survey of the thermal radiation characteristics of surfaces and in conclusion made recommendations for further work. Heat transfer in rarefied gas flow has been surveyed by Probstein. Westwater has discussed recent research trends in nucleate boiling. Further theoretical and experimental work necessary for understanding bubble birth, growth and escape from the heat source are indicated. The new field of plasma heat transfer has been dealt with by Emmons. Challenging problems in this area require a new level of instrumentation and experimental techniques, as also understanding of atomic phenomena, quantum theory, statistical mechanics and kinetic theory. Schultz-Grunow has discussed turbulent heat transfer in stratified flow, with particular reference to the Ranque-Hilsch tube. Krumhansl has reviewed theoretical and experimental aspects of thermal conductivity of solids from the viewpoint of the solid state physicist. Penner *et al.* have presented recent theoretical and experimental studies relating to the determination of gas radiation from isothermal systems. Hottel and Sarofim present a method, with greater generality, for determining gas radiation with temperature gradients and including allowance for isotropic scatter due to suspended particles in the gas and for the non-gray character of the walls.

Monaghan in his paper reviews the application of integral methods for evaluating momentum thickness, skin friction, and heat transfer for laminar boundary layer incompressible flow and on the state of the art for turbulent boundary layer. Frössling, while discussing heat transfer across laminar boundary layers for incompressible laminar flow, has indicated the many gaps in our knowledge in this field. Malkus in his paper has discussed free convection heat transfer between horizontal surfaces.

Research workers in a fast growing field like heat transfer have felt the need for keeping abreast of the latest developments. This book has fulfilled a genuine need. Prof. Clark who organized the symposium and subsequently edited this book deserves the sincere appreciation of all interested in heat transfer research.

A. RAMACHANDRAN

INTRODUCTION TO PHYSICS by A. Kitaigorodsky; translated by O. Smith (Foreign Languages Publishing House, Moscow), 1963. Pp. 719. Price Rs 8.00

The author has attempted to write a text-book for the engineers who need only a broad understanding of the physical basis of engineering. In a single volume the author has incorporated material starting from an elementary level to a fairly advanced level. In this situation, most of the topics are discussed in a paragraph or two and the exposition is descriptive. It has not been indicated as to how much time should be spent to cover the material given in the book. The book certainly cannot be adopted for a term or even a one-year course in physics of the Indian engineering institutions, considering the time allotted to physics in conformity with the model syllabus framed by All India Council of Technical Education. It is possible to use this book as one text-book for all the five years of undergraduate education in which case it can be covered slowly.

The style in which the book has been written will help to pass lot of information to the students without much emphasis on clearly understanding it. The author feels that this is a correct approach but many will disagree with this view.

The text is, at many places, supplemented with solved problems which will be helpful to the students in appreciating the use of material discussed. The

book is very reasonably priced and can be easily acquired by the students and teachers and it will certainly be very handy for reference by them. The printing is good.

R. P. SINGH

THE ELECTRONIC THEORY OF CATALYSIS ON SEMICONDUCTORS by F. F. Vol'kenshtein; translated by N. G. Anderson (Pergamon Press Ltd, Oxford), 1963. Pp. vi+169. Price 50*s*.

This English translation of Vol'kenshtein's book (Moscow, 1960) has already appeared earlier as Chapter 5 in *Advances in catalysis*, Vol. XII (1960). The subject matter has been only slightly expanded and a short chapter on 'The various types of adsorption' has been added to make the book easier for the non-specialist. The end of this chapter deserves special mention — here the author shows how an activation barrier can arise under certain conditions even for physical adsorption as a result of the interaction between the adsorbed molecules.

The electronic theory of catalysis is being erected on the foundation of the modern theory of chemical bonding and modern semiconductor physics. The author admits that it is not in anyway completed, "it is a building from which the scaffolding has not yet been removed".

Vol'kenshtein's monograph is still an excellent outline of the present state of the electronic theory of catalysis, which during the last 15 years has slowly been crystallizing out from his own work and the work of Roginskii, Boreskov and Terenin in Russia, Hauffe, Schwab and Rienäcker in Germany, Dowden in England and Boudart, Weiz and others in USA. This book has emerged out of a course of lectures given by the author in Moscow, Yaggelon (Poland) and Paris. The emphasis is naturally on the author's own outstanding contributions, but due credit has been given to the work from outside Russia as well. The most striking aspect of this book is the freshness and originality of the author's approach as a physicist to the traditionally 'chemical' problems of chemisorption and catalysis. For instance, the chemisorbed particles are regarded as a kind of structural defects of the surface. In such a treatment the chemisorbed particle and the lattice of the adsorbent can be treated as a single quantum-mechanical system. Another important consequence of this is that for the formation of valency bonds between chemisorbed particles and the surface it is not necessary that free valencies are available beforehand; they may be generated in the process of chemisorption itself, where they are always generated in pairs (a positive and a negative valency).

The position of the Fermi level at the surface as the main factor in the reactivity of chemisorbed particles (Chapter 5) and in the catalytic properties of the semiconductors (Chapter 6) has been given due emphasis. Since the Fermi level at the surface depends on its position inside the crystal, the relationship between the surface and bulk properties of the semiconductor can be established (Chapter 7).

The electronic theory of catalysis does not contradict or deny the role of geometric factors in catalysis as postulated in Balandin's multiplet theory of catalysis; it only emphasizes the role of these factors and gives a physical meaning to Balandin's geometrical schemes. This has served as a stimulus to Balandin, who is now trying to evolve a comprehensive theory of catalysis, bringing the theory of surface chemical compounds, the multiplet theory and the electronic theory all in one fold.

The electronic theory is not applicable at present to purely metallic catalysts except in so far as the surfaces of metallic catalysts can often consist in reality of a thin layer of essentially semiconducting compound (e.g. oxide) in contact with the metal.

A valuable addition to this book over the earlier version of it in *Advances in catalysis* is the last section on 'Some unsolved problems'. Several important hints are given here for both theoreticians and experimentalists in the field of surface chemistry and catalysis. For anyone who wants to keep himself up to date in this field of research this book is a 'must'.

P. G. MENON

OPTICAL ACTIVITY AND CHEMICAL CONSTITUTION — UP Scientific Research Committee Monograph No. 7, by Bawa Kartar Singh & O. N. Perti (Asia Publishing House, Bombay), 1963. Pp. xii +149. Price Rs 8.00

The book under review is a monograph written by Dr B. K. Singh, one of the most distinguished Indian workers in stereochemistry, and his former pupil, Dr O. N. Perti. Dr Singh unfortunately died before the book could be finished, and the last three chapters were written by the second author. The book consists of five chapters.

The monograph begins with a historical account of the earlier work on the optically active organic compounds and the various attempts to correlate the rotation with structure. Some of the earlier views have been expressed interestingly by putting in extracts from the original memoirs. Chapter 2 describes the influence of various physical factors, such as temperature, solvent, concentration and wavelength of light used, on the optical rotatory power of a compound. The last part of this chapter and the next one have been devoted solely to a discussion of the physical basis of optical rotatory dispersion. The discussion is, in general, orderly, systematic and clear, though according to the reviewer, a few more graphical illustrations, e.g. of plain and anomalous rotatory dispersion curves, could have been more helpful. Chapter 4 deals with the difference in properties between the optically active forms and racemic compounds and their various modifications. This treatment, which has been adequately dealt with in all text-books in stereochemistry, has been unnecessarily lengthened. One gets the feeling that this has been done in order to accommodate the works of the authors. In the last chapter, a synopsis has been made of the relationship between optical activity and chemical constitution of various compounds, especially substances having one asymmetric carbon atom, carbohydrates, amino acids, polypeptides and proteins, steroids and terpenoids. Obviously, the subject is too vast to be adequately dealt with in such a monograph. The presentation, however, is quite lucid and systematic. The salient points have

been covered and for the rest, the readers can go through the important reviews referred to at the end of the chapter.

As indicated in the preface, this book reviews the literature till the end of 1959 and incorporates the work of Dr B. K. Singh and coworkers. References (perhaps too many of them) have been supplied at the end of each chapter; many of them will prove useful to the readers.

The book has been written in good readable style which, unfortunately, has been marred often by innumerable misprints and other typographical errors. As a result, sometimes the meaning of many sentences has been rendered obscure.

The price of the book seems to be rather high, but perhaps is not too unreasonable in view of the very specialized nature of the subject.

D. NASIPURI

GRAVIMETRIC ANALYSIS: Vol. 1 (International Series of Monographs on Analytical Chemistry), by Laszlo Erdey; translated by Gyula Svehla (Pergamon Press Ltd, Oxford), 1963. Pp. viii +324. Price 50*s*.

This book is the seventh volume in the International Series of Monographs on Analytical Chemistry published by Pergamon Press. This is the English edition translated from Prof. Erdey's original Hungarian text by Dr Gyula Svehla. This first volume on *Gravimetric analysis* is to be followed by two more, the second one on determination of metals and the third giving collected methods involving determinations and separations of non-metallic elements.

The book consists of four chapters. Chapter 1 is a general introduction to the subject of quantitative gravimetric analysis. Chapter 2 deals with the various operations of gravimetric analysis, starting right from sampling and preparation of sample. The operations of weighing, dissolution and fusion, precipitation, filtration, heating and weighing of precipitates and the calculation of results are systematically dealt with. Chapter 3 covers a wide range of techniques of analytical separations including fractional precipitation, separations using organic reagents, solvent extraction, ion exchange, adsorption and partition chromatography and electrolysis. The short Chapter 4 is devoted to the different methods of determination of water in solid substances.

In many ways the book presents a new and very instructive approach to the old subject of classical gravimetric analysis. The theory of even simple practical operations used in gravimetric analysis is discussed. For instance, fusion of samples has been treated on the basis of the theory of Lewis acids and bases. Again, the theoretical background presented is not isolated from the practical. In every case, discussion of theory is immediately followed by detailed description of the practical procedures. In many instances, this is followed by notes which are based on actual experiments conducted by Prof. Erdey and coworkers at the Technical University of Budapest for critical evaluation of the methods. This greatly adds to the reliability of the practical procedures given in the book. The book is profusely illustrated with drawings showing the apparatus used in a procedure, and in some cases even the sequence of operations is illustrated like a flow-sheet diagram.

The book is a welcome addition to the literature on analytical chemistry, since it should prove useful to new entrants in the field and to experienced analysts alike for understanding the basic theories on which the various practical procedures of gravimetric analysis are based. Publication of the two subsequent volumes to follow, one on analysis of metals and the other on analysis of non-metals, will, therefore, be eagerly awaited.

V. T. ATHAVALE

PAPER AND BOARD IN PACKAGING edited by J. H. Young, G. A. Gordon & D. J. Hine (Pergamon Press Ltd, Oxford), 1963. Pp. vii+199. Price 70*s*.

Packaging technology, one of the newer branches of applied sciences, is now recognized by all the industrially advanced countries in the world as an essential and integral part of industrial production. Since its recognition in the early twenties, this subject has made tremendous progress. In earlier days, the losses of products due to damage caused by several kinds of hazards like handling, transport and climatic were taken for granted. In recent times, the importance of adequate and functional packaging which could reduce the losses to the minimum, with benefit to the producer, shipper and the buyer has been fully realized and a variety of functional packaging materials and newer packaging techniques have been developed. The competition among the producers and convertors of packaging materials resulted in the materials having improved and specific properties each suited for specific purposes. Simultaneously automatic packaging machines with greater and greater speeds of production came to be invented. Thus, packaging technology has been a dynamic subject and rapid strides are being made in all industrially advanced countries. It may be mentioned in this context the rapid industrialization of Indian packaging is assuming importance.

Of all the packaging materials used in packaging, nearly 85 per cent is contributed by paper, paper boards and a variety of laminates. In this context, the book under review is of immense value to the packaging technologists.

This book is based on the lectures delivered at the summer school organized jointly by the Manchester College of Science & Technology and PATRA with the cooperation of the Institute of Packaging, England.

The book consists of 16 chapters on several aspects of paper, paper boards and laminates each by experienced technologists in the field. The first chapter deals with the use of paper and paper products for the conversion of paper sacks, fibre drums, carboys, fibre board cases, etc.; particularly the views on the replacement of glass carboys by folding boxes for filling in liquids, etc., are most welcome in view of the need for conservation of metal containers now being used for the purpose. The other chapters dealing with aluminium foil and laminates, corrugated containers, solid fibre board

containers and multiwall paper sacks give a comprehensive picture of their manufacture, usage and requirements. Of particular interest to the reader is the information given in brief on pages 126-27 on the specific uses of some important laminates for the packaging of some specific products. A separate chapter on the above aspect would have greatly enhanced the value of the book, more so in view of the variety of ways in which paper and paper products are finding use in packaging. There are also chapters dealing with adhesives used in packaging, organic coatings and laminates which are of interest to manufacturers. The theoretical aspects dealt with in the chapters on packaging hazards, strain behaviour of paper, biological aspects, test procedures and adhesive theory are highly illuminating to the packaging technologist and research worker alike. Owing to the specificity of the subject chosen for each lecture, the authors have obviously confined themselves to essentials in each case, thus stimulating the reader to refer to more exhaustive treatises on the subject.

The book gives some important aspects of paper, paper products and laminates which are of immense value for all those engaged both in conversion and use of these materials for packaging.

The presentation of the book is excellent and some of the chapters are quite stimulating and of absorbing interest.

In view of the fact that there are very few books on the subject of packaging, this book is welcome and deserves the attention of those in the field of packaging research and technology.

N. V. R. IYENGAR

FIFTY YEARS OF SCIENCE IN INDIA — PROGRESS OF GEOLOGY by S. Ray (Indian Science Congress Association, Calcutta), 1963. Pp. iv+194. Price Rs 3.75

The volume under review is one of the series of monographs brought out by the Indian Science Congress Association in connection with the Golden Jubilee of the Association. Prof. Ray's review of the progress of geology during the last fifty years is authoritative, comprehensive and up to date. The volume starts with a racy review of the stratigraphy of India (Early Precambrian, Late Precambrian, Palaeozoic, Mesozoic, Tertiary and Gondwana). This is followed by a fairly detailed survey of progress in palaeontology (invertebrate and vertebrate) and palaeobotany. The next major topic, petrology, covers the studies in Deccan Traps, anorthosites, alkaline rocks and charnockites, granites, ultramafic rocks, lamprophyres, minor intrusions, metamorphic and sedimentary petrology, etc. The review of structural geology includes notes on magma tectonics, petrofabrics and petrotectonics apart from the regional tectonics and structure and tectonics of the Himalayas. The mineralogical review is restricted to feldspars and pyroxenes alone, apparently for the reason of their being the most intensively investigated mineral groups. Under economic geology, special attention has been bestowed on fossil fuels (coal and petroleum) and ferrous metals (iron and manganese). There are also brief chapters devoted to geophysical investigations, engineering geology and ground water geology.

Prof. Ray has taken great pains to go through the voluminous published and unpublished work during the last fifty years in the field of geology and the detailed bibliographies that accompany each chapter bear ample testimony to his thoroughness in this regard. Occasionally, however, one finds references to 'interesting results' obtained by some research worker, without a mention of the nature of the result or the name of the journal in which the results are being published. Such references are only tantalizing, without being helpful.

This otherwise admirable review suffers from unevenness in presentation — for instance, more space (p. 36) is devoted to palaeobotany than to the entire subject of Indian stratigraphy (p. 33). It is hoped that the numerous 'printer's devils' would be corrected in the forthcoming editions of the volume.

The volume would be an invaluable reference work to postgraduate students and research workers in geology.

U. ASWATHANARAYANA

FOUNDATIONS OF GENERAL TOPOLOGY by Á. Császár (Pergamon Press Ltd, Oxford), 1963. Pp. xix +380. Price £ 5 5s.

This book, first published in French and now appearing in an English translation with additions, deals with the fundamental role of order in the study of topology, uniformity and proximity structures. A topogeneous (or semitopogeneous) structure is a special type of order among the subsets of a set E. A topology can be defined by what is called a simple, perfect topogeneous order: this corresponds to the relation: $A < B$ meaning A is contained in the interior of B. A uniformity is defined by a family of biperfect, symmetrical syntopogeneous orders, corresponding to the family of relations of the form: $A <_i B$, which means A is contained in the U_i neighbourhood of B, the U_i forming a basis of surroundings defining the uniformity. And a proximity structure corresponds to a symmetrical syntopogeneous order: which can be taken as the relation $A < B$ defined by: A is not proximate to the complement of B.

A process of immersion enables the author to treat parallelly the compactification of proximity structures and the completion of uniform structures. Immersions into cubes are also studied for these structures. It is possible to have generalizations of these ideas to a Boolean algebra, instead of the algebra of all subsets of a set E, though the author prefers to keep that out, as it is not within the scope of his book.

V. S. KRISHNAN

THE TECHNOLOGY OF POLYESTER FIBRES by B. V. Petukhov; translated from the Russian by Margaret F. Mullins; English translation edited by B. P. Mullins (Pergamon Press Ltd, Oxford), 1963. Pp. xiv+89. Price 30s.

This monograph, translated from the Russian, deals with both the theoretical and applied aspects of

polyester fibre production from polyethylene terephthalate. Besides giving the properties of the fibre, the author has indicated the main fields of its application. According to the author, "the monograph is intended for workers in the chemical industry, especially the synthetic fibre industry; it could also perhaps be used by specialists in other branches of industry connected with the treatment and application of synthetic fibres". Viewed in the light of recent announcement of rapid expansion of the chemical industry in the USSR, this monograph brings out the important results from one particular branch of a rapidly growing industry, viz. synthetic fibre industry. The availability of considerable natural resources in the USSR forms the basis for the expansion of the polyester fibre industry.

The monograph is divided into seven chapters besides the introduction, wherein a brief historical development of the polyethylene terephthalate fibre is indicated in various countries. Chapter I deals with the production and properties of the raw materials needed for drawing 'Lavsan' (polyethylene terephthalate) fibres, viz. dimethyl terephthalate and ethylene glycol. The steps involved in obtaining these two raw materials in a pure form are described.

The synthesis of polyethylene terephthalate is described in Chapter II. Such methods as ester interchange and polycondensation are described in detail and profuse references have been presented. The important physico-chemical properties of polyethylene terephthalate form the subject matter of Chapter III. The different forms in which the polymer can be obtained, viz. amorphous and crystalline states, and the various changes taking place during fibre drawing have been presented. It is shown that amorphous polyethylene terephthalate possesses a *cis* configuration, which after crystallization changes to a *trans* configuration. In Chapter IV, the industrial process for producing the fibre is described in detail with relevant flow-sheets and this should be of value to those actually engaged in this field. Dealing with the economics of production of polyester fibre, the author shows the need to use the efficient process and also to use polyester wastes to lower the cost of production. Among the properties of polyester fibres considered in Chapter V are: the mechanical, moisture absorption, thermal stability, light resistance, dielectric and chemical resistance. In Chapter VI, the different methods adopted for dyeing the fibre are enumerated and the industrial applications of the fibre are presented. The concluding chapter on new types of polyester fibres describes briefly the Kodel and Vycron fibres, both under production in the USA. The development of copolyester fibres for improving the dyeing properties and also to decrease the cost of production has led to the use of *m*-isophthalic acid, sebacic acid and *p*-hydroxyethoxy-benzoic acid for copolymerization. The improvements in the properties obtained by the use of such copolymers are indicated.

This monograph fulfils the intentions of the author very well and should serve as a useful guide for technologists in this field.

N. KRISHNASWAMY

VAUCHERIACEAE — ICAR Monograph on Algae, by G. S. Venkataraman (Indian Council of Agricultural Research, New Delhi), 1961. Pp. 112. Price Rs 17

This monograph, which is fourth in the algological series published by the Indian Council of Agricultural Research, New Delhi, deals with 58 taxa belonging to four genera, viz. *Vaucheria*, *Vaucheriopsis*, *Dichotomosiphon* and *Pseudodichotomosiphon*. The family Vaucheriaceae is of great interest to algologists, since its systematic position is still disputed and the last word has not yet been said about it. While all the earlier authors assigned it to the order Siphonales, under Chlorophyceae, recent investigations indicate that it is a member of the Xanthophyceae. It is, therefore, intriguing to find why the author still prefers to keep it in Chlorophyceae, in spite of the fact all the cytological evidence, pigment analyses and nature of cilia which he has summarized clearly point to its inclusion under Xanthophyceae.

The volume begins with a historical introduction, dealing with the growth in knowledge of the important members of this group and a summary of research work done and records made of the various species in India. In the next chapter, a review is given of the order Siphonales, and the place assigned to Vaucheriaceae in the different systems of classifications proposed. Following this an account is given of the characteristics of the family and a brief survey of the affinities of the group. The next chapter deals with occurrence and distribution, structure of the thallus and the reproductive processes among the various members of the family, summarizing practically all the work done during the past nearly a century. These general chapters are followed by a systematic description of all the species and varieties included in the four genera, their distribution and affinities. A key is given, not only for the sections under which the major genus *Vaucheria* is divided, but also a detailed key for the species included under each section. A bibliography and two indices, one of the authors and the other of genera and species, conclude the volume. The various taxa are illustrated with drawings of essential parts, reproduced from original publications.

The monograph covers a large field of literature, very much dispersed and the author has done a great service in summarizing this information in an easily accessible form. However, it is regrettable that a number of minor blemishes, mostly in editing, have been allowed to mar an otherwise useful publication. Thus a number of references cited in the text are not included in the bibliography, e.g. Arechavelata, 1875; Borge, 1906; Chodat, 1909; Dangeard, 1939; Fritsch, 1948 and 1954; Oltmanns, 1904; Printz, 1927; Smith, 1950; and Taylor, 1957. Similarly, references cited in the bibliography are not included in the text, e.g. Ernst, 1902 (p. 38); De Wildman, 1900 (p. 57). De Candolle has been wrongly spelt throughout as De Condolle. Some of the species and varieties do not find a place in the index, e.g. *V. arrhyncha* (p. 98), *V. caespitosa* (p. 68), *V. clavata* (p. 69), *V. fuscescens* (p. 52), *V. piloboloides* var. *compacta* (p. 54), *V. scrobiculata* (p. 77) and *V. tuberosa* (p. 38).

In spite of these minor blemishes, the book is a valuable compendium, handy and useful to all workers in this problematical family.

PROCEEDINGS OF THE FIRST INTERNATIONAL PHARMACOLOGICAL MEETING — MODE OF ACTION OF DRUGS, General Editor: Börje Uvnäs (Pergamon Press Ltd, Oxford), 1963. Pp. viii+193. Price £ 5

This publication of the Proceedings of the First International Pharmacological Meeting, which dealt mainly with the mode of action of drugs, consists of two parts. Part I, 'Bradykinin and vasodilating polypeptides', contains nine papers by outstanding experts in the field, dealing with the definition of bradykinins and kinins, the structure and synthesis of bradykinins and with their pharmacological action, antagonists and possible pathophysiological role. Great interest has been evinced recently in bradykinin and related polypeptides because of their possible role as mediators of functional vasodilation and inflammatory response, and as agents causing accumulation and migration of leucocytes.

These proceedings have already been published as a special issue of *Biochemical pharmacology*, and as such they have lost much of their importance, particularly as a symposium on the same subject was held subsequently in 1962 under the auspices of the NY Academy of Sciences and its proceedings have already been published [*Ann. N.Y. Acad. Sci.*, **104** (1962)]. Proceedings of such symposia, dealing with topics engaging so much attention, can be of use only if they are published immediately. The subject is rather specialized and would be of interest only to peptide chemists and pathologists and pharmacologists in the field of haemodynamics.

Part II, 'Pharmacology of the lung', deals with problems of pulmonary circulation. There are six papers in this part: 'Effect of drugs on lung vessel tone', 'The effect of acetylcholine on the pulmonary circulation in man', 'Effect of histamine on the pulmonary circulation in man', 'Pharmacology of the bronchial circulation', 'Effects of drugs and dust particles on volume of isolated perfused guinea-pig lung', and 'Influence of drugs on bronchiolar smooth muscles' by such authorities in the field as Berglund, Soderholm, Westling, Aviado, Heymans and Konzett. Problems of pulmonary circulation have aroused enormous interest of late due to their relationship with pulmonary hypertension and other conditions of the lung, and the possibility of their detailed study due to the introduction of catheterization techniques. This collection of papers would be of immense use to physiologists and pharmacologists working primarily on various problems of the lung and its circulation.

Each chapter in both the parts is followed by a report of the discussion. A more faithful and detailed recording of the discussion would have added greatly to the value of the book.

The get-up of the book is excellent and it is, as would be expected of a Pergamon Press publication, remarkably free from errors.

NITYA ANAND

THE ASCLEPIADACEAE AND PERIPLOCACEAE OF BOMBAY (University of Bombay, Botanical Memoirs No. 4, 1960) by H. Santapau & N. A. Irani (Registrar of the University of Bombay, Bombay 1), 1962

The present monograph deals with members of two families, Asclepiadaceae and Periplocaceae, the latter an offspring of the former. The monograph reflects, in an admirable way, the magnitude of the task involved in the revision of even one family of plants, occurring in a small area as Bombay State. The monograph deals with 28 genera, 25 belonging to Asclepiadaceae and 3 assigned to Periplocaceae. In the introductory chapters, a historic review is given of the classification of the Asclepiadaceae, followed by a brief historic sketch of the group in Bombay: a short account is then given of the distinguishing morphological characters of the two families and of economic importance of some of their members.

The systematic part is dealt with under two parts: Part I — Asclepiadaceae, and Part II — Periplocaceae. An artificial key to the genera, based on some of the easily recognizable morphological characters, is given under each family. The various genera are dealt with in alphabetical order. The generic description is followed by a short note, regarding the derivation of the name and by the mention of the type species. Where more than one species are present a key is given. The specific descriptions are fully detailed, as regards plant characters, flowering and fruiting period in Bombay, number of herbarium sheets examined, distribution both inside and outside India, occurrence in Bombay and uses, if any. Local names and English names are added wherever they are known. The monograph covers Bombay State before reorganization as Maharashtra and Gujarat, from North Canara northwards to whole of Gujarat, excluding Cutch and Saurashtra.

While congratulating the authors as well as the publishers on the splendid and useful publication that has been brought out, one wishes some more details were given. For example, one wishes some figures are included of carpuscula, caudicles and pollen types to illustrate the important differences on which the two families are separated. Unfortunately, none of the species or genera belonging to Periplocaceae is illustrated. It would have been worth while if all the species had been illustrated.

Secondly, wherever uses have been mentioned, it would have been useful if a reference to *Watt's Dictionary* or *Wealth of India* were given, where the uses are already known, so that information newly added can be easily recognized.

Lastly, the phytogeographical terminology requires modification. One cannot still use Western Peninsula for Deccan and Malabar (cf. pp. 42, 46, 50, 57, 84). J. D. Hooker used this to designate the present Peninsular India, as distinct from the Eastern Peninsula comprising Burma and Malaya.

The printing and get-up of the volume are fairly good, but the book requires careful editing, particularly regarding citation of literature and uniformity in style of presentation; e.g. *Flora of British India* is cited as Hook. f., as FBI and also as Fl. Br. Ind. The type species are not mentioned for some of the genera dealt with; a few of the references

to authors and publications in the text do not find a mention in the bibliography. A more detailed bibliography would have enhanced the value of the publication.

In spite of these minor drawbacks, the present monograph is valuable not only as a handy reference for all interested but as a befitting model for Indian systematists surveying their regional flora.

K. R. RAMANATHAN

ADVANCES IN AUTOMOBILE ENGINEERING — Proceedings of a Symposium on Vehicle Ride, Cranfield, July 1962; edited by G. H. Tidbury (Pergamon Press Ltd, Oxford), 1963. Pp. viii +188. Price 35*s*.

With the increasing speeds of the present-day vehicular traffic, the problems of riding comfort and riding safety have become more and more significant. These two factors are in turn mainly dependent upon the characteristics of the moving vehicle and of the road surface upon which the vehicle moves, and very often these two types of characteristics are interrelated, e.g. an uneven road surface will cause severe vibrations in the vehicle or excessive vibrations of the vehicle can further accentuate the degree of unevenness of the road surface. The characteristics of the moving vehicle affecting riding comfort and safety may be grouped as speed, vibrations due to acceleration and other motive causes, springing of the vehicle suspension system, type of tyre cushion, etc. The characteristics of the road surface can be grouped as frictional properties, surface evenness, development of static and dynamic stresses at the road surface level, tractive resistance, noise, vibration, wear, light reflection, and so on. So far as the highway engineer is concerned, a whole new science of road surface mechanics is taking shape. But in order to contribute towards attaining higher degrees of riding comfort and safety, both the highway engineer and the automobile engineer have to work together so that the interrelated problems can be solved efficiently. The book under review, prepared by the Advanced School of Automobile Engineering, Cranfield, Bucks, UK, is a step in the right direction. The papers presented at the symposium do not cover all aspects of the subject, but are related mainly to vibration due to acceleration, rubber springing, air suspension of rubber tyres, measurement of road evenness and methods of evaluation of riding comfort. In a developing branch of a new science, it is but natural that experiments are conducted with different aspects in view, and it takes quite some time to fit all these pieces of information into a uniform and relevant frame. This is particularly applicable to the field of vehicular riding comfort and safety, and it may be rather too early to draw definite conclusions. It is, therefore, felt that at future symposia more aspects should be discussed in a more comprehensive manner.

Y. C. GOKHALE

PUBLICATIONS RECEIVED

CALCULUS AND ITS APPLICATIONS by P. Mainardi & H. Barkan (Pergamon Press Ltd, Oxford), 1963. Pp. vi+537. Price 55*s*.

ACCELERATORS OF CHARGED PARTICLES by B. S. Ratner; translated by L. A. Fenn; translation edited by H. W. Curtis (Pergamon Press Ltd, Oxford), 1964. Pp. viii+120. Price 17*s*. 6*d*.

PROBLEMS OF THE DESIGN AND ACCURACY OF COMPLEX CONTINUOUS ACTION DEVICES AND COMPUTER MECHANISMS edited by N. G. Bruyevich; translated by Gerald Segal; English translation edited by A. M. Andrew (Pergamon Press Ltd, Oxford), 1964. Pp. xi+264. Price 70*s*.

OPERATIONS RESEARCH IN RESEARCH AND DEVELOPMENT (Proceedings of a Conference at Case Institute of Technology) edited by Burton V. Dean (John Wiley & Sons Inc., New York), 1963. Pp. xii+289. Price $ 8.50

A COMPREHENSIVE BIBLIOGRAPHY ON OPERATIONS RESEARCH 1957-58, compiled by the Operations Research Society of America under the editorship of David B. Hertz (John Wiley & Sons Inc., New York), 1963. Pp. xiii+402

THE FLORA OF DELHI by J. K. Maheshwari (Council of Scientific & Industrial Research, New Delhi), 1963. Pp. viii+447. Price Rs 28.00; 56*s*.; $ 8.00

EFFECT OF IONIZING RADIATION ON THE REPRODUCTIVE SYSTEM (Proceedings of an International Symposium held at Colorado State University, Fort Collins, Colorado), Editors: William D. Carlson & F. X. Gassner (Pergamon Press Ltd, Oxford), 1964. Pp. xii+478. Price £ 5

AZEOTROPY AND POLYAZEOTROPY by W. Swietostawski; translation edited by K. Ridgway (Pergamon Press Ltd, Oxford), 1963. Pp. 226. Price 70*s*.

CHEMICAL ENGINEERING: Vol. 1 — FLUID FLOW, HEAT TRANSFER AND MASS TRANSFER by J. M. Coulson & J. F. Richardson (Pergamon Press Ltd, Oxford), 1964. Pp. xi+492. Price 50*s*.

THE INTERNATIONAL ENCYCLOPEDIA OF PHYSICAL CHEMISTRY AND CHEMICAL PHYSICS, Topic 19: GAS KINETICS: Vol. 5 — CHEMISTRY IN PREMIXED FLAMES by C. P. Fenimore (Pergamon Press Ltd, Oxford), 1964. Pp. ix+119. Price 35*s*.

FATIGUE RESISTANCE by P. Ye Kravchenko; translated from the Russian by O. M. Blunn; translation edited by N. L. Day (Pergamon Press Ltd, Oxford), 1964. Pp. xxvii+112. Price 30*s*.

THE APPLICATION OF COMPUTING TECHNIQUE TO AUTOMATIC CONTROL SYSTEMS IN METALLURGICAL PLANT by A. B. Chelyustkin; translated from the Russian by D. P. Barrett; translation edited by D. K. Ghosh (Pergamon Press Ltd, Oxford), 1964. Pp. x+225. Price 70*s*.

EFFECT OF MANUFACTURING TECHNOLOGY AND BASIC THREAD PARAMETERS ON THE STRENGTH OF THREADED CONNEXIONS by A. I. Yakushev; translated from the Russian by S. H. Taylor; translation edited by the staff of NEL (Pergamon Press Ltd, Oxford), 1964. Pp. xiii+259. Price 50*s*.

SHORT GUIDE TO GEO-BOTANICAL SURVEYING by S. V. Viktorov, Ye. A. Vostokova & D. D. Vyshivkin; translated by J. M. Macleman; translation edited by M. C. F. Proctor (Pergamon Press Ltd, Oxford), 1964. Pp. xi+158. Price 63*s*.

INORGANIC ULTRAMICRO-ANALYSIS by I. P. Alimarin & M. N. Petrikova; translated by M. G. Hell (Pergamon Press Ltd, Oxford), 1964. Pp. xv+151. Price 40*s*.

NOTES & NEWS

Interpretation of singularity in Schwarzschild's solution of Einstein's field equations

The possible existence of a minimum radius for a given mass of a particle is one of the interpretations suggested by W. H. McCrea [*Nature, Lond.*, **201** (1964), 589] of the Royal Holloway College, Englefield Green, Surrey, from an analysis of the Schwarzschild's solution of the Einstein's field equations.

The Schwarzschild's space-time metric exterior to a spherically symmetric mass M occupying a spherical space of radius $r = R$, where $R > 2M > 0$ is given by

$$ds^2=(1-2M/r)dt^2-(1-2M/r)^{-1}dr^2 -r^2d\theta^2-r^2\sin^2\theta d\phi \quad . \quad . \quad . \quad (1)$$

where gravitational units are used, the light speed and the gravitational constant being then unity. The radius $r = 2M$ gives the singularity of solution. The following interpretation has been suggested by McCrea: If the boundary of the mass M is taken to a distance $R = 2M$ and we try to add to the mass by bringing material from infinity up to the boundary, then the binding energy (i.e. the lost potential energy) would exactly cancel the proper mass which we are trying to add. Thus the mass M is the maximum mass that can be contained within radius $R = 2M$. This in effect means that the radius $R = 2M$ is the minimum radius possible for the mass M. From the well-known principle of equivalence of energy and mass itself, an idea regarding the existence of a critical radius can be formed. In order to justify this interpretation the following derivation has been given by McCrea.

When a particle of proper mass, m is projected radially inwards from infinity in the space-time given by Eq. (1) the particle is stopped at the boundary $R(>2M)$; the energy in excess of the rest energy is radiated radially outwards in the form of a single photon of energy $h\nu$.

Making use of the geodesic equations, Lorentz's transformation equations and the formula for the red shift in the space-time, the frequency of the liberated photon ν at infinity is found to be

$$h\nu = m[c-(1-2M/R)^{\frac{1}{2}}] \quad . \quad . \quad (2)$$

when $R \to 2M$; $h\nu = cm$

where cm is the total energy of the particle at infinity. From Eq. (2) it is seen that when the radius has the critical value, the whole energy of the ingoing particle is converted into radiation, so that there is no net addition to the mass of the particle.

Low temperature stars

Scientists at the International Telephone & Telegraph Corporation have discovered stars with unexpectedly low temperatures. The team of scientists detected these stars using an ultrasensitive infrared telescope — so sensitive that the measurements were interrupted by the heat from the bodies of insects flying past, or from the heated currents emanating from a cigarette 50 ft away. The scientists observed that many stars, far too faint to be visible, were extremely bright stars at infrared wavelengths. They concluded that the comparative lack of visible energy from these stars indicates that previous estimates of their temperatures have been too high. They have undertaken a comprehensive programme of detecting and mapping of such low temperature stars; so far, only 20 per cent of the sky has been plotted.

The radiometer used in these investigations was a reflecting optical system of 50·8 cm. aperture with an F/2·5 spherical primary mirror and a Newtonian folding mirror, directing the radiation to the detector (interchangeable according to the measurement range) mounted on the side of the tube. For the range of measurement of wavelengths 1·3-3·2 μ, a lead sulphide detector cooled to 195°K. (equipped with a fused silica field lens and a gold-plated conical condenser) was used; the effective speed attainable was F/1 and the field of view was $\frac{1}{4}$ deg. sq. For the 3-4 μ range, a tellurium detector with a germanium field lens was used giving an effective speed of F/1·2. For 8-13 μ region, a liquid helium-cooled, mercury-doped germanium detector was used, giving an effective speed of F/2·5 and a field of view of 0·1 deg. sq.

The discovery has practical applications in space technology, from the fact that satellites silent at radio frequencies can be detected by virtue of their heat, which cannot be suppressed [*J. Franklin Inst.*, **276** (1963), 575].

Determination of satellite ranges by laser

An experiment for fixing the range of a satellite, as it passes across the sky, by means of a laser beam is proposed to be carried out at the Radio Research Station, Slough, near London. In this experiment, the light beam will be used as electromagnetic waves as used in radar. By this means it is expected that the range of the satellite can be fixed more accurately (to within 15 m.) than by any other method.

At Slough, a 60 in. diameter searchlight mirror will be used for transmitting and receiving the laser beam from the satellite, which is fitted with special reflectors. The laser is mounted at the centre of the mirror. After roughly sighting the satellite through telescopes the laser will fire, at the right moment, a powerful beam (4 MW.) of light at the satellite, the flash lasting for only four hundred-millionth second. At a distance of 1000 km. the beam will be *c.* 1 km. in diameter, so that satellites within a distance of 1000 km. can easily be ranged [*British Information Services*].

A new method for determining elastic constants of metals

A simple, rapid and somewhat novel way of determining the Young's modulus (E) and the Poisson's ratio (μ) of metals has been reported from the Department of Civil Engineering, University of Illinois. In this method a ring made out of the material whose elastic constants are to be measured is subjected to diametral compression along the vertical

and the change in length of the horizontal and vertical diameters observed. A relation connecting the slope of the plots of the dimensional data of the specimen with E has been derived and this relation is used for evaluating E. For evaluating the value of μ a similar expression connecting the change in diameters and other dimensional data of a disc loaded diametrally is made use of. An analysis of these expressions connecting elastic constants with the dimensional data shows that in evaluating E best results are obtained when the ratio of the external to internal diameter of the ring is in the range 0·775-0·845. Even though a disc is to be preferred for evaluating μ, values of μ within limits of experimental error can also be evaluated using the same ring used for evaluating E, provided the ratio of the external to internal diameters does not exceed 0·3 [*Materials Res. & Stand.*, **3** (1963), 998].

An automatic microwave phase measurement system

A new phase measuring instrument that can cope with the stringent demands of the modern microwave systems has been designed at the Rantec Corporation, Calabasas, California. The new instrument has the following desirable features: (1) the phase angle is directly readable in degrees (with an accuracy of 0·1°) over a wide frequency range; (2) the readings are independent of the attenuation or gain of the component under test, or the output power of the signal source; and (3) the calibration is simple, stable and operation versatile. Systems designed for the measurement of phase earlier do not have this unique combination of features. The principle of working of the system is as follows: An input continuous wave signal is divided between two branches of the network of a 'hybrid tee'. The component under test is inserted in series with the test branch, while the reference branch is adjusted to have approximately the same phase-versus-frequency slope. The two branches are joined by a phase discriminator circuit which directly measures the phase difference between the two branches. The phase slope of the reference branch is made approximately equal to that of the test branch to reduce the range of variation of the phase measured to a few degrees over the entire frequency band studied. As a result the accuracy of measurement of phase is enhanced considerably as compared to the methods in which the full phase variation is measured [*Microwave J.*, **7** (2) (1964), 49].

Polyhedral boranes

Derivative chemistry of $B_{10}H_{10}^{-2}$ and $B_{12}H_{12}^{-2}$ has been found to be analogous to that of aromatic hydrocarbons as is evident from their disubstituted derivatives having amine, amide, nitrile and carbon monoxide substituents. It is found that the diazonium compounds $B_{10}H_8(N_2)_2$ and $B_{12}H_{10}(N_2)_2$ and the dicarbonyl $B_{10}H_8(CO)_2$ and $B_{12}H_{10}(CO)_2$ are the most useful intermediates for making these borane derivatives.

For the preparation of diazonium compound, $B_{10}H_{10}^{-2}$ is allowed to react with a 10-12 equivalent excess of nitrous acid and then reducing the precipitated intermediate with sodium borohydride in methanol. The mechanism of the two-step synthesis is probably the same as for the direct diazotization of aromatic compounds. However, the reduction step is not necessary in organic system. The diazonium compound is a colourless solid which decomposes slowly at 125° without melting. It can be sublimed at 90-100° under reduced pressure. Within the detection limits of boron nuclear magnetic resonance spectroscopy, the stereochemistry is maintained throughout reactions with amines, nitriles, ammonia and carbon monoxide. Nitrogen is lost during substitution reactions at 115-40°, giving the corresponding $B_{10}H_8(\text{ligand})_2$ species. Similar displacement occurs with amides, but the stereochemistry of these products is unknown. The dicarbonyl derivatives are prepared by the action of carbon monoxide at 120-40° without solvent. The dicarbonyls are useful for making other derivatives. The dicarbonyls are thermally stable and are purified by sublimation at 100° in vacuum [*Chem. Engng News*, **42** (4) (1964), 45].

Improved method for preparing Raney nickel catalysts

The preparation of conventional Raney nickel catalysts W1-W5 (and to a lesser extent W6 and W7) suffers from two disadvantages: the final product needs extensive washing; and the reproducibility of the reactions carried out using this product varies. A modified preparative method for Raney nickel catalysts has been developed at Brunel College, London. The catalyst can be prepared in small batches as required with reasonably consistent activity. Nickel-aluminium (1 : 1) alloy (30 g.) is stirred mechanically and heated at 70-80° with water (90 ml.) for *c.* 2 hr. The mixture is allowed to settle, decanted, the residue washed with methanol (90 ml.) and further added to give a suspension of volume, 90 ml. The catalyst may also be isolated by centrifuging or with the usual precautions, by filtration. The dried catalyst has approximately the composition Ni/Al_2O_3 (36·5 per cent nickel) and although both this and the structure are not known with certainty the catalyst can be described as a supported skeleton type.

The catalyst (10 per cent) has been used for the hydrogenation of compounds containing $C = O$, $-CH = CH-$, conjugated $-CH = CH-$, $-NO_2$, $-CH = N-$ (Schiff's base) and $-CN$ (aryl) groups. After a prolonged time acetophenone can be reduced with 2·5 per cent nickel. Cinnamic acid is more slowly reduced (incompletely) than its methyl ester. Acetophenone oxime or its sodium salt is only reduced to a small extent in methanol solution in agreement with previous findings at normal temperatures and pressures with Raney nickel. Aromatic ketones are more easily reduced than the aldehydes [*Chem. & Ind.*, (1964), 404].

New synthesis of quinolones

A method for obtaining 2- and 4-quinolones in 10-20 and 60-70 per cent yields respectively has been reported from the University of Münster/Westfalen (Germany). The method consists in heating α-acetylenic esters without solvent

at 230-50° for 10-15 min. with aromatic amines in the presence of a small amount of cuprous chloride or cuprous oxide. The resulting mixture of 2- and 4-quinolones can be separated by taking advantage of their different behaviour towards alkali [*Angew. Chem., internat. Ed.*, **2** (1963), 741].

Naphthocyclobutadiene derivative

A relatively stable crystalline analogue of benzocyclobutadiene, 1,2-diphenylnaphtho(b)cyclobutadiene, the first example of a compound containing a cyclobutadiene nucleus which has only one pair of neighbouring carbons fused to an aromatic nucleus has been synthesized. The starting material, bispropargylic alcohol, is treated with warm, dry methanolic hydrogen chloride to form 1,2-dimethoxy, 1,2-diphenylnaphtho(b)cyclobutene. The reaction of the cyclobutene derivative in ether with acetyl chloride at room temperature gives a 66 per cent yield of 1,2-dichloro-1,2-diphenylnaphtho-(b)cyclobutene. The dichloro derivative is allowed to react with zinc dust in boiling benzene for 3 min. to form the stable 1,2-diphenylnaphtho(b)cyclobutadiene. The evidence for the formation of the stable compound is provided by the following two reactions: (i) in the presence of Pd/C catalyst, a solution of the compound in benzene-ethanol is reduced rapidly at room temperature to *cis* 1,2-diphenylnaphtho(b)cyclobutene in 95 per cent yield; and (ii) oxidation of the cyclobutadiene derivative with potassium permanganate in acetone gives 2,3-dibenzoylnaphthalene in 80 per cent yield. This compound shows unexpected thermal stability. In the crystalline form it does not change for several weeks at room temperature in air and light. When molten, the compound retains its scarlet colour to about 260° where the melt fades to yellow. The stability of the naphthocyclobutadiene may arise from the fact that α,β-bonds in naphthalene have appreciably more double band character than the β,β-bonds. This should diminish the cyclobutadienoid character of the four-numbered ring by increasing the single bond character of the bond between C-8 and C-17 [*Chem. Engng News*, **42** (3) (1964), 36].

Production of lysine by chemical and microbiological synthesis

A new method for the production of L-lysine which combines the efficiency of synthetic method and the stereo-specificity of the enzymic method has been developed at the Electrochemicals Department of E.I. du Pont de Nemours & Co., Wilmington, Del. (USA). So far L-lysine has been manufactured either by synthetic methods which though cheap give rise to racemic amino acid requiring costly methods for resolution or by fermentation methods which are expensive though they produce L-isomer directly. In the present method diaminopimelic acid is synthesized from ethoxydehydropyran by the hydrolysis of a hydantoin which is decarboxylated to L-lysine by an enzymic preparation from *Bacillus sphaericus*.

Diaminopimelic acid is prepared in 4 steps starting from 2-ethoxy-3,4-dihydropyran. In the first step 2-ethoxy-3,4-dihydropyran is converted to glutaraldehyde by hydrolysis with dilute aqueous sulphuric acid. Glutaraldehyde on reaction with hydrogen cyanide at *p*H 4-6 and at a temperature of *c.* 0°C. forms biscyanohydrin which on heating with excess ammonia and carbon dioxide under autogenous pressure gives a mixture of products in which the trimethylene bishydantoin is an important component. Finally a hydrolysis of this mixture with hot aqueous sulphuric acid yields *meso*- and DL-diaminopimelic acids which are characterized by paper chromatography, bioassay and calorimetric assay.

To prepare the enzyme, *B. sphaericus* is fermented and the cells harvested by centrifugation and their acetone powder prepared. Before subjecting the cells to decarboxylation it was found advantageous to rupture the semi-permeable membrane coating of the bacteria; this treatment enhances the cell activity many times. The cells in the form of slurry are mixed with an aqueous solution of amino acid and the *p*H adjusted to 6·8. The mixture is shaken at 30-40°C. for 8 hr. Fresh cornsteep liquor (or the addition of pyridoxal phosphate) increases the rate of conversion. That the *B. sphaericus* decarboxylates only *meso* isomer and not the D- and L-isomer is shown by the fact that the left over material after the reaction shows no optical activity and could be resolved into two fractions under conditions known to separate *meso*- and DL-diaminopimelic acid into the L-isomer and a mixture of the *meso* and D-isomers. The presence of the L-isomer in the mixture along with an equal amount of the D- and L-isomer is, therefore, indicated. The possibility that the D- and L-isomers could have been decarboxylated at equal rate is ruled out when an authentic sample of the D-isomer is shown not to be decarboxylated.

After filtration, the lysine containing liquor is passed through an ion-exchange resin and recovered by elution with aqueous ammonia. Ammonia is removed by boiling and the *p*H adjusted to 5·15 with hydrochloric acid. Relatively pure L-lysine monohydrochloride is recovered from this solution by boiling off the solvent *in vacuo*. The unchanged DL-diaminopimelic acid is converted into *meso* isomer by epimerization with sulphuric acid or more efficiently by using ion-exchange resin [*Industr. Engng Chem., Proj. Res. Develop.*, **2** (1963), 308].

Glucocorticoid stimulation of biosynthesis of glutamic-alanine transaminase

Among the mechanisms put forward to explain the molecular basis of hormone action, the one which has attracted wide attention of biochemists and for which there are several evidences relates to the hormonal control of biosynthesis of specific enzymes [Karlson, P., *Perspectives Biol. Med.*, **6** (1963), 203]. It has been demonstrated that thyroxine which promotes anatomical metamorphosis also induces a striking change in carbamyl-phosphate synthetase activity and there is an increased incorporation of amino acids into this enzyme in the liver after the hormone administration. Similarly, increased amino acid incorporation has been found into

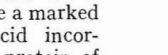
the glutamic acid-tyrosine transaminase of rat liver after the administration of cortisol to animals. Early hormonal effects have been found on the metabolism of RNA, particularly in the nuclear fraction. Altered hormonal states have been found to have a marked influence on amino acid incorporation into the total protein of cell-free systems.

Recently, the effect of prednisolone administration on the activity of glutamic acid-alanine transaminase activity has been investigated by H. L. Segal and Y. S. Kim [*Proc. nat. Acad. Sci., Wash.*, **50** (1963), 912]. Administration of prednisolone has been found by other workers to increase the activity of glutamic-alanine transaminase [Rosen, R., Roberts, W. R. & Nicol, C. A., *J. biol. Chem.*, **234** (1959), 476]. From a calculation of the half-life of the enzyme in control and treated rats and from incorporation studies using leucine-C^{14}, it has been concluded that the increased activity of the enzyme is due to an increased rate of biosynthesis of the enzyme. There is a lag period of the order of a day preceding the attainment of the maximum rate of synthesis. On the basis of this lag period it is speculated that the action of the hormone is to stimulate the production of an essential component of the protein synthesizing system (messenger RNA). There does not, however, appear to be a connection between the observed hormonal effect and the early metabolic response to glucocorticoid stimulation. Although an increased incorporation of pyruvate and alanine into glycogen has been observed after prednisolone administration (Segal, H. L. & Lopez, C. G., *Nature, Lond.*, in press), it is too early to ascribe these to changes in glutamic-alanine transaminase activity.

From these available evidences it may be concluded that the above proposed mechanism of hormonal control of biosynthesis of specific enzymes has good experimental support. — M. R. SAIRAM

Structural modifications of hadacidin and their effects on adenylosuccinate synthetase activity

Hadacidin (I), present in the embryonated egg and in the culture medium of *Penicillium frequentans* Westling, has been reported earlier to be active against human adenocarcinoma. The structure of this compound has been established as N-formylhydroxyaminoacetate



It has been observed that (I) suppresses the *de novo* synthesis of adenylic acid and deoxyadenylic acid by Ehrlich ascites tumour cells and rat liver. This effect of (I) is reversed by aspartate. The action of (I) has been shown to be due to an interference of the formation of adenylosuccinic acid, an intermediate in the synthesis of adenosine-5′-monophosphate, according to the sequence:

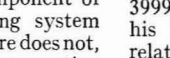
(i) Inosinic acid-5′-phosphate + L-aspartic acid + GTP $\xrightarrow[\text{Adenylosuccinate synthetase}]{Mg^{2+}}$ Adenylosuccinic acid + Pi + GDP

(ii) Adenylosuccinic acid $\xrightarrow{\text{Adenylosuccinase}}$ Adenosine-5′-phosphate + Fumarate

The inhibition of adenylosuccinate synthetase by (I) is competitively reversed by aspartate, which is structurally similar to (I).

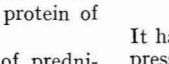
In a recent paper, H. T. Shigeura [*J. biol. Chem.*, **238** (1963), 3999] has reported the results of his investigations on the interrelationship between the structure and biological activity of (I). This was carried out by studying the effects of various structural analogues of (I), synthesized by K. Folkers and E. A. Kaezka (unpublished data) on adenylosuccinate synthetase purified 100-fold from *Esch. coli*.

Among the compounds tested, the α-methyl derivatives of (I) N-formyl-α-hydroxyaminopropionate

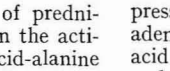


(II) had 90 per cent the inhibitory activity of (I) on adenylosuccinate synthetase. Similar to the phenomenon observed with (I), the inhibition of (II) was also competitively reversed by aspartic acid. Comparison of their K_i values [K_i for (I) $8{\cdot}7\times10^{-6}M$; K_i for (II) $4{\cdot}2\times10^{-6}M$] revealed that (I) is twice as effective as (II) in its activity. Substitution of ethyl or propionyl groups in the α-position, resulting in the formation of N-formyl-α-hydroxyaminobutyrate or N-formyl-α-hydroxyaminocaproate, resulted in a complete loss of activity.

N-hydroxyaminoacetate

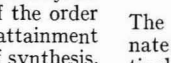


and N-acetylhydroxyaminoacetate



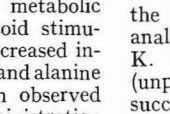
in which the formyl group of (I) is either removed as in the case of the former, or substituted by an acetyl group as in the case of the latter, exhibited nearly 30 per cent of the activity of (I). Higher homologues in this series had not been tested. These results reveal that the presence of a formyl group is essential for (I) to exhibit its maximum activity.

N-formylaminoacetate (OHC—NH—CH_2—COOH), in which the hydroxyl group of (I) is absent, and the amide of hadacidin, i.e. N-formylhydroxyaminoacetamide

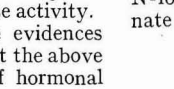


possessed 8 per cent and 4 per cent the activity of hadacidin respectively, indicating the necessity of both an N-hydroxyl group and a free carboxylic acid group.

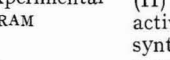
The following compounds, viz. N-formyl-1-hydroxyaminocyclopentane-1-carboxylic acid



N-formyl-α-hydroxyamino-β-phenylpropionate



N-formyl-β-hydroxyamino-β-phenylpropionate



or its *o*-chlorophenyl and *p*-nitrophenyl derivatives, were inactive, indicating that (I) loses its activity on the introduction of an alicyclic ring, or the substitution with an aromatic nucleus into the molecule.

From the data presented above it appears that the functional groups and the structural integrity of hadacidin have to be maintained for it to exhibit maximum activity. — N. RAMAN

Translational control of protein synthesis in a cell-free system directed by a polycistronic viral RNA

Evidence has accumulated to demonstrate that genetic information is transferred from the genome to the protein synthesizing unit through the mediation of 'messenger RNA' (mRNA) molecules. Regulatory mechanisms can thus operate at two sites, viz. at the site of synthesis of mRNA (transcription site) and at the site where the genetic message is translated into protein (translation site). A control of 'gene transcription' has been demonstrated in *Escherichia coli* where induction of the enzyme, β-galactosidase, resulted in an accumulation of mRNA complementary to the 'gal' and 'lac' loci. The RNA's of the RNA viruses are polycistronic molecules containing, as they do, the structural programme for at least two proteins, viz. a RNA dependent RNA polymerase necessary for viral multiplication and the viral coat protein. The existence of such polycistronic messages raises the question of their regulated use in terms of the order and relative frequency of translation of the component cistrons. In a recent investigation, Y. Ohtaka and S. Spiegelman [*Science*, **142** (1963), 493] used the RNA bacteriophage MSϕ2 whose RNA codes for three proteins have demonstrated a control mechanism for the translation of the cistrons specific for each of the proteins.

Earlier, with the f_2 coliphage it had been shown that the synthesis of f_2 coat protein is mediated by f_2RNA in *Esch. coli* extracts and that, while the coat proteins formed the major component, other proteins were also synthesized to a lesser extent. These observations had raised the question whether the viral RNA acted directly as a template or through some intermediate complementary strand. However, the conservation of the viral RNA during a complete lytic cycle [Doi, R. H. & Spiegelman, S., *Proc. nat. Acad. Sci., Wash.*, **49** (1963), 353] indicated that the viral RNA itself must serve as a messenger molecule and the control mechanism operative in protein synthesis must be of the translational type. The coat protein subunit of the bacteriophage MSϕ2 has molecular weight of about 20,000 and there are approximately 200 subunits per particle. From a calculation of the burst size of the phage it follows that 2×10^5 to 2×10^6 coat protein molecules are made per cell per lytic cycle. Since the synthesis of an equal number of polymerase molecules is unlikely, it is necessary that the cistron for the coat protein be translated more frequently than for other proteins. In order to test the validity of this, it should be possible to differentiate the proteins from one another and in the present instance this has been rendered possible by the fact that the coat protein lacks histidine. Therefore, the kinetics of appearance of the different proteins has been studied using tritium-labelled histidine and C^{14}-labelled amino acids. The results of this study show that incorporation of histidine takes place after a lag of 6 min. while no such lag is observed with other amino acids. Electrophoresis and distribution of radioactivity in the proteins synthesized during the first 10 min. and after 60 min. show that the former contained almost a single peak which corresponded with the coat protein and did not contain histidine. The protein synthesized during the 60 min. showed three peaks corresponding to the RNA polymerase, the coat protein and a third whose function is not yet clearly known. These observations rule out both random translation of viral RNA molecules as well as ordered translation with equal frequency for all cistrons. On the other hand, a sequential translation of the coat protein cistron is indicated. Translational controls at the stage of message-use provide additional devices for regulating protein synthesis, which can supplement those functioning at the transcription step, where genetic messages are produced. These workers further suggest that such mechanisms may not be exclusive to the RNA viruses alone, but may be operative in bacterial and mammalian systems as well. — (Miss) M. PREMA BAI

Active centre of glyceraldehyde-3-phosphate dehydrogenase

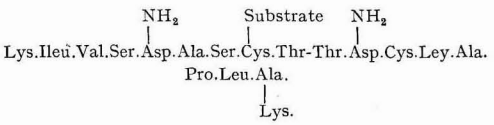
Glyceraldehyde-3-phosphate dehydrogenase (GPD) catalyses the following reactions: (1) reversible oxidation and phosphorylation of aldehyde substrates to the corresponding acyl phosphates in the presence of NAD and inorganic phosphate, e.g. the reversible conversion of glyceraldehyde-3-phosphate to 1,3-diphosphoglyceric acid in the presence of NAD and inorganic phosphate; (2) the transfer of acyl group of acyl phosphates to acceptor molecules, such as coenzyme A or arsenate; and (3) the hydrolysis of *p*-nitrophenylacetate to *p*-nitrophenol and acetate, in the absence of NAD.

The crystalline enzyme from rabbit muscle has a molecular weight of 120,000-138,000 and contains 3·0-3·6 moles of firmly bound NAD. The active enzyme contains 12 titrable —SH groups. The activity of the pure enzyme is completely lost by reaction with 3 moles of iodoacetate or *p*-chloromercuribenzoate. Under these conditions, three of the constituent —SH groups of the enzyme are also lost. Also, in the presence of substrates three —SH groups are found to disappear from the enzyme. Further, the substrates are effective in protecting the enzyme against inhibition by iodoacetate. These results suggest that the inhibitors function by competing with the substrates for the same three reactive —SH 'sites' in the enzyme molecule.

Several reactions catalysed by GPD have been shown to involve the formation of covalent intermediate acyl-enzyme compounds. In the enzyme catalysed hydrolysis of *p*-nitrophenylacetate the formation of the covalent intermediate is inhibited by substrates, as well as by cofactors such as NAD and inorganic phosphate of the dehydrogenase reaction. The dehydrogenase and esterase activities of the enzyme are mutually exclusive and are both inhibited in a stoichiometric and competitive manner by iodoacetate. These observations suggested that all the

three reactions are mediated by the same chemical groups in the 'active centre' of the enzyme molecule.

A recent paper [Harris, I., Meriwether, B. P. & Park, J. H., *Nature, Lond.*, **197** (1963), 154] reports the identification of the chemical nature of the three reactive sites and the elucidation of the sequence of the amino acid residues in the immediate environment of the reactive sites. Using iodoacetate-1-C^{14} and *p*-nitrophenyl-1-C^{14}-acetate as substrates, the reactive sites of the enzyme have been labelled. The labelled enzyme has been hydrolysed by conventional methods and the amino acid sequence in the isolate peptide has been established:



The reactive sites in GPD from rabbit muscle have been identified as the —SH groups of three of its constituent cysteine residues. These —SH groups react selectively with iodoacetate-1-C^{14} to form 1-C^{14}, S-carboxymethyl-cysteine or with *p*-nitrophenyl-1-C^{14}, S-acetyl enzyme. The earlier report of E. Racker [*Physiol. Rev.*, **35** (1955), 1] that the —SH group of glutathione is involved in the catalytic site of the enzyme is not supported by these investigations. Each molecule of fully active enzyme contains at least three structurally equivalent catalytic 'centres'. Each 'active centre' contains a reactive —SH group. The presence of hydroxyl and amide side chains in the immediate vicinity of the reactive —SH group creates a hydrophilic environment favourable to the formation of ancillary hydrogen bonds with aldehyde substrates. The absence of negative charges is significant in view of the fact that substrates and cofactors, such as glyceraldehyde-3-phosphate, NAD and inorganic phosphate, are in themselves all negatively charged. Another important feature is the presence of the second cysteine residue which in the native enzyme does not react with iodoacetate in the presence or absence of bound NAD.— V. C. JOSHI

Progress Reports

Nuffield Foundation

The Nuffield Foundation, UK, during the year ended March 1963 granted over 1·75 million pounds in support of scientific research, particularly in biology and medicine. The major part of the grant for medicine was sponsored for inquiries into rheumatic disease at a number of research centres. These include studies of therapeutic compounds and of treatment procedures; research into the structure of connective tissue from biochemical and biophysical viewpoints; metabolic studies; and investigation into normal processes of tissue behaviour at the cell level with a view to having better understanding of what happens when these processes become disorganized by rheumatic disease.

At the University of Birmingham, an investigation is being made into the chemistry of mucopolysaccharides with a view to elucidating the chemical structure of tissues liable to rheumatic conditions. The molecular size and structure of hyaluronic acid in the synovial fluid in normal joints and those of patients with rheumatic and other joint disorders have been compared. Work now in progress is concerned with the separation and chemical examination of the protein hyaluronic acid complexes present in synovial fluids, and the determination of the cause of the lower molecular size of the hyaluronic acid found in rheumatoid arthritis fluids.

An investigation on the enzymic breakdown of skeletal and connective tissue and the factors which promote or inhibit the process is being carried out at the Strangeway Research Laboratory, Cambridge. The discharge of hydrolytic enzymes from lysozymes has been found to profoundly alter organ structure and function. An investigation in progress at the Institute of Orthopaedics, London, is directed towards the disorders of cartilage. Chondromucopeptides or chondrotin sulphate, derived from cartilage matrix, form complexes with fibrinogen and β-lipoprotein in plasma *in vitro* and these precipitate as the plasma is acidified. This observation will help differentiate between exogenous and endogenous chondrolytic mechanisms.

Other investigations in progress are directed towards the study of inflammatory mechanism in general and into inflammation with hypersensitivity, especially delayed hypersensitivity; delayed hypersensitivity phenomena with reference to the interaction of macrophages with particulate antigens; and the antigenic properties of synthetic polypeptides containing proline and hydroxyproline.

Grants in other fields of medical research were made available for projects such as reducing incidents of back injuries in industrial workers by improving working methods and evaluating various forms of treatment; clinical and biochemical relationship between lead poisoning and acute intermittent porphyria; chromosome abnormalities in cases of heart disease in which there is either a familial or hereditary tendency; oxygen consumption and environmental temperature of new-born infants using an improved apparatus; nature and frequency of psychological changes that occur in the disease such as depression and euphoria.

A detailed histological study of changes which occur in the hypothalamic region of the brain in the pituitary gland and in the other endocrine organs when the pituitary stalk is severed is being carried out at the Institute of Psychiatry, London. Regeneration has been found to occur in man and animals not only of the neural elements of the stump of the pituitary stalk but also in some cases of the glandular elements. It has also been found that hormones may be secreted into the lymph and not as believed up to now solely into the blood. It appears that the lymphatic pathway may be of general importance for the transfer of protein hormones or of hormones firmly bound to proteins.

With a view to understanding the mechanism of antibody

formation the *in vitro* synthesis of antibodies by different tissues and by different cell lines has been studied. This study is expected to provide evidence of variation in the structure of gamma globulin synthesized by the selective cells.

The inquiries instituted in the field of biological research were confined to such varied topics as study of toxicity of food additives; application of optical and biophysical methods to biological and medical problems, in particular for the development of histochemical methods applicable to both optical and electron microscopy; and chemical and microbiological investigations into the biosynthesis of complex phenolic compounds.

Studies on chemical changes induced by radiation in progress at the King's College, University of Durham, are directed towards planning a physico-chemical investigation of the bonding between nucleic acid and histone in different nucleohistone structures, and a study of radiation induced reactions in nucleohistones and histones; the investigation of RNA synthesis in irradiated calf thymus nuclei is also planned.

A method for the isolation of neurons from mammalian brain in sufficient quantities to allow chemical analysis of their functional units is being worked out at the University College, London. The studies will be confined to neurons from brain nuclei whose functional significance is known and determine as precisely as possible the lipid composition of their mitochondria, microsomes and membranous material.

Division of Tribophysics, CSIRO, Australia

The annual report of the Division of Tribophysics of the Commonwealth Scientific & Industrial Research Organization, Australia, for the year 1962-63 gives an account of its research activities directed towards the ultimate aim of designing materials of specified properties and thereby widen the range of materials available for industry. Investigations have been carried out both on the bulk properties as well as on surface properties of solids.

An outstanding piece of work with potential practical application is the evolution of a new concept leading to a possible method of refrigeration which requires no supply of power. The method is based on the principle that if a radiating surface has a selective property of absorption and emission at selective wavelengths for which the atmosphere is transparent, the surface will cool rapidly since it will emit more heat than it absorbs. A thin film of silicon monoxide on an aluminium reflector is being tried as such a selective surface. The device would be suitable both for refrigeration and for cooling buildings in hot climates.

In order to assess the extent of conformation of metal surfaces used in experiments to that of ideal surfaces, a new technique called the ' decorating technique ' has been developed. In this technique a very thin layer of gold is made to condense on the surface and any departure from the ideal flat surface conditions is indicated by the orientation of the decoration. This technique has also been applied to polycrystalline films evaporated on to glass for studying the nature of variation of the surface structure with conditions of preparation and annealing. Two experiments have been designed to investigate the energetics of hot silver in inert atmospheres and in the presence of oxygen. Results from these experiments will be helpful for ascertaining the true cause of thermal etching. Studies of damage caused in gold crystals by bombardment of inert gases have shown that gas is trapped on the surface layer of specimens even for bombarding ions of energies less than 30 eV. A number of experiments for measuring trapping probabilities have been planned with a view to understanding the mechanism of sputtering. Studies made on the effects of concentration of the different surface defects on the catalytic decomposition of formic acid on evaporated silver films have shown that there is no direct relationship between changes in concentrations of these defects on the catalytic decomposition of formic acid on evaporated silver films and the changes in catalytic activity. With a view to understanding the origin of hardening a programme of investigations of the number, type and arrangement of defects in plastically deformed crystals has been undertaken and some useful deductions have been made. The energy released and the changes in electrical resistivity for copper deformed at −196°C. have been studied in the range of temperatures −196°C. to the recrystallization temperature and the results indicate that all the point defects generated by plastic deformation at 196°C. have been annealed by room temperature. A detailed study of the marked changes observed in the properties of copper due to recrystallization indicated that a considerable proportion of the energy released during recovery arises from configurational energy of dislocations.

Announcements

▪ *A Training Course in Documentation & Reprography*, of one year's duration (August-July), is being organized, for the first time, by the Indian National Scientific Documentation Centre (INSDOC), New Delhi. Admission to the course is open only to candidates who have at least a second class Master's degree, except in the case of deputed candidates who are already working in the national laboratories and research institutions. For the first course beginning on 10 August 1964, fifteen students will be taken. The total fee for the course is Rs 240, payable in four instalments. On the completion of the course, the successful candidates will be awarded a diploma in Documentation and Reprography by the Council of Scientific & Industrial Research. Further details regarding the course can be had from the Director, Indian National Scientific Documentation Centre, Hillside Road, New Delhi 12.

▪ *The First Matscience Summer School in High Energy Physics* will be held in Bangalore from 24 August to 14 September 1964. The school is being supported by a grant from the Council of Scientific & Industrial Research. The following scientists will be guest lecturers at the school: Prof. K. Symanzik, New York University;

Prof. E. R. Caianiello, Naples University; Prof. R. Oehme, University of Chicago; Dr F. Calogero, University of Rome; Dr A. Fujii, Tokyo University; and Dr J. Lukierski, University of Wroclaw. Supplementary lectures will be given by Drs R. Vasudevan, N. R. Ranganathan, T. K. Radha and K. Venkatesan of the Institute of Mathematical Sciences, Madras. Those intending to participate should contact the office of the Director, Institute of Mathematical Sciences, Madras.

▪ *A Symposium on Oils & Fats* will be held in Delhi during 26-29 December 1964 on the occasion of the Twentieth Annual Convention of the Oil Technologists' Association of India. The symposium will consist of two technical sessions on (1) Augmentation of oil and fat resources and (2) Utilization of some lesser used oils, and a group discussion on ' Prospects of soybean oil in the national economy of India'. Papers containing results of original investigations, plant studies and reviews may be submitted to the convener, Dr Sadgopal, Deputy Director (Chemicals), Indian Standards Institution, New Delhi.

▪ *The Indian Chemical Society* has invited applications for the Basudev Banerjee Medal and cash prize of Rs 400 to be awarded on the merit of research contribution in organic chemistry (including biochemistry). Applications accompanied by 4 copies of reprints or typescripts of the papers should reach the Hony Secretary, Indian Chemical Society, 92 Acharya Prafulla Chandra Road, Calcutta 9, by 31 August 1964.

▪ *A Symposium on Chemical & Non-chemical Interactions* will be held under the auspices of the Chemistry Department, Gorakhpur University, Gorakhpur, during October 1964. The topics of discussion at the symposium will be: (1) Non-chemical interactions: van der Waals and dipolar interactions; (2) Charge-transfer interactions; (3) Chemical interactions, including photochemical processes; (4) Interactions of matter with high-energy particles; and (5) Ionic interactions. Further details regarding the symposium can be had from the convener, Prof. R. P. Rastogi, Chemistry Department, Gorakhpur University, Gorakhpur.

▪ *The D.T.M. & H. and L.T.M. & H. Courses*, 1964-65 — The nine months' course of instruction for the (1) D.T.M. & H. (Diploma in Tropical Medicine and Hygiene) under Calcutta University and (2) L.T.M. & H. (Licentiate in Tropical Medicine and Hygiene) under the Faculty of Tropical Medicine, West Bengal, will begin from 22 October 1964. The D.T.M. & H. course is open to medical graduates of Indian universities or candidates possessing equivalent qualifications recognized by the Calcutta University for this purpose, who have been engaged in medical practice for a continuous period of at least 15 months or held residential appointment in a teaching hospital for at least one year. The L.T.M. & H. course is open to medical licentiates registered in any State Medical Council of India but medical graduates may also be admitted, if they desire. Applications for admission in the prescribed form (obtainable from the school office) should reach the Director, School of Tropical Medicine, Calcutta, by 31 August 1964.

▪ *The Fifth International Coal Preparation Congress*, to be jointly organized by the US Bureau of Mines and the American Mining Congress, will be held in Washington DC, during 3-7 October 1966. Correspondence concerning the congress should be directed to the Secretary, International Organizing Committee, Fifth International Coal Preparation Congress, US Bureau of Mines, Washington DC 20240.

▪ *The Second International Conference on Palynology* will be held at the State University, Utrecht, Netherlands, from 29 August to 5 September 1966. Enquiries regarding the conference should be addressed to Prof. F. P. Jonker, Botanical Museum and Herbarium, State University, Lange Niewstraat, 106 Utrecht, Netherlands.

▪ *Award of doctorate degrees* — The following have been declared qualified for the award of Ph.D. degree for their respective theses shown against their names in parentheses:

Delhi University: Prabodh Kumar Shrivastava (*Palmar dermatoglyphics of Murias and Marias of Bastar*); Vijender Bhalla (*The genetic analysis of ABO, MNSs, PhHr and Duffy blood group systems in three endogamous groups of Panjabi Hindus, and an association of blood groups with tuberculosis*); P. Narayanaswamy (*The covariant Green's function approximation scheme and its application to the problem of the electromagnetic form factors of the nucleon*); and Rajinder Pall Nayyar (*Karyological and histochemical studies of germ cells of some Teleostean fishes*).

Mysore University: S. Satyanarayana Rao (*Studies on sewage treatment and utilization*); S. N. Balasubramanyam (*Studies on aliphatic synthesis of compounds related to natural products — Synthesis of isomer of C-11 and C-12 acid obtained by degradation of abietic acid*); and R. Vimala Devi (*Cytology, cytochemistry and physiology of some Ciliates*).

Panjab University: Madan Lal (*Morphological and histochemical studies on the female germ cells of Arachnids*); Chuni Lal Mandahar (*Nutritional studies of some pathogenic fungi*); Kailash Chander Malhotra (*Ethyl acetate as a polar solvent*); Shiv Kumar Kundra (*Studies on the separation of light lanthanons from Indian monazite*); Surinder Kumar Aggarwal (*Histochemical studies of Vitellogenesis in the oogenesis of insecta*); and Hans Raj Panji (*Post-embryonic development of Callosobruchus analis F. (Bruchidae: Coleoptera*).

Saugar University: C. V. Padmanabham Pillai (*Studies on the so-called blue peroxychromic acid*); Kishan Lal Handoo (*Studies in some physico-chemical properties of chromium selenite, ferric selenite and aluminium selenite sols*); Kuldeep Singh Mukharya (*Studies on nitrogen transformations by vigorous oxidizing substances with and without catalysts*; and Narayan Hari Joshi [*Studies in the fluorescence spectra of CaS (Bi, Mn) phosphors*].

Shri Venkateswara University: P. Ramachandra Naidu (*Thermodynamics of liquid mixtures — A study of molecular interactions*).

ABSTRACTS

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

RECEIVED DURING JANUARY-MARCH 1964

No. 3, JULY 1964

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1964, Vol. 23, No. 3

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ABSTRACTS

53 PHYSICS

532 Fluid Dynamics

403. GOPALA RAO, R. V., DAS, C. D. & KEER, H. V. (National Chemical Laboratory, Poona): A finite virial expansion of fluid state, *Indian J. Chem.*, **2** (1964), 29

A method has been outlined to extend the virial equation so as to include a finite number of higher virial coefficients. An equation has been derived between $C_1 \equiv [\delta(1/\beta)/\delta P]^T$, vapour pressure and compressibility coefficient using the virial equation up to the seventh virial coefficient. The equation has been applied to a number of polar liquids and the calculated values of C_1 are in good agreement with the observed values.

404. GOPALA RAO, R. V., KEER, H. V. & DAS, C. D. (National Chemical Laboratory, Poona): Imperfect vapour phase, compressibility and force constants of liquids, *Indian J. Chem.*, **2** (1964), 27

Assuming the vapour phase of fluids to be imperfect, a relation between vapour pressure, compressibility coefficient and intermolecular energy constant (C_1) of liquids has been derived from the idea of continuity of states by using the virial equation. The derived relation has been applied to a number of liquids and the calculated values of C_1 are in good agreement with observed values.

533.7 Kinetic Theory

405. GAMBHIR, R. S. & SAXENA, S. C. (Physics Department, Rajasthan University, Jaipur): Translational thermal conductivity and viscosity of multicomponent gas mixtures, *Trans. Faraday Soc.*, **60** (1964), 38

The rigorous kinetic theory Chapman-Enskog expressions for the translational thermal conductivity, $\lambda_{mix.}$, and viscosity, $\eta_{mix.}$, of a binary gas mixture have been transformed into the following form suggested earlier by Sutherland and Wassiljewa

$$\lambda_{mix.}\ (\text{or } \eta_{mix.}) = \frac{\lambda_1\ (\text{or } \eta_1)}{1+\phi_{12}\,(x_2/x_1)} + \frac{\lambda_2\ (\text{or } \eta_2)}{1+\phi_{21}\,(x_1/x_2)}$$

The temperature and composition dependences of the constants ϕ_{ij} have been investigated. A general relation giving the ratio ϕ_{12}/ϕ_{21} is derived. It is also possible to obtain explicit expressions for ϕ_{ij} for a particular type of binary mixture, viz. where the mass of one component is far greater than that of the other. Both these simpler expressions do not involve terms requiring the knowledge of intermolecular forces.

406. GAMBHIR, R. S. & SAXENA, S. C. (Physics Department, Rajasthan University, Jaipur): Zero pressure Joule-Thompson coefficient for a few non-polar gases on the Morse potential, *Indian J. Phys.*, **37** (1963), 540

Theoretical values of $\mu^0 C_p^0$ (μ^0 being the zero pressure Joule-Thompson coefficient, and C_p^0, the zero pressure specific heat at constant pressure) for the gases He, Ar, CH_4 and N_2 calculated on the Morse potential and using the potential parameters determined from second virial coefficient data have been compared with the experiment. Calculations on Lennard-Jones (12-6) potential are also reported. Both the potentials give good agreement with experiment except for He where the Morse potential shows rather large deviations. The viscosity parameters for He give still worse results.

534.8 Ultrasonics

407. VISWANATHAN, R. (Department of Physics, Indian Institute of Science, Bangalore): Pulse method of determining acoustic velocities in solids, *Indian J. pure appl. Phys.*, **2** (1964), 53

Design details of an apparatus for the determination of ultrasonic velocities in solids based on the pulse echo technique are given. The experimental set-up consists of a quartz transducer excited at its fundamental frequency to produce pulses of 1-2 sec. duration at intervals of 500 μsec. by a pulsed transmitter. Echoes received by the transducer as well as the transmitted pulse are fed to an oscilloscope which is triggered by the same pulse which triggers the transmitter, but with a delay of a few microseconds. The construction and alignment of the circuit are simple and tuning is not critical. With this set-up, ultrasonic velocities can be determined with an accuracy of 0·5 per cent. Studies carried out with the apparatus have shown that the ultrasonic velocity in solids is not affected by the size and shape of the specimens and also by the interference effects of the various types of waves inside the specimen.

535 Optics

408. VED PRAKASH (Department of Physics & Astrophysics, University of Delhi, Delhi): Production of large fluorite crystals of optical quality, *Indian J. Technol.*, **2** (1964), 46

Single, colourless and transparent crystals of calcium fluoride suitable for use in optical components have been produced by heating high quality natural fluorspar (m.p. 1400°C.) to 1600°C. in a chemically clean graphite crucible and freezing it slowly under

high constant and non-linear temperature gradient. Addition of lead fluoride at 2 per cent level as scavenger improves the quality of the product. The construction details of the furnace which is an electric vacuum furnace of the elevator type with a graphite heating element and other accessories, such as the graphite crucible, 10 kVA. low tension transformer, are described.

535.33 Spectroscopy

409. DWIVEDI, C. P. D. (Department of Physics, University of Gorakhpur, Gorakhpur): Near ultraviolet absorption spectrum of *o*-ethylaniline vapour, *Indian J. pure appl. Phys.*, **2** (1964), 105

The near ultraviolet absorption spectrum of *o*-ethylaniline vapour lying in the region 3000-2836 A. has been investigated and assignments of three (155, 179 and 294 $cm.^{-1}$) fundamental vibrational frequencies in the ground state and six (112, 167, 242, 392, 500 and 638 $cm.^{-1}$) in the excited states have been proposed.

410. SHARMA, V. S., MATHUR, H. B. & BISWAS, A. B. (National Chemical Laboratory, Poona): Structure and stability of nickel (II) ion-amino acid complexes: Studies on the absorption spectra, *Indian J. Chem.*, **2** (1964), 5

The absorption spectra of Ni^{2+}-amino acid complexes show four bands in the regions 8000-11,000, 12,000-13,000, 15,000-19,000 and 25,000-29,000 $cm.^{-1}$. The results are interpreted in the light of the ligand field theory and Ni^{2+} is shown to be in octahedral coordination. The relative values of the ligand field splitting parameter are discussed in relation to the thermodynamic properties of these complexes.

411. TRIPATHI, LAXMI NARAIN (Department of Physics, University of Gorakhpur, Gorakhpur): Near ultraviolet absorption spectrum of *o*-fluoroanisole vapour, *Indian J. pure appl. Phys.*, **2** (1964), 105

The near ultraviolet absorption spectrum of *o*-fluoroanisole has been studied in the vapour phase and the observed bands have been explained in terms of eight (149, 228, 286, 347, 482, 518, 640 and 764 $cm.^{-1}$) ground state and fourteen (100, 186, 253, 293, 433, 477, 529, 672, 728, 914, 1023, 1128, 1237 and 1285 $cm.^{-1}$) excited state fundamental frequencies. Difference frequencies of 29 and 48 $cm.^{-1}$ towards the red side and of 46 and 77 $cm.^{-1}$ towards the violet side of the 0,0 band have also been observed.

535.44 Crystal Physics

412. DEO, P. G. & SHARMA, S. D. (Department of Applied Sciences, Panjab Engineering College, Chandigarh): Spiral configurations in sodium chloride crystals, *Indian J. pure appl. Phys.*, **2** (1964), 13

Etch patterns in plastically deformed sodium chloride single crystals have been studied by selective etching using methanol-acetic acid etchant. When the crystals are repeatedly polished and etched, the patterns are observed on (110) plane of the crystal. Etch figures consisting of single, two, three and four spirals have been observed. The possibility of these configurations being dissolution spirals or Frank-Read sources has been discussed.

536.41 Thermal Expansion

413. SHARMA, K. C. & JOSHI, S. K. (Physics Department, Allahabad University, Allahabad): Thermal Expansion of solids on the basis of anisotropic dispersive continuum model, *Phil. Mag.*, **9** (1964), 99

The temperature variation of the Gruneisen parameter is calculated for copper and germanium on the basis of anisotropic dispersive continuum model, from the observed elastic anharmonicity. The detailed nature of the frequency spectrum does not seem to have any pronounced effect on the thermal expansion of a solid.

537.21 Electrical Circuits

414. CHIPLONKAR, V. T. & DESAI, S. K. (Institute of Science, Bombay): Frequency response of a.c. circuits with negative magnitudes for inductance, capacitance and resistance, *Indian J. pure appl. Phys.*, **2** (1964), 40

The frequency response of a circuit containing a negative inductance (L) and a positive capacitance (C) or vice versa when they are in parallel and in series has been analysed. It has been shown that in a parallel L-C circuit with a negative inductance or a negative capacitance the total impedance shows a maximum at a characteristic frequency and the phase difference between the voltage and current shows an asymptotic extremum of $\pi/2$ at higher frequencies. For a series L-C circuit with a negative inductance or a negative capacitance, the total impedance shows a minimum and the phase difference an extremum at a characteristic frequency.

539.2 Solid State Physics

415. JAIN, S. C. & DAHAKE, S. L. (Solid State Physics Division, National Physical Laboratory, New Delhi): Ionic conductivity of sodium chloride crystals doped with nickel and other impurities, *Indian J. pure appl. Phys.*, **2** (1964), 71

The electrical conductivity (σ) of sodium chloride crystals doped with divalent metallic impurities has been investigated theoretically and experimentally. The three regions (I, II and III) of the log σT-$1/T$ plots are investigated and it is found that th ey are separated by large transition regions. The plots in the three regions are straight lines and their slopes are proportional to $(W/2)+E$, E and $E+(W_a/2)$ respectively where W is the energy of formation of a separated pair of Schottky vacancies, E is the energy of activation for migration of a cation vacancy and W_a is the energy of combination of a cation vacancy and the divalent impurity ion. The plots in the transition regions are curves; the

slope in the first transition region changes from $(W/2)+E$ to E and in the second transition region from E to $E+(W_a/2)$. It has been shown that the extents of regions I and II decrease rapidly with increasing concentration (C) of the impurity. For $C > 100$ p.p.m., regions I and II are absent and the log σT-$1/T$ plots cannot be used to determine the energies W and E. The rate of formation of vacancy impurity pairs has been calculated and is found to be so fast that non-equilibrium condition cannot be frozen in and the pairs are in equilibrium with the quenched crystals at the lowest temperature at which measurements have been made. The formation of higher aggregates being a slow process, the effects of formation of pairs and those of higher aggregates are separated by rapidly quenching and very slowly cooling the crystals. The conductivities of quenched and slowly cooled sodium chloride crystals doped with different concentrations of Ni^{2+} as well as of Ca^{2+}, Cd^{2+} and Ba^{2+} impurities have also been measured. A detailed comparison of the experimental and theoretical results on the effect of impurity on the conductivity has shown good agreement between the two. The values of W and E are: $2{\cdot}34\pm0{\cdot}01$ eV. and $0{\cdot}75\pm0{\cdot}01$ eV. respectively, and the value of E has been found to be independent of the impurity added. The values obtained by previous workers are usually lower for W and higher for E, and the value of E has been reported to be different for different impurities. The possible causes of these discrepancies are discussed. The dependence of σ on the concentration of Ni^{2+} impurity has also been studied at different temperatures and a value of $W_a = 0{\cdot}32$ eV. for Ni^{2+} impurity in sodium chloride has been obtained. The factors influencing the value of W_a are also discussed.

416. NARASIMHAMURTY, A. (Physics Department, Andhra University, Waltair): Electron paramagnetic resonance in single crystals: Part IV — Copper ammonium chloride dihydrate, *Indian J. pure appl. Phys.*, **2** (1964), 37

The results of experimental investigations on the anisotropy of g factor and line width of the paramagnetic resonance line in a single crystal of copper ammonium chloride dihydrate are reported. The principal g values obtained are $g_z = 2{\cdot}07$ and $(g_x+g_y)/2 = 2{\cdot}24$. The values compare favourably with corresponding values for the potassium salt reported by H. Abe *et al.* [*J. phys. Soc. Japan*, **9** (1954), 814]. The g factors have also been calculated theoretically from the known crystal structure data for the two suggested structures and on comparison with the observed values it has been possible to uniquely establish the structure of copper ammonium chloride. Line width variation in copper ammonium chloride dihydrate is closely similar to the variation in the potassium salt and also agrees with theoretical predictions; the slight disagreement in the *ac* and *bc* planes is attributed to the fact that Van Vleck's equations [*Phys. Rev.*, **74** (1948), 1168] employed in the theoretical calculations hold good strictly for identical spins only.

417. SUSILA, (Miss) G. (Department of Physics, Indian Institute of Science, Bangalore): A method for the determination of short lifetime of carriers in a photoconductor from the transient photoresponse, *Indian J. pure appl. Phys.*, **2** (1964), 44

A theoretical method for the evaluation of the lifetime of excess carriers in a photoconductor which is smaller than the decay time of the injecting pulse is reported. In this method the differential equation for the rate of change of excess carrier concentration has been solved by taking into account the effect of the function controlling the generation of electron-hole pairs, and a universal set of curves representing the transient photoresponse of photoconductors for the case of injecting pulses in the form of a symmetric trapezium and a symmetric triangle has been computed. The lifetime (τ) of carriers is evaluated by a comparison between the theoretically evaluated and experimentally observed photoconductivity decay curves; in addition, the possibility of estimating τ from the ratio of the response at two different instants within the duration of the pulse is also indicated.

53 : 523.2 Solar Physics

418. DAS GUPTA, M. K. & BASU, D. (Institute of Radio Physics & Electronics, Calcutta): Effect of the earth's orbital eccentricity on incident solar flux at 10·7 cm., *J. atmos. terr. Phys.*, **26** (1964), 135

The known variation of the earth-sun distance due to the earth's orbital eccentricity indicates that the intensity of the incident solar radiation in June-July should be 6·5 per cent less than that in December-January. However, from an analysis of the solar radio noise flux at 10·7 cm. over the entire sunspot cycle (1949-59) it has been observed that the basic component of the flux in the month of July is less than that in January by 7·6 per cent. This reduction figure is in close agreement with that of 7·5 per cent obtained by Appleton in the case of solar ionizing radiation responsible for the formation of the E layer.

53 : 549.73 Ferrites

419. LAROIA, K. K. & SINHA, A. P. B. (National Chemical Laboratory, Poona): Effect of impurities on magnetic properties of hard ferrites, *Indian J. pure appl. Phys.*, **2** (1964), 48

The effect of a number of impurity ions on the saturation magnetization, remanence, coercivity and Curie temperature of sintered polycrystalline barium and sodium lanthanum ferrites has been studied. In many cases substantial changes in the magnetic properties have been observed. The mechanism responsible for these changes has been investigated in detail. The improvement in the magnetic properties brought about by certain additives has been found to be due to (i) impurity phase changing the sintering characteristics of the magnetic phase whereby a more dense product is obtained at a lower sintering temperature, and (ii) enhancement of the rate of crystal growth in the presence of the impurity phase and the size of the crystallites having

the right orientation growing at the cost of the wrong ones. The deterioration in magnetic properties brought about by certain other additives has been established to be due to the competitive removal of one of the phases taking part in the solid state reaction and thus decreasing the ultimate yield of the magnetic phase.

53 : 621.319.1 Ferroelectricity

420. SINHA, K. P. & SINHA, A. P. B. (National Chemical Laboratory, Poona): Role of Jahn-Teller effects in the origin of ferroelectricity: Occurrence of ordered phase in Perovskite-type ferroelectrics, *Indian J. pure appl. Phys.*, **2** (1964), 91

It is shown that in the Perovskite-type ferroelectrics, e.g. $BaTiO_3$, the near-lying electronic states of the oxygen ion in the Ti-O-Ti unit which have opposite symmetry lead to a distortion of the system resulting in a permanent dipole. In this approach, the role of the Jahn-Teller effect as extended by U. Öpik and M. H. L. Pryce [*Proc. roy. Soc.*, **A238** (1957), 425] is invoked for electron-vibration coupling. The availability of a low transverse frequency fulfils the appropriate condition for a Jahn-Teller distortion. This approach furnishes a new basis to the theory of ferroelectricity.

531.3 : 548.71 Lattice Dynamics

421. SHARMA, P. K. & JOSHI, S. K. (Physics Department, Allahabad University, Allahabad): Model for the lattice dynamics of metals: Part II — Application to face-centred cubic copper, *J. chem. Phys.*, **40** (1964), 662

A model for the lattice dynamics of metals propounded by us earlier is applied to copper, a representative of face-centred cubic metals. The force constants appearing in secular equation for the lattice frequencies are estimated from the knowledge of elastic constants. The phonon dispersion curves for three symmetry directions [100], [110] and [111] are presented and are found to be in fair agreement with the neutron spectroscopic measurement. The frequency distribution function has been calculated. The specific heat computed from the frequency distribution function is found to be in good agreement with the experimental measurements.

538 : 548 Crystal Magnetism

422. NEOGY, D. & MOOKHERJI, A. (Physical Laboratories, Burdwan University, Burdwan): A note on magnetic properties and crystal field in praseodymium ethyl sulphate, *Indian J. pure appl. Phys.*, **2** (1964), 28

The magnetic susceptibilities and crystal field parameters of praseodymium ethyl sulphate have been re-examined, and the values obtained employing the set of parameters proposed by J. M. Baker and B. Bleaney [*Proc. roy. Soc.*, **245** (1955), 156] have been compared with those of J. van den Handel [*Physica 's Grav.*, **8** (1941), 513] and A. Mookherji [*Proc. Rajasthan Acad. Sci.*, **2** (1951), 1]. The need for revising the magnetic susceptibility and crystal field parameter data on rare earth ions is pointed out.

539.1 : 538 : 534.24 Nuclear Magnetic Resonance

423. SHARMA, P. K. & JOSHI, S. K. (Physics Department, Allahabad University, Allahabad): Saturation effects in nuclear spin lattice relaxation in solids, *Phys. Lett.*, **9** (1964), 13

Saturation behaviour of NMR lines in the presence of radio frequency field for quadrupolar interaction is considered for $I = \frac{7}{2}$ and $\frac{9}{2}$. Explicit expressions for the saturation factor are derived in special cases of separate and superposed lines.

54 CHEMISTRY

541.124-8 Chemical Reactions

424. ANANTAKRISHNAN, S. V. & JAYARAMAN, H. (Department of Chemistry, Madras Christian College, Tambaram): Studies in oxidation: Part VII — Effect of substituents on the oxidation of aromatic aldehydes by chromium (VI) oxide, *Indian J. Chem.*, **2** (1964), 91

Kinetics of oxidation of benzaldehyde and a number of substituted benzaldehydes by chromic acid has been studied under conditions of constant ionic strength and constant hydrogen ion concentration in binary solvent mixtures of acetic acid and water. Generally, the kinetic rates of oxidation of the various substituted aldehydes are in accord with the well-known theory of electronic substituent effects. It is found that electron attracting groups accelerate the rate of oxidation and that electron releasing groups retard it.

425. ANANTAKRISHNAN, S. V. & JAYARAMAN, H. (Department of Chemistry, Madras Christian College, Tambaram): Studies in oxidation: Part X — Mechanism of the oxidation of aromatic aldehydes with chromium (VI) oxide, *Proc. Indian Acad. Sci.*, **59A** (1964), 93

Both structural and solvent influences on the rate of oxidation of a series of aromatic aldehydes by chromic acid show the following features: the formation of a chromate ester is not a prerequisite to oxidation; in the rate-determining step of the reaction the C-H hydrogen is removed as a hydride anion. That the rate-determining step involves a two-electron transfer has been proved by a study of the induction factor method. A tentative mechanism, based on an analogy to the well-known 'S_N2' process, has been proposed.

426. JAYARAMAN, H. (Department of Chemistry, Madras Christian College, Tambaram): Studies in oxidation: Part VIII — Proximity and cumulative effects on oxidation of benzaldehydes with chromium (VI) oxide, *Indian J. Chem.*, **2** (1964), 94

The oxidation of *o*-chloro-, *o*-nitro- and *o*-methoxybenzaldehydes by chromium (VI) oxide has been

studied in binary mixtures of acetic acid-water, under constant ionic strength and *p*H, between 60° and 80°C. The lower kinetic rate observed for *o*-chloro- and *o*-nitrobenzaldehydes, compared to the corresponding *p*-isomers, is due to intramolecular hydrogen bonding leading to the stable five- and six-membered rings respectively; it is also due to the cumulative effect of the bulky substituents. The kinetic rate of oxidation of 2,4-dichlorobenzaldehyde is found to be between those of *p*-chloro- and *o*-chlorobenzaldehydes. This has been accounted for by the fact that chlorine in *p*-position accelerates the kinetic rate whereas it is retarded by chlorine in the *o*-position because of steric influence.

427. JAYARAMAN, H. (Department of Chemistry, Madras Christian College, Tambaram): Studies in oxidation: Part IX — Influence of solvent on rate of oxidation of aromatic aldehydes by chromium (VI) oxide, *Proc. Indian Acad. Sci.*, **59A** (1964), 68

The rates of oxidation of several aromatic aldehydes with chromic acid have been measured using several mixtures of acetic acid and water as solvents. This study points to the fact that the oxidation proceeds by an ion-dipole mechanism. Evidence has also been obtained from these studies that the active oxidant is a cationic species, such as $HCrO_3^+$ or $H_3CrO_4^+$. Amis' equation for an ion-dipole reaction gives remarkably good values of *r*, thus confirming an ion-dipole mechanism.

428. SATYA PRAKASH, PANDEY, JATA DHARI & ICHHAPORIA, FIROZE MANECKJI (Department of Chemistry, University of Allahabad, Allahabad): Effect of concentration, bulk and intensity of the sonochemical decomposition of tetrachloroethane, *Indian J. Chem.*, **2** (1964), 76

The effect of ultrasonic intensity on the sonochemical decomposition of saturated solution of tetrachloroethane has been studied. The percentage decomposition in a given time is found to increase with concentration. There is also an optimum volume of the solution which produces the maximum sonochemical decomposition. The reaction is found to be governed by the phenomenon of ultrasonic cavitation. Complete inhibition of sonochemical decomposition of tetrachloroethane in the presence of nitrogen atmosphere has been observed which probably shows that the cavitation bubbles are formed but the energy is not sufficient to maintain the reaction.

541.13 Electrochemistry

429. GUPTA, S. L., CHATTERJEE, M. K. & SHARMA, S. K. (Department of Chemistry, Birla College of Science, Pilani): Organic a.c. polarography and tensammetry in non-aqueous media, *J. electroanal. Chem.*, **7** (1964), 81

The a.c. polarography of organic compounds and tensammetry in non-aqueous media and their merits and demerits over aqueous media have been investigated. It has been found that dissolved oxygen does not interfere in tensammetry as well as in organic a.c. polarography in aqueous media but the base currents are considerably reduced in non-aqueous media, thereby making a.c. polarography of organic compounds in non-aqueous media more sensitive as compared to that in aqueous media. The result that tensammetric peaks are practically absent and enhanced reduction peaks are observed in non-aqueous media can be used in determining the nature of the capacity peaks observed with organic compounds at the d.m.e. in pulsating field, which has not been successfully done with aqueous supporting electrolytes so far. The absence of the adsorption phenomenon in non-aqueous media and the fact that the peaks due to organic compounds are reduction peaks may be utilized in the elucidation of the electrode kinetics and in the resolution of peaks from a mixture of organic compounds in non-aqueous media which would have been complicated in aqueous media because of adsorption processes. A.c. polarography of organic compounds in non-aqueous media may also prove advantageous over aqueous media because of limited solubilities of organic compounds in aqueous media.

430. GUPTA, S. L. & SHARMA, S. K. (Department of Chemistry, Birla College of Science, Pilani): A.c. polarographic studies on the influence of tensammetric waves on reduction peaks of inorganic cations and vice versa, *Talanta*, **11** (1964), 105

The effect of nature and concentration of surface active substances (s.a.s.) on a.c. reduction peaks of Cd^{2+} and Zn^{2+} ions and vice versa has been investigated by a.c. polarography. It is seen that the magnitude of the reduction peak is not influenced up to a certain concentration of the s.a.s., but with concentrations higher than this the magnitude of the reduction peak progressively decreases; a concentration of 1·3 per cent *n*-amyl alcohol completely removes the $10^{-3}M$ Cd^{2+} peak. The magnitude as well as the peak potential of the tensammetric peak of *n*-amyl alcohol are not influenced by the presence of Cd^{2+} ions. There is a linear relation between the concentration of the electroactive species and the optimum concentration of the s.a.s. as well as the concentrations of the s.a.s. just required to remove the reduction peak. These observations are supported by the curve which gives the linear relation between concentration of the electroactive species and the amount of the s.a.s. required to reduce the magnitude of the reduction peak to half its value. The amount of the surfactants required to completely remove the reduction peak is in the order *n*-amyl alcohol > Cerfak > cetyl pyridinium bromide.

431. NARAYANAN, K. S. & NAMBOODIRIPAD, C. P. (Central Electrochemical Research Institute, Karaikudi): Redoxokinetic and impedance titrations of zinc and cadmium salts with potassium ferrocyanide, *J. electroanal. Chem.*, **6** (1963), 480

It has been shown that the techniques of redoxokinetic and impedance titrations can be successfully applied to the titration with potassium ferrocyanide,

of (i) zinc salts and (ii) cadmium salts, both in the presence of traces of potassium ferricyanide to establish the redox system. The titrations have been carried out at elevated temperatures, and the results are compared with those obtained by conventional potentiometry.

541.41 Complex Compounds

432. SHARMA, V. S., MATHUR, H. B. & BISWAS, A. B. (National Chemical Laboratory, Poona): Jahn-Teller stabilization and entropy changes accompanying the formation of metal-amino acid complexes, *J. inorg. nucl. Chem.*, **26** (1964), 382

Enthalpy (ΔH) and entropy (ΔS) changes accompanying the formation of metal-amino acid complexes have been determined. The higher values of ΔS for complexes of Cu^{2+}, as compared to the corresponding complexes of Ni^{2+}, Co^{2+} and Zn^{2+}, are attributed to the effects of tetragonal distortion of the octahedral symmetry due to Jahn-Teller effect.

433. SHETTY, P. S., SUBBARAMAN, P. R. & GUPTA, J. (National Chemical Laboratory, Poona): Complex formation of nickel, cobalt and lead with sodium triphosphate, *Indian J. Chem.*, **2** (1964), 8

The complex formation of nickel (II), cobalt (II) and lead (II) with sodium triphosphate in aqueous solutions has been investigated using spectrophotometric and ion-exchange techniques. In the *p*H range 3-5 complex species of the type $MHP_3O_{10}^{2-}$ are formed which have log *Kf* (formation constant) values 4·18, 4·03 and 6·32 at 30°C. and unit ionic strength for nickel, cobalt and lead respectively. However, the salts which crystallize out from aqueous solution of *p*H 5 correspond to the composition $Na_3NiP_3O_{10}$, $12H_2O$ and $Na_3CoP_3O_{10}$, $12H_2O$.

434. THANKARAJAN, N. & SEN, D. N. (National Chemical Laboratory, Poona): Reactivity of chelated acetylacétones, *Indian J. Chem.*, **2** (1964), 64

Nitration of tris-(2,4-pentanediono) aluminium (III) yields two new compounds, tris-(3-nitro-2,4-pentanediono) aluminium (III) and mono-(3-nitro-2,4-pentanediono) - bis - (2, 4 - pentanediono) aluminium (III). Treatment of tris-(3-nitro-2,4-pentanediono) aluminium (III) with sodium aluminium hydride in tetrahydrofuran converts it back to tris-(2,4-pentanediono) aluminium (III). On reduction with hydrazine hydrate and Raney nickel the tris-nitro compound yields a metal-free condensation product, 4-nitro-3,5-dimethylpyrazole.

541.6 Chemical Structure

435. AGARWAL, S. C. & SESHADRI, T. R. (Department of Chemistry, University of Delhi, Delhi): A reinvestigation of the structure of pinastric acid and isopinastric acid, *Indian J. Chem.*, **2** (1964), 17

The structures of pinastric acid and isopinastric acid have been reinvestigated. On reduction with zinc and acetic acid, the two acids afford 1-phenyl-4-(*p*-methoxyphenyl)-3-oxobutane-1-carboxylic acid methyl ester (methyl 4'-monomethoxyhydrocornicularate) and 1-(*p*-methoxyphenyl)-4-phenyl-3-oxobutane-1-carboxylic acid methyl ester (methyl 4-monomethoxyhydrocornicularate) respectively. These esters have been synthesized starting from *p*-methoxycinnamaldehyde and cinnamaldehyde respectively. It is thus established that pinastric acid and isopinastric acid are position isomers, having the methoxyl group in different phenyl rings. Based on the study of their infrared spectra both the acids have been assigned the *trans-trans* configuration.

436. MAHESHWARI, M. L., VERMA, K. R. & BHATTACHARYYA, S. C. (National Chemical Laboratory, Poona): Structure and absolute configuration of norketoagarofuran, 4-hydroxydihydroagarofuran, 3,4-dihydroxydihydroagarofuran and conversion of β-agarofuran to α-agarofuran, *Tetrahedron*, **19** (1963), 1519

In addition to the furanoid compounds reported previously three more crystalline furanoids of the selinane group have been isolated from agarwood oil, obtained from the fungus infected plant *Aquillaria agallocha* Roxb. The structures and absolute configuration have been determined by their interconversions into the compounds previously reported.

437. NARAYANAN, C. R., PACHAPURKAR, R. V., PRADHAN, S. K. & SHAH, V. R. (National Chemical Laboratory, Poona) & NARASIMHAN, N. S. (University of Poona, Poona): Structure of nimbin, *Indian J. Chem.*, **2** (1964), 108

Nimbin, the main crystalline bitter constituent obtained from *Melia azadirachta* Linn., is proposed to have the structure and stereochemistry of a triterpenoid derivable from apoeuphol with the C-ring oxidatively broken between C_{12} and C_{13} and appropriate oxidations at other sites.

542.952 Polymerization

438. JOSHI, R. M. (National Chemical Laboratory, Poona): Heat of polymerization of vinyl chloride, *Indian J. Chem.*, **2** (1964), 125

Heat of polymerization of vinyl chloride has been determined on the isothermal distillation calorimeter working at 74·5°C. with carbon tetrachloride as the heat exchange medium. The value obtained, $-\Delta H^{ls} = 22{\cdot}9 \pm 0{\cdot}3$ kcal./mole, appears to exceed that of the unsubstituted ethylene in corresponding states of monomer and polymer, and exhibits a strong effect of the electrophilic substitution, similar to that observed in the heat of hydrogenation.

543 Chemical Analysis

439. SRIVASTAVA, T. N. & RUPAINWAR, D. C. (Chemistry Department, Lucknow University, Lucknow): Use of benzoic acid and its derivatives as reagents for the gravimetric estimation

of gallium: Part I, *Indian J. appl. Chem.*, **26** (1963), 100

Benzoic acid has been used for the estimation of gallium in solution. The precipitation is quantitative between *p*H 3·72 and 5·89. The precipitate can be ignited and weighed as Ga_2O_3. Separation from a number of other ions has been found possible. Some of the derivatives of benzoic acid such as *m*-nitrobenzoic, *o*-chlorobenzoic, 3,5-dinitrobenzoic and *m*-toluic acid can also be used instead of benzoic acid.

440. SRIVASTAVA, T. N. & RUPAINWAR, D. C. (Chemistry Department, Lucknow, University, Lucknow): Use of benzoic acid and its derivatives as reagents for the gravimetric estimation of gallium: Part II — Composition of the precipitate, *Indian J. appl. Chem.*, **26** (1963), 105

The composition of the precipitate formed by treating gallium, in buffered solutions of its chloride, with benzoic acid and its derivatives varies significantly with change in *p*H. Pure basic salt of the formula $Ga(OH)(C_6H_5COO)_2$ is obtained only at lower *p*H range, but with increase in *p*H, the proportion of gallium hydroxide is obtained. The conclusions derived are supported by microscopic and microphotographic examinations and infrared absorption spectra of the samples.

545.844 Chromatography

441. MODI, B. D., PATIL, J. R. & BOSE, J. L. (National Chemical Laboratory, Poona): Separation of isopropylidene derivatives of monosaccharides by thin-layer chromatography, *Indian J. Chem.*, **2** (1964), 32

A quick and convenient method for the separation and detection of mono- and di-O-isopropylidene derivatives of some monosaccharides is presented employing thin-layer chromatography on silica gel. A simple apparatus for carrying out descending thin-layer chromatography is also described.

547.25 Organo-metallic Compounds

442. NATH, R. L. & DAS, I. (School of Tropical Medicine, Calcutta): Preparation of some mono-alkyl phosphates, *Bull. Calcutta Sch. trop. Med.*, **12** (1964), 18

The barium salts of the mono-alkyl phosphoric acids having *n*-propyl, *iso*-propyl, *n*-butyl, *iso*-butyl, *sec*-butyl, *tert*-butyl, *n*-amyl, *iso*-amyl and *tert*-amyl as the alkyl groups respectively have been prepared for use as substrates for the investigation of the influence of the structure of alkyl groups upon the action of phosphatase from *Dolichos lablab*. The method of King and Nicholson, which involves the condensation of phosphorus oxychloride with the corresponding alcohol in pyridine solution, was modified starting the reaction at low temperature and completing at room temperature. The purity of the compounds was determined by estimating barium and, where necessary, phosphorus also in the barium salts.

443. SRIVASTAVA, T. N. & TANDON, S. K. (Chemistry Department, Lucknow University, Lucknow): Some triphenyl tin derivatives, *Indian J. appl. Chem.*, **26** (1963), 171

Several hitherto unknown triphenyl tin compounds like isothiocyanate, nitrate, phosphate, arsenate, sulphate, oxalate, phthalate and chloroacetate have been prepared by the action of triphenyl tin iodide on the suspension of the corresponding silver salts in benzene. Triphenyl tin acetate, benzoate and sulphide, already reported in the literature, have also been obtained by this method. All these compounds have been characterized by determining some of their physical properties.

547.596 Terpenes

444. CHETTY, G. L. & SUKH DEV (National Chemical Laboratory, Poona): Ketones from 'Mayur Pankhi'— Some new cuparene-based sesquiterpenoids, *Tetrahedron Lett.*, No. 2 (1964), 73

Six new sesquiterpene ketones have been isolated from the essential oil of 'Mayur Pankhi' and the structures of two of them, α-cuparenone and β-cuparenone, have been established.

547.94 Alkaloids

445. MANSA RAM & BHATTACHARYYA, P. K. (National Chemical Laboratory, Poona): Transformations of *Kurchi* alkaloids: Part IV — Structural correlation of the *Kurchi* alkaloid, holarrhimine and the Apocyanacae alkaloids, paravallarines, *Indian J. Chem.*, **2** (1964), 41

Kurchi alkaloids have been structurally correlated with the Apocyanacae alkaloids, paravallarines, by synthesizing from holarrhimine, 18,20α-(S)-dihydroxy-3-dimethylamino-5-pregnene, a product of lithium-aluminium hydride reduction of methyl paravallarine.

54 : 58 Plant Chemistry

446. CHALIHA, B. P., SASTRY, G. P. & RAO, P. R. (Regional Research Laboratory, Jorhat): Chemical studies on Assam citrus fruits: Part I — Examination of the peels of *Citrus limon* (Linn.) Burm. f., *Indian J. Chem.*, **2** (1964), 40

β- and γ-sitosterols have been isolated from the petroleum ether extract and hesperidin from the methanolic extract of the peels of *C. limon*.

447. GOVINDARAJAN, V. S. & MATHEW, A. G. (Central Food Technological Research Institute, Mysore): Polyphenolic substances of arecanut: Part I — Chromatographic analysis of fresh mature nut, *Phytochemistry*, **2** (1963), 321

The polyphenols of arecanut have been examined by the use of paper chromatography and specific spray reagents. Besides (+)-catechin and leucocyanidin, a monomeric and some polymeric leucocyanidins have been shown to be present. The data on the high yield of the cyanidin from the polymeric compounds suggest that they contain readily

cleavable linkages. Quantitative estimation of the different components shows a preponderance of the polymeric flavan-3,4-diols yielding cyanidin.

448. MATHEW, A. G., VENKATARAMU, S. D. & GOVINDARAJAN, V. S. (Central Food Technological Research Institute, Mysore): Studies on arecanut: Part I — Changes in chemical composition and physical characteristics of nuts with maturity, *Indian J. Technol.*, **2** (1964), 90

Physical and chemical characteristics of arecanuts of different maturities, collected from various growing regions of south India, have been determined with a view to understanding the changes that occur with maturation and ripening. A high concentration of total water extractives, polyphenols, nitrogen and mineral matter is found at the tender stages. With maturity, the alkaloid, fat, fibre and polysaccharides are formed, bringing down the concentration of the former constituents. However, calculated on nut basis, continued formation of all constituents is evident. Significant differences in the characteristics of the nuts from certain regions, such as Mysore, Thirthahalli and Vittal have been observed.

449. SENGUPTA, P. & GHOSH, S. (Organic Chemistry Laboratory, University of Kalyani, Kalyani): Chemical examination of *Breynia rhamnoides*, *Indian J. Chem.*, **2** (1964), 83

β-Sitosterol has been isolated from the benzene extract of the roots of *B. rhamnoides*.

450. SHARMA, R. C., ASIF ZAMAN & KIDWAI, A. R. (Department of Research in Unani Medicine & Department of Chemistry, Muslim University, Aligarh): Chemical examination of *Prosopis spicigera* Linn., *Indian J. Chem.*, **2** (1964), 83

The flavone glycoside patulitrin has been isolated from the ethanolic extract of the flowers of *P. spicigera*.

451. SINGH, A., SRIVASTAVA, S. N. & SHARMA, V. N. (National Botanic Gardens, Lucknow): Chemical examination of the fruits of *Santalum album* Linn., *Indian J. Chem.*, **2** (1964), 82

Betulic acid, β-sitosterol, and an oil consisting of the glycerides of octadec-11-en-9-ynoic, palmitic, oleic and linoleic acids have been isolated from the fruits of *S. album* Linn.

547 : 542.915 Organic Synthesis

452. AMIN, J. H., PATNEKAR, S. G., MATHUR, H. H. & BHATTACHARYYA, S. C. (National Chemical Laboratory, Poona): Alkyl cyclopentenones: Part II — A practical synthesis of dihydrojasmone, *Indian J. Chem.*, **2** (1964), 14

Stobbe condensation of diethyl succinate with octan-2-one in the presence of potassium or sodium *tert*-butoxide gives a mixture of 3-ethoxycarbonyl-4-methyl dec-3-enoic and 4-enoic acids. The mixture is cyclized by refluxing with aqueous hydrobromic acid in acetic acid and the resulting γ-methyl-γ-hexyl paraconic acid on pyrolysis yields a mixture of γ-methyl-γ-decanolactone and the corresponding unsaturated acid. Cyclodehydration of this mixture with polyphosphoric acid furnishes dihydrojasmone (3-methyl-2-amyl-cyclopent-2-en-1-one) in an overall yield of 70 per cent.

453. BHAT, V. V. & BOSE, J. L. (Natiònal Chemical Laboratory, Poona): 1-Phenyl-4-cinnolones, *Chem. & Ind.*, (1963), 1930

o-Hydroxyphenylglyoxal-2-phenylhydrazones obtained through the alkaline hydrolysis of 2,3,4-triketochroman-3-phenylhydrazones have been successfully cyclized to the hitherto unknown 1-phenyl-4-cinnolones.

454. GOPAKUMAR, G. & NAIR, P. MADHAVAN (National Chemical Laboratory, Poona): Preparation of deuterochloroform from trichloroacetophenone, *Indian J. Chem.*, **2** (1964), 128

An improved method for the preparation of deuterochloroform from trichloroacetophenone is described. The yield of deuterochloroform obtained by the modified method is 88-93 per cent compared to 30 per cent obtained by W. M. Boyer, R. B. Bernstein, T. L. Brown and V. H. Dibeler [*J. Amer. chem. Soc.*, **73** (1951), 770].

455. JOSHI, K. C. & SEN GUPTA, (Miss) JHARNA (Chemistry Department, University of Gorakhpur, Gorakhpur): Synthesis of some fluorohydroxy ketones and related compounds of potential biological interest, *J. Indian chem. Soc.*, **40** (1963), 851

Several fluoro-hydroxy ketones and related compounds derived from 2-bromo-4-fluoro and 2-chloro-4-fluoro-phenol have been prepared with a view to evaluating their biological activity.

456. MATHUR, K. C. & SAHARIA, G. S. (Department of Chemistry, University of Delhi, Delhi): Studies in the cycloheptane series: Part IX — Synthesis of simple and substituted benz-3-ethyl-3-methylcycloheptanes, *Indian J. Chem.*, 2 (1964), 22

Anhydride of β-ethyl-β-methyl glutaric acid has been condensed with benzene, toluene, chlorobenzene and isomeric xylenes in the presence of anhydrous aluminium chloride to give the corresponding γ-aroyl-β-ethyl-β-methyl-*n*-butyric acids. These acids on reduction furnish the respective δ-aryl valeric acids; the corresponding acid chlorides on cyclization in carbon disulphide using anhydrous aluminium chloride give the cyclic ketones which on subsequent reduction furnish the respective benz-3-ethyl-3-methylcycloheptanes.

55 METEOROLOGY

550.3 Geophysics

457. HAYAKAWA, MASAMI & BALAKRISHNA, S. (Geological Survey of Japan, Tokyo, & National Geophysical Research Institute, Hyderabad):

Measurement of longitudinal and transverse wave velocities in some rocks of Hokkaido and India, *Bull. nat. Geophys. Res. Inst.*, **1** (1963), 232

Ultrasonic velocities, both longitudinal (V_p) and torsional (V_s), have been measured in rocks of Hokkaido and of India employing the pulse technique at atmospheric pressure and temperature. Ultrasonic velocity values (V_p) of the order of 8·0 kc/s. are noticed in ultrasonic rocks, while they give values (V_s) of 4·0 kc/s. These are compared with field measurements. Anisotropy is noticed in rocks where preferred orientation is observed. Possible stress energy that can be stored in a rock by long-time lapse under pressure has been calculated and its effect on elastic moduli of rocks has been discussed.

458. JAI KRISHNA & CHANDRASEKARAN, A. R. (School of Research & Training in Earthquake Engineering, University of Roorkee, Roorkee): Earthquake resistant design of an elevated water tower, *Bull. Indian Soc. Earthquake Technol.*, **1** (1964), 29

This paper deals with the design of water towers in seismic zones with reference to a specific problem. The criterion for design suggested is that the system remains elastic under the effects of moderately strong ground motion which are expected to be more frequent in the particular zone, and under the effect of a severe ground motion, which may be expected there once in the lifetime of the structure, the system may undergo plastic deformations.

459. SANKER NARAYAN, P. V. & KRISHNAN, M. S. (National Geophysical Research Institute, Hyderabad): A gravity study of the Godavari valley, *J. Indian Geophys. Un.*, **1** (1964), 1

The available gravity data (published Bouguer anomaly values of the Survey of India) have been examined to see if there is any expression of the postulated graben structure of the Godavari river valley in the gravity picture. While surface Bouguer anomaly shows this feature as a broad, elongated anomaly, the downward continued Bouguer map and the second derivative map show it as a long, narrow and arcuate structure with a slight convexity towards the north-east. Judging from the contour density, the north-eastern flank appears to be steeper than the south-western confirming in a qualitative way the evidence gleaned from surface geology which shows that the strata occupying it dip to the north-east. The zero contour of the second derivative shows almost exact coincidence with the boundary between the Gondwana exposures and the unclassified crystallines on the north-eastern flank, though on the south-western side such a coincidence is vague or lacking. The north-western limit of the structure appears to end at the place where the Deccan traps commence, but this cannot be confirmed in the present study as the gravity data in this part of the map are extremely meagre, making the contours rather conjectural.

551.51 : 533.6 Atmospheric Turbulence

460. VENKITESHWARAN, S. P. (National Aeronautical Laboratory, Bangalore): Observations in India of turbulence in the upper air from sounding balloon ascents, *Tech. Note No. TN-AE-23-64* (National Aeronautical Laboratory, Bangalore), 1964

The paper describes the special features of the F-type radiosonde in distinguishing from the rotation of the fan whether the downward movement of the radiosonde balloon is due to a strong vertical downward current or due to the accumulation of snow. It shows how the rate of rotation of the fan can be used to identify regions of turbulence in the atmosphere. The observations of turbulence with the F-type radiosonde are compared with the inference drawn by turbasondes in the USA and the Dines meteorograph records in India. The regions where turbulence may be observed in India have been indicated. The existence of severe turbulence in the upper troposphere and in the stratosphere has been emphasized.

551.46 Oceanography

461. RAMA RAJU, V. S. (Oceanography Research Wing of NGRI, Cochin): Note on the sea surface currents of the western part of the Indian Ocean, *Bull nat. Geophys. Res. Inst.*, **1** (1963), 175

An analysis of the surface currents caused during the February-March 1960 part of the 31st cruise of the Soviet research vessel *Vitiaz* in the western part of the Indian Ocean is presented. The currents were computed from the observations on the drift of the vessel at different oceanographic stations when its propellers were not working.

551.573 Evaporation

462. DEO, A. V., KULKARNI, S. B., GHARPUREY, M. K. & BISWAS, A. B. (National Chemical Laboratory, Poona): Film pressure-area isotherms of monolayers of *n*-long chain alcohols and *n*-alkoxy-ethanols on water surface, *Indian J. Chem.*, **2** (1964), 43

Film pressure-area isotherms of monolayers on water surface of a number of *n*-long chain alcohols (C_n-OH) and of *n*-alkoxy-ethanols, C_n-OC_2H_4OH (n = 14, 16, 18, 20 and 22) in the temperature range 15-35°C. are reported. All the alcohols, with the exception of C_{14}-OH at higher temperatures, exhibit the liquid-condensed and the solid phases. The film expansion of C_{14}-OH starts between 20·9° and 25·4°C. A phase transformation within the solid phase at the lower temperatures is shown by C_{16}-OH. The higher two alcohols, eicosanol and docosanol, exhibit diffused first order transition from liquid-condensed to the more compact liquid-solid phase at temperatures higher than those reported by earlier workers. The C_{14}- and C_{16}-OC_2H_4OH show expanded and intermediate phases throughout the temperature range. The higher three compounds give the liquid-condensed region in which the

isotherm is not rectilinear and in which higher order phase transformations may be operative. The higher alkoxy-ethanols also show diffused first order transition from liquid-condensed to the liquid-solid phase, though at slightly higher temperatures than the corresponding alcohols. In addition, C_{22}-OC_2H_4OH has a pronounced diffused first order transition at the lowest temperature. This type of transition does not appear to have been reported earlier. The area at zero compression for the liquid-condensed phase is higher (23-25 A.²) for the alkoxy-ethanols with their extended polar group compared to the alcohols (21-22 A.²). For the solid state, on the other hand, the two areas are nearly equal suggesting the alignment of extended polar groups of the former along the carbon zigzag chain at high film pressures.

463. KATTI, S. S., KULKARNI, S. B., GHARPUREY, M. K. & BISWAS, A. B. (National Chemical Laboratory, Poona): Evaporimeter studies on water evaporation reduction due to monomolecular films during day and night, *Indian J. Technol.*, **2** (1964), 81

Reduction in water evaporation due to monomolecular films of long chain alcohols and alkoxy-ethanols and their mixtures during day and night times has been measured in evaporimeter pans in an open field. Most of the films have been found to give much better reduction during the day than during the night. This is in contrast to the laboratory experiments wherein the film efficacy decreases at higher temperatures. It has been postulated that the difference in water evaporation reduction during day and night times may be attributed mainly to the influence of temperature on the spreading rate from the floating specks of the retardant.

57 BIOLOGICAL SCIENCES

577.15 Enzymes

464. BHUVANESWARAN, C. & SREENIVASAN, A. (Central Food Technological Research Institute, Mysore): Effect of B-vitamins on the levels of respiratory enzymes in rat liver, *Indian J. exp. Biol.*, **2** (1964), 12

A decrease in succinoxidase, succinic dehydrogenase, cytochrome C and catalase of liver is noticeable with minimal level of vitamin supplementation as compared to the optimal level in the diets of rats. However, there is no change in the cytochrome oxidase activity in the two groups. The factors leading to the decrease in these enzyme activities have been discussed. Similar decreases in the enzyme activities are also observed in pantothenic acid deficient rats. Administration of a single dose of pantothenic acid (10 mg.) restores these enzyme activities partially to the control values. Maximum restoration is achieved only 72 hr after the administration of pantothenic acid. It is concluded that an optimal level of vitamin intake is necessary for effective utilization of protein and maintenance of tissue enzyme levels.

465. JOSEPH, RICHARD, SREEKANTIAH, K. R. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on pectolytic enzyme production by fungi: Part V — Use of pectolytic enzyme preparation in the extraction and clarification of grape juice, *Food Sci.*, **12** (1963), 369

A pectolytic enzyme preparation has been used in the extraction and clarification of juice from Bangalore Blue variety of grapes. When the enzyme was used at 0·25 per cent concentration of the grape pulp, maximum extraction of juice was obtained within 4 hr of treatment when the pulp was incubated at 40°C. If the grapes are to be used for wine making an enzyme concentration of 0·15 per cent is sufficient to give the desired results. The enzyme is active at the natural *p*H (3·3) of the grapes. The enzymatic treatment helps in the sedimentation and deposition of argol, thereby helping to obtain clear grape juice.

466. NATH, R. L. & DAS, I. (School of Tropical Medicine, Calcutta): Energy changes in the complex formation and effect of enzyme purification in the mechanism of the hydrolysis of substituted phenyl phosphates by phosphatase from *Dolichos lablab*, *Enzymologia*, **26** (1963), 269

The action of an orthophosphoric monoester phosphohydrolase from *Dolichos lablab* has been studied kinetically determining the thermodynamic parameters against some substituted phenyl phosphates. The overall reaction was of the first order and the optimum *p*H *c.* 5·0. The enzyme-substrate complex formation was facilitated by electron attraction with acetone-dry powder, but by electron release with partially purified enzyme, thereby resulting in an additional explanation for the mechanism of complex formation proposed by earlier workers. The specially high affinity of the enzyme observed with the *m*-methoxyphenyl phosphate led to the postulation of a superimposed attachment between the free electrons of the oxygen of the methoxy group and some electron-poor site in the enzyme molecule which appears to undergo a configurational alteration as shown by its positive entropy change to facilitate this attachment. ΔF-values were negative as expected. *o*-Methylphenyl phosphate was resistant to the enzyme unlike its *m*- and *p*-isomers.

467. SREEKANTIAH, K. R. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on pectolytic enzyme production by fungi: Part I — Screening of organisms, *Food Sci.*, **12** (1963), 347

A number of fungi isolated from infected apple, jack-fruit, wood apple, coconut, ash gourd, papaya, pomegranate fruits, *Bhindi*, rotting wood and from air-borne fungal spores and members of *Aspergillus* and *Penicillium* groups maintained at the culture collection of fungi at the Institute have been grown on modified Czapeck-Dox solution as such, and after fortification with 0·2 per cent pectin. Culture filtrates of *Aspergillus aureus*, *A. wentii-I*, *A. wentii-II*, *A. oryzae-I*, *A. oryzae-V* and *Penicillium*

expansum showed good enzyme activity. When these six organisms were grown on wheat bran and defatted rice bran, *Aspergillus aureus* was found to be the best organism for pectolytic enzyme production. On liquid culture *P. expansum* also gave good enzyme yield. When the enzymes secreted by these organisms were analysed for pectinesterase (PE) and polygalacturonase (PG) activities, all these organisms showed low PE activity. *P. expansum* and *A. aureus* showed very good PG activity. These two fungi have, therefore, been selected for future trials to produce pectolytic enzymes for commercial purposes.

468. SREEKANTIAH, K. R. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on pectolytic enzyme production by fungi: Part III — Development of enzyme preparations for commercial use, *Food Sci.*, **12** (1963), 358

The growth of *A. aureus* on wheat bran and rice bran has been investigated in order to standardize conditions for the production of pectolytic enzymes. Wheat bran medium containing maize meal or sucrose induced better sporulation and, therefore, is suitable to raise inoculum for large-scale cultivation of the fungus. Addition of ammonium salts, molasses, groundnut cake or rice bran extract did not significantly increase the enzyme yield when the fungus was grown on wheat bran. For the extraction of the enzyme from the mouldy bran, cooled water containing 5 per cent glycerine was the most suitable. The optimum *p*H for the precipitation of enzyme from aqueous extract was 5·6. Mouldy bran dried by using either acetone or ethanol compared very well with similar commercial preparations. Both the precipitated enzyme and dried mouldy bran kept very well when stored at room temperature (22-32°C.) and 5°C. for over 6 months. These two enzyme preparations have been extensively used for the clarification of fruit juices and for extracting juices from fleshy fruits like guava, banana, papaya, mango and jack, and found satisfactory.

469. SREEKANTIAH, K. R., SHAH, V. K. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on pectolytic enzyme production by fungi: Part II — Effect on nutrients and cultural conditions on the secretion of enzyme, *Food Sci.*, **12** (1963), 353

Aspergillus aureus and *Penicillium expansum* have been grown on media containing 15 different carbon and 15 nitrogen sources. Ammonium nitrate has been found to be the best nitrogen source for both the organisms. *A. aureus* could utilize nitrogen from both organic and inorganic sources for secreting pectolytic enzymes while *P. expansum* preferred nitrogenous salts. The latter was found more suitable for submerged fermentation than for growing on solid substrates. Optimum temperature for growth differed from that for enzyme production. *P. expansum* had higher enzyme activity when grown at 68-70°F., while *A. aureus* produced maximum enzyme at 85-88°F.

470. SREEKANTIAH, K. R., SHASTRY, M. C. S., JOHAR, D. S., RAMACHANDRA RAO, T. N. & BHATNAGAR, H. C. (Central Food Technological Research Institute, Mysore): Studies on pectolytic enzyme production by fungi: Part IV — Use of pectin-degrading enzymes in the extraction and clarification of fruit juice, *Food Sci.*, **12** (1963), 364

Pectin-degrading enzymes prepared in the laboratory have been tested along with the standard preparations for the clarification of fruit juices and to express juice from fruits. The crude enzyme powder has been found to help in the clarification of the juice. By enzyme treatment 82 per cent of juice by weight of the pulp could be extracted. The juice obtained could be easily clarified and retained fresh fruit flavour and there was no loss in the important nutrients. Both crude enzyme powder and the mouldy bran gave results comparable to those of commercial preparations.

471. SRIVASTAVA, R. B. & KRISHNA MURTI, C. R. (Central Drug Research Institute, Lucknow): Lysine decarboxylase of *Bacterium cadaveris*, *Indian J. exp. Biol.*, **2** (1964), 52

B. cadaveris, when grown in a simple glucose-mineral salts medium supplemented with L-lysine and pyridoxine hydrochloride, shows significantly higher lysine decarboxylase activity than when grown in the conventional pancreatic casein digest medium.

472. TEWARI, K. K., SHARMA, O. K. & KRISHNAN, P. S. (Plant Metabolism Unit, Department of Biochemistry, Lucknow University, Lucknow): A general inhibitor of enzymes from the spores of *Aspergillus niger*, *Indian J. exp. Biol.*, **2** (1964), 56

The spores of *A. niger* contain a pigmented material which inhibits a large number of enzymes. The inhibition of hexokinase, which has been studied as a typical example, is of the non-competitive type and the reaction is reversible. The inhibitor may play a decisive role in spore metabolism.

58 BOTANY

581.09 Tissue Culture

473. MITRA, G. C. & KAUL, K. N. (National Botanic Gardens, Lucknow): *In vitro* culture of root and stem callus of *Rauvolfia serpentina* Benth. for reserpine, *Indian J. exp. Biol.*, **2** (1964), 49

Root callus tissue of *Rauvolfia serpentina* Benth. has been raised and maintained in a continuous aseptic culture using modified White's medium supplemented with 2,4-dichlorophenoxyacetic acid, coconut water and adenine. Root callus tissue has been found to contain reserpine. The three types of callus tissue, isolated from the initial callus mass during successive transfers, differ in their external and internal morphology, nutritional requirements, potentiality for differentiation and ability to synthesize reserpine. Stem callus tissue of *R. serpentina* has also been raised in aseptic culture using a different medium.

581.14 Germination

474. TALWALKAR, R. T., GARG, N. K. & KRISHNA MURTI, C. R. (Central Drug Research Institute, Lucknow): Lipid changes in germinating gram (*Cicer arietinum*), *Indian J. exp. Biol.*, **2** (1964), 37

Changes in the concentration of different lipid constituents have been followed during germination of Bengal gram (*Cicer arietinum*). The content of tocopherols and phytosterols decreases during germination. The phosphatide content also registers a steady fall. Although the phosphorus content of the phosphatides isolated from the gram at different stages of germination does not show any appreciable change, the choline content becomes negligible towards the terminal phase (72 hr in the present study). The increase in nitrogen content of the phosphatides isolated from the gram at different stages of germination has been shown to be due to the presence of amino acids which may be lipid-bound or artefacts.

581.3 Embryology

475. SINGH, H. & CHATTERJEE, JYOTSNA (Department of Botany, University of Delhi, Delhi): A contribution to the life history of *Cryptomeria japonica* D. Don, *Phytomorphology*, **13** (1963), 429

The paper gives a description of the cones and deals with male and female gametogenesis and formation of the embryo in *C. japonica* D. Don.

581.8 Cytology

476. TANDON, S. L. & RAO, G. R. (Department of Botany, University of Delhi, Delhi): Cytogenetical investigations in relation to the mechanism of evolution in hexaploid *Solanum nigrum* L., *Nature, Lond.*, **201** (1964), 1348

The naturally occurring population of *Solanum nigrum* growing in Delhi has been classified into three distinct forms mainly on the basis of fruit colour. In type I the fruits are shiny bluish black, in type II orange coloured and in type III dull purplish black. The cytological analysis of the types I, II and III showed these to be diploid, tetraploid and hexaploid respectively. Crosses were made between tetraploid and diploid forms and the morphology and cytology of triploids obtained studied. The triploid plants were treated with colchicine to obtain hexaploid shoots. The morphology and cytology of the synthesized hexaploids were studied and compared with the naturally recurring hexaploid forms. The close similarity in the morphological characters and the meiotic behaviour of chromosomes between the naturally occurring and the artificially synthesized hexaploid indicates that the former has arisen by natural crossing between tetraploid and diploid forms followed by spontaneous chromosome doubling of the triploid hybrid. This is further supported by the fact that a pentaploid plant obtained by crossing the naturally occurring hexaploid with the tetraploid showed as many as 22 bivalents.

582.26 Algae

477. SITAKARA RAO, V. & TIPNIS, (Mrs) U. K. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): Protein content of marine algae from Gujarat coast, *Curr. Sci.*, **33** (1964), 16

Twenty-one species of marine algae collected from Gujarat coast have been analysed for protein content using Kjeldahl's method. *Ulwa fasciata, U. rigida, Acanthophora muscoides* and *'Centroceras clavulatum* contain a higher percentage of proteins (20-26 per cent on air dry basis) than others and hence may be used for the extraction of proteins. In general, *Phaeophyceae* contains smaller quantities of crude proteins than *Chlorophyceae* and *Rhodophyceae.*

478. THIVY, FRANCESCA & VISALAKSHMI, V. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): *Spongomorpha indica*, a new species from Gujarat, *Bot. Notiser*, **116** (1963), 495

A morphological description of the new species of Cladophoraceae (*Chlorophyceae*) is given. *S. indica* is found in 22° N.L., whereas *S. saxatilis* (Ruprecht) Collins belongs to 40-90° N.L. The cells of the former are for the greater part wider and have, generally, greater length/diameter ratios; these differences are especially marked in the lower half of the plant. The equatorial species, *S. conjuncta* Taylor, is also distinct from *S. indica.* In general, the diameter of the cell is less and the length/diameter ratio of the cell greater in *S. indica* than in *S. conjuncta.* The cells of the new species are distinctly multinucleate.

59 ZOOLOGY

591.1 Physiology

479. BANDYOPADHYAY, ASOK & BANERJEE, SACHCHIDANANDA (Department of Physiology & Biochemistry, Sardar Patel Medical College, Bikaner): Effect of vegetable oils on tissue lipids of Rhesus monkeys, *Indian J. exp. Biol.*, **2** (1964), 16

Total lipids, cholesterol and phospholipids contents of different tissues, viz. plasma, heart, thoracic aorta, abdominal aorta, liver, brain, kidney, adrenals and skin, of Rhesus monkeys fed sesame oil (iodine value, 110), mustard oil (iodine value, 104) and coconut oil (iodine value, 9), with or without cholesterol supplementation, for nine months have been determined. No correlation has been observed in the distribution of tissue lipids and the treatments given to the animals. While sesame oil increases cholesterol deposition in thoracic aorta and abdominal aorta, mustard oil and coconut oil diminish arterial cholesterol. The deposition of cholesterol in the arteries does not depend on the unsaturation of the oils. Cholesterol formation in brain and skin is depressed by the oils, whereas heart is affected to a less extent. Coconut oil feeding produces increased liver lipid and mustard oil fed animals have higher liver cholesterol. The effects of different oils on the tissue distribution of lipids become less

clear when cholesterol is added to the diet. Tissue distribution of lipids appears to depend more on some unknown properties of the oils than on their unsaturation.

594 Mollusca

480. RAGHUPATHIRAMIREDDY, S. & SWAMI, KARUMURI S. (Department of Zoology, Sri Venkateswara University, Tirupati): Distribution of uric acid in the soft parts of the amphibious snail, *Pila*, *J. Anim. Morph. Physiol.*, **10** (1963), 154

A quantitative study of the distribution of uric acid in the different parts of active and aestivating *Pila* has been made. Uric acid accumulates during aestivation, not only in the nephridium but also in all other tissues examined. The extent of uric acid accumulation during aestivation differs in different tissues.

595.7 Entomology

481. MALVIYA, H. M. (Central Public Health Engineering Research Institute, Nagpur): Temperature-tolerance of viable ova of *Ascaris lumbricoides*, *Environ. Hlth*, **6** (1964), 63

Studies have been conducted on the effect of temperature on infective stages of *Ascaris lumbricoides* and it is concluded that 100 per cent mortality is obtained at 50°C. when exposed for 60 min. or more.

482. MUSTAFA, M. & NAIDU, M. B. (Regional Research Laboratory, Hyderabad): Chemical sterilization of *Dysdercus cingulatus* F. (Red Cotton Bug), *Indian J. exp. Biol.*, **2** (1964), 55

Sterility is produced in male and female *D. cingulatus* when exposed to surfaces on which Apholate [2, 2, 4, 4, 6, 6-hexahydro-2, 2, 4, 4, 6, 6-hexakis-1-aziridinyl)-1,3,5,2,4,6-triazatriphosphorine], a commercial chemosterilant (E. R. Squibb), has been deposited. The degree of sterility varies with the concentration of Apholate and exposure time. Females mated with males exposed to lower concentrations of Apholate lay relatively more eggs than those mated with males exposed to higher concentrations of Apholate.

61 MEDICAL SCIENCES

611.6 Urogenital System

483. KAMBOJ, V. P. & KAR, AMIYA B. (Central Drug Research Institute, Lucknow): Antitesticular effect of metallic and rare earth salts, *J. Reprod. Fert.*, **7** (1964), 21

The effect on the testis of some forty-two water-soluble salts of metals and rare earths has been investigated in rats and mice. In general, a single intratesticular injection caused varying degrees of degeneration of the seminiferous epithelium and the interstitium. Thirty-five of the salts tested exerted some degree of antitesticular effect. A single subcutaneous injection was ineffective but continuous administration by the same route caused selective spermatogenic arrest with nine salts. Some of the salts caused aspermia of the recipient animals; others disintegrated the residual spermatozoa in the ductus deferens by separation of the head and tail. The possible mechanism of action of the salts is discussed.

484. KAR, A. B. & DAS, R. P. (Central Drug Research Institute, Lucknow): The nature of protective action of selenium on cadmium-induced degeneration of the rat testis, *Proc. nat. Inst. Sci. India*, **29** (1964), 297

The prevention of cadmium-induced degeneration of the rat testis is of a permanent nature. It is possible that cadmium is promptly removed from the body by Se and thereby the testes are spared.

612.015 Metabolism

485. BALASUBRAMANIAN, A. S., PATTABIRAMAN, T. N., SARASWATHI, S., BASU, D. K. & BACHHAWAT, B. K. (Christian Medical College, Vellore): A controlled study of enzymic activities in three human disorders of glycolipid metabolism, *J. Neurochem.*, **10** (1963), 805

A representative profile of nine relevant enzyme systems has been studied in normals and in three selected human disorders of glycolipid metabolism. Both lysosomal hydrolases (acid phosphatase, arylsulphatase), mitochondrial and particulate enzymes were sampled in brain, liver and kidney. Two patients with metachromatic leucodystrophy showed consistently low arylsulphatase activity, both by chemical and by histochemical tests. These low values for arylsulphatase contrast with the much higher values for arylsulphatase found in control disorders. They also contrast with the higher values for the other enzymes studied in the same organs of the same two patients. In gargoylism, specific activities of UDPGlcNHAc pyrophosphorylase were lower in liver and kidney than in control patients. A possible explanation is given. In globoid leucodystrophy no particular enzyme activity was found reduced. Although acid phosphatase determinations were normal in brain, acid phosphatase activity was found histochemically to be concentrated in the globoid bodies and cells. Possible reasons for these descriptive findings are considered in the light of information currently available.

486. GUHA, S. R. (Central Drug Research Institute, Lucknow): Effect of certain hydrazino-peptides on glutamine metabolism in brain, *Acta biol. germ.*, **12** (1964), 253

The effects of hydrazinoacetic acid ethyl ester, glycylhydrazinoacetic acid ethyl ester and hydrazino-propionic acid ethyl ester on rat brain glutaminase I have been studied. Hydrazinoacetic acid ethyl ester inhibited glutaminase I, while the other two compounds activated the enzyme at certain concentrations. All the compounds strongly inhibited the glutamine-α-ketoglutarate reactions of brain. When oxaloacetate was used there was no effect with hydrazinoacetic acid ethyl ester, but the other two

compounds produced marked inhibition. All the compounds strongly inhibited the glutaminase II of rat liver. It is suggested that the inhibition caused by these drugs on the reaction of glutamine-α-keto acids may be due to inhibition of the transamination process.

487. SRINIVASAN, M., RAO, M. V. L., MEENA RAO, J. & SANKARAN, A. N. (Central Food Technological Research Institute, Mysore): A probable relationship between (a) peak blood sugar and (b) 3-hr blood sugar and urine sugar in oral tolerance tests with diabetics, *Indian J. med. Res.*, **52** (3) (1964), 313

From a set of data from oral glucose tolerance tests and urine sugar and making certain basic assumptions (e.g. GFR = 7·5 litres/hr), the following relationship between peak blood sugar (y), 3-hr blood sugar (x) and urine sugar (US) has been derived: $US = (y-x) \times 1/100 \times GFR \times t$. Assuming 200 mg. per cent-220 mg. per cent as the range of renal threshold, GFR = 7·5 litres/hr, t (time in hours) = 2 or 1 according as x is $\geqslant$ or $<$ 220 mg. per cent, then from equation above, the following 3 formulae arise: (A_1), $y = 20/3\ US+x(x \geqslant 220$ mg. per cent); (A_2), $y = 40/3\ US+x(x \geqslant 200$ mg. per cent but $<$ 220 mg. per cent); and (A_3), $y = 40/3\ US+200(x <$ 200 mg. per cent). Close agreement has been seen in 145 tolerance test data between the calculated and observed values for the peak blood sugar, validating the proposed formulae. Values calculated from an alternative formula statistically derived from experimental data and without assumptions support the formulae (A_1), (A_2) and (A_3).

612.39 Nutrition

488. DORAISWAMY, T. R., CHANDRASEKHARA, M. R., SUBBARAYA, B. H., SANKARAN, A. N., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Use of an infant food formula based on groundnut protein isolate and skim milk powder in feeding infants, *Indian J. Pediat.*, **30** (1963), 365

From feeding experiments on infants (3-12 months old) extending over 4·5 months no significant difference has been observed between the nutritive values of (1) an infant food formula containing *c.* 26 per cent protein and 18 per cent fat and based on groundnut protein isolate, skim milk powder, hydrogenated groundnut oil and dextrimaltose and (2) milk food.

489. NARAYANA RAO, M., ANANTHACHAR, T. K., KURUP, K. R., RAJAGOPALAN, R., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Studies on a processed protein food based on a blend of groundnut flour and full-fat soya flour fortified with essential amino acids, vitamins and minerals: Part I — Preparation, chemical composition and shelf-life, *J. Nutr. Dietet.*, **1** (1964), 1

A method for the preparation of a processed protein food based on a 1:1 blend of full-fat soya flour and groundnut flour, adequately fortified with calcium salts, vitamins A and D, thiamine, riboflavin and the limiting amino acids, lysine and methionine, has been standardized. A supplement of 40-50 g. of the protein food supplies one-third to one-half of the daily requirements of proteins, vitamins and minerals for children. The protein food has been made in two forms: (i) seasoned for use in soups and savoury preparations; and (ii) unseasoned for use in porridge, puddings and sweet preparations. Both the seasoned and unseasoned forms of the protein food keep well for over 9 months at 37°C. when packed in hermetically sealed tin containers. The losses of vitamin A and thiamine during the period are 25 and 15 per cent respectively.

490. PANEMANGALORE, MYNA, BALAJI RAO, M., NARAYANA RAO, M., RAJAGOPALAN, R., CHANDRASEKHAR, B. S., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Studies on a processed protein food based on a blend of groundnut flour and full-fat soya flour fortified with essential amino acids, vitamins and minerals: Part II — Amino acid composition and nutritive value of the proteins, *J. Nutr. Dietet.*, **1** (1964), 4

The protein efficiency ratio (PER), net protein utilization (NPU) and net protein ratio (NPR) of a protein food based on a 1:1 blend of groundnut and full-fat soya flours fortified with DL-methionine or with DL-methionine and L-lysine have been determined using albino rats. Fortification with DL-methionine brings about a marked improvement in the nutritive value of the proteins of the blend; the values for the unfortified and fortified foods were as follows: PER, 1·99 and 2·49; NPU, 54·1 and 65·3; and NPR, 2·69 and 3·46. Fortification with DL-methionine and L-lysine brings about a highly significant improvement in the nutritive value of the proteins of the blend; the values obtained for the protein food fortified with L-lysine and DL-methionine and for skim milk powder were as follows: PER, 2·80 and 2·96; NPU, 72·3 and 79·9; and NPR, 3·80 and 4·14 respectively.

491. PARTHASARATHY, H. N., JOSEPH, KANTHA, NARAYANA RAO, M., SWAMINATHAN, M., SANKARAN, A. N., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): The effect of supplementing processed soyabean meal proteins with DL-methionine hydroxy analogue (MHA) or DL-methionine on protein efficiency ratio and net protein utilization, *J. Nutr. Dietet.*, **1** (1964), 14

The protein efficiency ratio (PER), net protein utilization (NPU) and net protein ratio (NPR) of processed soyabean meal supplemented with DL-methionine hydroxy analogue (MHA) or DL-methionine at a level of 1·2 g./16 g. N have been determined using albino rats. Supplementation of soyabean meal with MHA or DL-methionine brought about a marked improvement in the nutritive value of the proteins. The PER and NPU(op) values for the different diets were as follows: soyabean meal, 2·37

and 64·8; soyabean meal + MHA, 3·20 and 77·9; soyabean meal + DL-methionine, 3·21 and 79·6; and skim milk powder, 3·08 and 80·8. The animals receiving diets based on soyabean meal supplemented with DL-methionine or MHA retained significantly larger amounts of nitrogen than those receiving a diet based on soyabean meal alone. The methionine hydroxy analogue (MHA) is equally effective as DL-methionine in supplementing soya proteins. There is no significant difference in the PER, NPU and NPR values of soyabean meal supplemented with DL-methionine or MHA. The nutritive value of the proteins of soyabean meal supplemented with DL-methionine or MHA at a level of 1·2 g./16 g. N compares favourably with that of milk proteins.

492. SHURPALEKAR, S. R., CHANDRASEKHARA, M. R., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Studies on the amino acid composition and nutritive value of the proteins of goat's milk, *J. Nutr. Dietet.*, **1** (1964), 25

Data regarding the chemical composition of skim milk powders from goat's milk, cow's milk and buffalo's milk are presented. The protein, calcium and niacin contents of skim milk powder from goat's milk have been found to be slightly higher than those of the skim milk powder from cow's milk. Goat's milk proteins contain lesser amounts of total sulphur amino acids than cow's or buffalo's milk proteins. The PER values of the proteins of different milks for male rats, during experimental periods of 4 and 8 weeks respectively, were as follows: goat's milk, 2·93 and 2·21; cow's milk, 3·23 and 2·49; and buffalo's milk, 3·37 and 2·74. Similar results were obtained in the case of female rats. The PER of goat's milk proteins was significantly lower than that of the proteins of cow's and buffalo's milk.

493. SHURPALEKAR, S. R., DANIEL, V. A., MOORJANI, M. N., LAHIRY, N. L., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): The effect of a supplementary protein food containing fish flour, groundnut flour and Bengal gram flour and fortified with vitamins on the digestibility coefficient, biological value and net protein utilization of poor rice diet given to undernourished children, *J. Nutr. Dietet.*, **1** (1964), 19

The effect of supplementing a poor Indian rice diet daily with 40 g. of protein food based on a 2:1:1 blend of groundnut flour, Bengal gram flour and fish flour from oil sardine and fortified adequately with vitamins A and D, thiamine and riboflavin (so as to provide *c.* 20 g. extra protein daily) on the biological value and digestibility coefficient of the proteins and net protein utilization was studied in 7 pairs of boys aged 9-10 years. The true digestibility coefficient of the mixed proteins of rice-protein food diet (88·8) was significantly higher than that (83·5) observed for the control rice diet. The biological value of the proteins of the rice diet supplemented with the protein food (52·0) was lower than that (56·2) of the proteins of control rice diet. This was due to the fact that the protein content of the rice-protein food diet (12·7 per cent) was higher than that (9·1 per cent) of the control rice diet. The NPU(op) of the rice diet supplemented with the protein food (46·2) was nearly of the same order as that (46·9) of rice diet. The NPU(st) of the rice-protein food diet (52·4) was, however, higher than that (48·4) obtained for the control rice diet. ND-p Cals per cent for the control rice diet (4·78) was significantly lower than that (6·56) observed for the rice-protein food diet. The net available protein per kg. body weight from the rice diet (0·98 g.) was nearly equal to the FAO reference protein requirements (1·05 g.) but lower than that (1·34) from the rice-protein food diet.

494. VENKAT RAO, S., DANIEL, V. A., JOSEPH, A. A., SANKARAN, A. N., SWAMINATHAN, M. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): A modified repletion method using young rats for the assay of the nutritive value of proteins and a comparative study of protein utilization by depleted and normal young rats, *J. Nutr. Dietet.*, **1** (1964), 38

A modified repletion method using young albino rats (28 days old) involving depletion and repletion periods of 10 days each is described. The results of a comparative study on the utilization of proteins (at 15 per cent level) from a 1:1 blend of soyabean flour and groundnut flour (with and without fortification with DL-methionine and L-lysine) and skim milk powder in normal and depleted young rats are reported. The mean protein efficiency ratios [PER (D)] obtained in depleted rats were higher than the corresponding PER values obtained in normal young rats and were nearly equal to the net protein ratios obtained for the same animals. The mean values for the percentage retention of proteins in depleted rats were higher than the corresponding values obtained for normal young rats and were nearly equal to the net protein utilization values obtained for the same animals. There was good correlation between the mean protein efficiency ratio and the mean per cent protein retention obtained with depleted rats indicating that the former could serve as a good index of the nutritive value of proteins for meeting the needs of protein depleted rats.

495. VENKAT RAO, S., DANIEL, V. A., PANEMANGALORE, MYNA, TASKER, P. K., PAUL JAYARAJ, A., ACHARYA, U. S. V., PARTHASARATHY, L. & NARAYANA RAO, M. (Central Food Technological Research Institute, Mysore): Studies on a processed protein food based on a blend of groundnut flour and full-fat soya flour fortified with essential amino acids, vitamins and minerals: Part III — Supplementary value to a maize-tapioca diet, *J. Nutr. Dietet.*, **1** (1964), 8

The nutritive value of a diet based on a 1:2 blend of maize and tapioca has been investigated. The diet contained only about 5 per cent protein and did not promote any growth in rats. Supplementation of the diet with a protein food based on a 1:1 blend of full-fat soya flour and groundnut flour fortified

with L-lysine and DL-methionine so as to provide 10 per cent extra protein in the diet resulted in a highly significant increase in the growth rate of rats, comparable to that obtained with a supplement of skim milk powder. The serum of rats receiving the maize-tapioca diet had a lower albumin content and a higher γ-globulin content than that of rats receiving the protein foods. The mean fat content of the livers of rats fed on the maize-tapioca diet was significantly higher and the protein content significantly lower than those of the rats fed on the supplemented diets. The xanthine oxidase activity of the livers of rats receiving the maize-tapioca diet was very low. Supplementation of the diet with the protein food resulted in a marked increase in the activity of the enzyme. The mean protein and fat contents of the carcass of rats fed on the maize-tapioca diet were significantly lower than those of rats receiving the protein supplements. The livers of rats fed on the maize-tapioca diet showed a moderate degree of cytoplasmic vacuolation of the protein deficiency type and severe periportal fatty infiltration. On the other hand, the livers of rats receiving the protein food and skim milk powder were quite normal indicating thereby that supplementation of the maize-tapioca diet with a protein food based on soya flour and groundnut flour at 10 per cent extra protein level is as effective as skim milk powder in correcting the protein deficiency in the diet and in preventing liver damage.

615 Pharmacology

496. CHAK, I. M. & PRADHAN, S. N. (Central Drug Research Institute, Lucknow): Central depressant effect of metaxylohydroquinone, *Indian J. exp. Biol.*, **2** (1964), 23

Metaxylohydroquinone (MXHQ) induces signs of depression of the central nervous system in mice, rats and cats. LD_{50} for MXHQ in mice is found to be 186 and 117 mg./kg. body weight following its intragastric and intraperitoneal administration respectively. MXHQ potentiates the barbiturate sleeping time in mice, the effect increasing with the dose; compared to chloropromazine, MXHQ is much weaker. MXHQ in high doses causes lowering of rectal temperature in mice and decrease in 'walking backward' reaction in rats induced by β,β′-iminodipropionitrile. It is probable that methemoglobinemia induced by MXHQ may be a factor responsible for its central depressant effect.

497. KAR, K. & PRADHAN, S. N. (Central Drug Research Institute, Lucknow): Pharmacological investigations on some β-dialkylaminoalkyl-2-4-substituted aryl ethers, thioethers and their quaternary salts, *Indian J. exp. Biol.*, **2** (1964) 26

Out of the nineteen derivatives from β-dialkylaminoalkyl-2-4-substituted aryl ethers, thioethers and their quaternary salts, five compounds, β-N,N-dimethylaminoethyl-2, 4-dibromophenyl ether hydrochloride, β-N,N-diethylaminoethyl-*o*-chlorophenyl ether hydrochloride, β-N,N-dimethylaminoethyl-2-4-dichlorophenyl thioether hydrochloride, β-N,N-dimethylaminoethyl-2,4-dichlorophenyl thioether benzbromide and β-N,N-diethylaminoethyl-2,4-dichlorophenyl thioether hydrochloride, have been found to possess antispasmodic activity against histamine, acetylcholine and barium chloride.

615.1 Pharmacy

498. SABRI, M. I. & MOHAN RAO, V. K. (Central Drug Research Institute, Lucknow): Some observations on the stability of vitamins A, B_1 and C in oral liquid formulations, *Indian J. Technol.*, **2** (1964), 30

The effect of incorporating casein hydrolysate, mixed tocopherols and rice bran phosphatides on the stability of vitamins A, B_1 and C in syrup-glycerol-water (2: 2: 1) and 60 and 75 per cent glycerol vehicles has been studied. The retention of the vitamins at the end of 6 months' storage at 37°C. in the absence of stabilizers is better with 75 per cent glycerol vehicle than with syrup-glycerol-water vehicle. In multivitamin preparations, casein hydrolysate alone or in combination with cysteine hydrochloride gives good protection to vitamins A and B_1, while 0·2 per cent cysteine hydrochloride is effective in stabilizing ascorbic acid in syrup-glycerol-water vehicle. Rice bran tocopherols and phosphatide exhibit partial protective action for vitamin B_1 only.

615.7 Chemotherapy

499. BASU, U. P., BOSE, A. N., GHOSH, B. K. & PATRA, B. B. (Bengal Immunity Research Institute, Calcutta): Chemotherapy of filariasis: Part II — 1,4-Disubstituted piperazine derivatives, *Indian J. Chem.*, **2** (1964), 38

Schiff's bases obtained by condensing 1-(3′-chlorophenyl)-4-aminopiperazine with phenolic and other aldehydes are described. Screening of these compounds for possible microfilaricidal activity on *L. carinii* infected albino rats after carrying out short-term oral toxicity tests has shown that none of the compounds possesses microfilaricidal activity.

615.777 Germicides

500. GULATI, A. S., KRISHNAMACHAR, V. S. & SUBBA RAO, B. C. (National Chemical Laboratory, Poona): Quaternary nitrogen germicides derived from the monophenolic components of cashewnut shell liquid, *Indian J. Chem.*, **2** (1964), 114

Several quaternary nitrogen compounds have been prepared starting from the main phenolic components of cashewnut shell liquid, viz. cardanol and anacardic acid. An attempt has been made to draw a relationship between the structural features of the phenolic component and the bactericidal activity of the resulting quaternary nitrogen compounds. The presence of groups like OH, OCH_3, Cl, COOH and (OCH_2CH_2) in the quaternary nitrogen compounds and their effect on bactericidal activity have been studied and it has been found that protection of the phenolic hydroxyl group either by etherification

or by ethoxy group enhances the activity of the quaternaries. Though some of the quaternary compounds prepared are water insoluble, several water-soluble compounds possessing unusually high activity have been obtained.

615.779 Antibiotics

501. BHATNAGAR, (Miss) U., BHATIA, M. C., SRIVASTAVA, O. P., THYAGARAJAN, T. R., DHAR, M. M. & VORA, V. C. (Central Drug Research Institute, Lucknow): A new macrolide antibiotic, *Indian J. exp. Biol.*, **2** (1964), 57

An antibiotic, X-387-1, possibly a new member of the macrolide group of antibiotics, has been isolated from *Streptomyces* species (X-387). The cultural characters of X-387 and the physico-chemical properties of X-387-1 are described.

502. CHANAN SINGH (Central Drug Research Institute, Lucknow): Interactions between cationic and anionic compounds of biological importance with special reference to inorganic condensed phosphates and polymeric antibiotics, *Indian J. Chem.*, **2** (1964), 67

A study has been made of the interactions between condensed phosphates and cationic compounds like polymeric antibiotics (neomycin, viomycin, polymyxin), quaternary pyridinium compounds, guanidine and protamine. The binding capacity of the interacting compounds has been studied by the dissolution of the complexes by (i) potassium chloride and (ii) excess of polyphosphates; polyphosphate method of determining binding capacity is a new method. The affinity of phosphates for basic compounds, determined by the potassium chloride titre method, increases with their molecular weight up to P_{16} and then it shows a plateau. This relationship explains the biochemical difference between ' soluble ' and ' insoluble ' polyphosphates. The binding capacity of some basic compounds for higher phosphates decreases in the order of neomycin, protamine, polymyxin, viomycin and streptomycin and for the other basic compounds in the order of guanidine, dodecyl pyridinium chloride ($QPXC_{12}$), cetyl pyridinium chloride ($QPXC_{16}$) and strychnine. The capacity of a phosphate to dissolve a complex increases with its molecular weight up to P_{16}; thereafter it becomes constant for all the higher phosphates. The affinity of the basic compounds for higher phosphates as determined by this method decreases in the order of protamine, neomycin, guanidine, $QPXC_{16}$, polymyxin, viomycin, streptomycin and strychnine. Guanidine reacts only with higher condensed phosphates and thus it distinguishes these inorganic polymers from other anionic polyelectrolytes of biological importance.

616.83 Nervous System

503. GUHA, S. R. (Central Drug Research Institute, Lucknow): Effect of hydrazine acetic acid ethyl ester and its glycyl derivative on oxidation and ammonia formation in rat brain tissues, *Biochem. Pharmacol.*, **13** (1964), 45

The effects of hydrazine acetic acid ethyl ester and the glycyl derivative on the process of ammonia formation and oxidation in rat brain tissues *in vitro* have been studied. It has been found that these substances increase the endogenous ammonia formation in brain homogenates and slices. When the hydrazine compounds were added to rat brain homogenates respiring in the presence of various oxidizable substrates, the rate of oxidation was greatly enhanced, whereas the ammonia suppressing action of these substrates was strongly inhibited. Similar result was obtained when brain cortex slices respiring in the presence of glucose or glutamate were used. The possible mechanism of the action of these hydrazine compounds in inhibiting the process of ammonia suppressing action of these substrates has been discussed.

504. PATTABIRAMAN, T. N., SEKHARA VARMA, T. N. & BACHHAWAT, B. K. (Christian Medical College & Hospital, Vellore): Enzymic degradation of uridine diphosphoacetylglucosamine, *Biochem. biophys. Acta*, **83** (1964), 74

Uridine diphosphoacetylglucosamine is shown to undergo a hydrolytic cleavage by an enzyme present in sheep brain. The products of the reaction are identified as N-acetylglucosamine 1-phosphate and UMP. The enzyme responsible for this degradation has a wide distribution in the tissues of the rat. ATP, UTP, ADP and N-acetylglucosamine 1-phosphate act as powerful inhibitors of this enzyme. The enzyme requires Co^{2+} for its maximal activity. It shows a broad optimal range of *p*H from 8 to 9. The enzyme preparation cleaves uridine diphosphoglucose and uridine diphosphoglucuronic acid to lesser extents than uridine diphosphoacetylglucosamine.

62 ENGINEERING

621.38 Electronics

505. BISWAS, N. N. (Department of Electrical Engineering, University of Roorkee, Roorkee): A transistor ring counter with inherent pulse dodging, *Instrum. Pract.*, (1964), 239

A new method of interconnecting flip-flops to give a novel design of a ring counter is described. Although diodes may be used to prevent saturation, they are not required for the purpose of either steering or triggering. A third transistor following each flip-flop stage shifts state '1' to the next stage at the incidence of a counting pulse. Thus each stage requires only three transistors with the associated resistors and capacitors. No separate delay network is necessary to dodge the counting pulse, that is, to avoid the interaction of the counting and transfer pulses. The property of pulse dodging is inherent in the design, and the ring counter truly simulates a single or multiple bank electromechanical rotary switch.

506. KRISHNAN, A. (National Aeronautical Laboratory, Bangalore): A stabilized low voltage

power supply, *Indian J. pure appl. Phys.*, **2** (1964), 98

Design details of a stabilized transistor circuit for a low voltage regulator (12 V., 3 amp.) with very low output impedance have been described. The advantages of the circuit are (i) its simplicity, (ii) remarkably good performance characteristics, and (iii) use of transistors which are easily available in India. The power transistors used are rated conservatively for continuous service with excellent performance. An overload protection circuit is provided so that even repeated short circuits at the output will not damage the comparatively expensive power transistors. The stabilization factor is about 1500 and the ripple content is less than 200 μV. (r.m.s.) at a maximum load of 3 amp.

621.383 Photoelectric Devices

507. NARASIMHAN, V. & BANSAL, G. D. (Central Building Research Institute, Roorkee): Cosine error correction of selenium rectifier photocells, *Indian J. pure appl. Phys.*, **2** (1964), 64

The response of a helium-sealed 856 Weston type photocell fitted with a diffuser disc to obliquely incident radiation has been investigated with a view to determining the percentage deviation from Lambert's cosine law. The effects of the angle of incidence, thickness of the diffuser disc, screening angle and the gap between the photocell and the diffuser, on the observed deviation from the cosine law, have been studied. It is found that the percentage deviation from the cosine law decreases with increasing screening angle for any angle of incidence of light, reaching a limit for a value of the screening angle of *c.* 80°. The gap between the diffuser disc and the photovoltaic cell is found to have negligible effect on the deviations from the cosine law. Values of the parameters which result in optimum deviation from cosine law have been obtained.

621.548 Wind Power

508. RAO, D. V. L. N., NARASIMHASWAMY, K. N. & RADHAKRISHNAN, S. R. (National Aeronautical Laboratory, Bangalore): A study of the hourly wind speeds at Jagdalpur and Jamshedpur from the point of view of wind power utilization, *Tech. Note No. TN-WP-34-64* (National Aeronautical Laboratory, Bangalore), 1964

Jagdalpur has an annual mean wind speed as low as 3 km.p.h. The annual output of energy from a windmill of 30 sq. m. swept area, cut-in speed of 8 km.p.h. and constant overall power coefficient of 12 per cent works out to 89 kWh. The quantity of water that can be pumped in a year by a WP-2 type windmill of 23·6 sq. m. swept area and overall power coefficient of 12 per cent has been estimated at 2600 kl. Jamshedpur has an annual mean wind speed of 5 km.p.h. The annual output of energy here works out to 236 kWh. The quantity of water that can be pumped by a WP-2 type windmill at Jamshedpur has been estimated at 6580 kl. per year.

624.01 Building Engineering

509. DEB, A. K. & SUBBASH CHANDRA (Central Building Research Institute, Roorkee): The bearing capacity of short bored piles in expansive clays, *Cement & Concr.*, (1964), 207

Short bored piles have been found to be best suited for buildings founded on expansive clays like black cotton soil which crack on traditional strip footings. Field load tests (short and long term) have been carried out at different sites on three categories of short bored piles, viz. straight bored piles, single under-reamed piles and double under-reamed piles. The three types of piles are satisfactory for foundations in shallow black cotton soil, foundations of light structures in deep black cotton soil and foundations for heavy structures in black cotton soil respectively.

510. SAXENA, B. K. (Central Building Research Institute, Roorkee): Thermoflash apparatus and coefficients of heat conduction of insulating and other building materials, *Indian J. Technol.*, **2** (1964), 27

An apparatus designed for the determination of thermal diffusivity, thermal conductivity and specific heat of insulating and other building materials is described. The design of the apparatus is based on the principle of imparting a heat flash to the blackened surface of a thin specimen of the material and recording the time-temperature variation of the rear face. The thermal diffusivity, thermal conductivity and specific heat values of insulating materials can be determined with an accuracy of ± 10 per cent employing a 200 W. infrared lamp, an exposure period of 2 sec. and specimen of 0·25-0·50 in. thickness.

511. SUBBASH CHANDRA & KHEPAR, S. D. (Central Building Research Institute, Roorkee): Double under-reamed piles for foundations in black cotton soils, *Indian Concr. J.*, **38** (1964), 50

The load bearing capacity of double under-reamed piles in black cotton soils has been found to be about one and a half times that of single under-reamed piles. The theory of double under-reamed piles and design details are discussed and the results of a series of load tests carried out in black cotton and similar soils are given.

628 Public Health Engineering

512. BHAKUNI, T. S. & SASTRY, C. A. (Central Public Health Engineering Research Institute, Nagpur): Studies on demineralization of water, *Environ. Hlth*, **6** (1964), 7

A system of cation and anion exchange resins prepared indigenously has been studied for the demineralization of water from a tubewell and calcium chloride solutions of different concentrations at different flow rates. Flow rate was found to have great influence on the break-through capacity of the system.

513. BULUSU, K. R. & SEN, A. K. (Central Public Health Engineering Research Institute, Delhi

Zonal Centre, Delhi): Rapid determination of sulphate in water, *Environ. Hlth*, **6** (1964), 1

A comparative study has been made of three methods of estimating sulphate ion in water, viz. turbidimetric method, barium chloride titration method and ion-exchange method. The ion-exchange method is simple, inexpensive and accurate to $\pm 1{\cdot}0$ mg./litre in the absence of organic acid anions.

514. VARDE, R. S. (Central Public Health Engineering Research Institute, Bombay Zonal Centre, Bombay) & AJWANI, S. H. (Atomic Energy Commission, Bombay): Industrial pollution of Ulhas river, *Environ. Hlth*, **6** (1964), 13

A pollution survey of Ulhas river and its tributaries has been carried out with a view to finding the extent of pollution and its possible effects on the fish life. The wastes discharged into the river were acidic, their range being outside the limits fish can safely tolerate. While there is plenty of dilution offered by the river, the area in and around the outfall probably acts as pollution barriers to the migratory Hilsa.

628.9 Illumination Engineering

515. DAS, S. R. (National Physical Laboratory, New Delhi): Light patterns on interior surfaces: Part I — The primary pattern, *Indian J. Technol.*, **2** (1964), 35

A sector flux method is proposed for determining the primary pattern formed by the flux directly reaching the surface from the luminaires. A flux field bounded by angular sectors passing through the luminaire line is considered, and equations for such a field developed for three typical luminaire distributions in the axial plane. The integral factors in the expressions for flux have been solved. Calculations of direct flux for a number of installations have been made using these results. The results obtained show good agreement with those obtained using the method of J. R. Jones and J. J. Neidhart [*Illum. Engng*, **46** (1951), 601; **48** (1953), 141]. The method has the advantage that the luminaire intensity distribution need not be symmetrical in the normal plane, and that the flux values are obtained in narrow strips parallel to the luminaire line.

516. NARASIMHAN, V. & SAXENA, B. K. (Central Building Research Institute, Roorkee): Daylighting through northlight factory roofs, *Indian J. Technol.*, **2** (1964), 102

A zonal method of computing the illumination on the working plane of a factory (geographical location, north of 23°N latitude) employing a saw-tooth northlight roof from the known values of the incident luminous solar radiation outside is described. A method of estimating the same using scaled models, under the natural sky, is also described. Illumination levels estimated from model studies have been compared with those measured inside the actual factory simulated by the model. It has been shown that the illumination levels in a building can be estimated with reasonable accuracy employing scaled models.

517. SHARMA, M. R. & RAO, K. R. (Central Building Research Institute, Roorkee): Solar radiation protractors, *J. nat. Build. Org.*, **8** (4) (1963), 3

A simple device in the form of a chart with the flexibility of varying orientation and latitude to provide an easy approach to the solution of the problem is described. A composite solar chart and solar radiation protractors for horizontal, vertical and inclined surfaces have been designed. These protractors when used in conjunction with the solar chart enable the designers to estimate the solar radiation incident on respective surfaces.

62 : 532 Fluid Dynamics

518. KRISHNAMURTHI, S., KUMAR, R. & DATTA, R. L. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Formation of bubbles through non-circular orifices, *Indian J. Technol.*, **2** (1964), 3

The formation of air bubbles at orifices of non-circular configuration has been investigated. Comparison of the results, obtained with those for the corresponding inscribed circular orifices shows that the concept of hydraulic diameter or an equivalent diameter based on area or perimeter equality is inapplicable to bubble formation studies. The following relationship has been developed correlating the bubble volume at non-circular orifice (V_a) with that at the inscribed circular orifice (V_i): $V_a = V_i\,(R)^{0{\cdot}365}$, where R is the ratio of the area of a non-circular orifice to that of the corresponding inscribed circular orifice.

519. KRISHNAMURTHI, S., KUMAR, R., DATTA, R. L. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Correlation of data on bubble formation in viscous liquids, *Indian J. Technol.*, **2** (1964), 67

The formation of bubbles from nozzles of diameter ranging from 0·10 to 0·31 cm. in liquids of viscosities varying from 200 to 900 cp. at bubble frequencies up to 200 bubbles/min. has been studied. A correlation has been obtained between the bubble volume at the tip of the nozzle and volumetric air flow rate, capillary diameter, liquid viscosity and density, gas density and static bubble volume. The maximum deviation between calculated and experimental values is 10 per cent, and most of the experimental values are within ± 5 per cent of the calculated values.

520. KRISHNAMURTHY, P. G., KUMAR, R., DATTA, R. L. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Formation of air bubbles through nozzles at right angles to liquid column, *Indian J. Technol.*, **2** (1964), 68

The formation of bubbles from nozzles at right angles to liquid column at low and intermediate frequencies has been studied for different liquids. The following equation has been derived for calculating bubble volume (V_f) from experimentally determined values

of surface tension (γ), density (ρ) and viscosity (μ):

$$V_f^{5/3} = 0{\cdot}069 \frac{\mu_l}{(\rho_l - \rho_g)} . Q . D \left(\frac{\mu_w}{\mu_l}\right)^{0{\cdot}87} + \left[1{\cdot}22 \left(\frac{\mu_l}{\mu_w}\right)^{0{\cdot}09} \cdot \frac{D.\gamma}{(\rho_l - \rho_g)g}\right]^{5/3}$$

where ρ and ρ are the densities of the liquid and air; μ_w and μ_l, the viscosities of water and the liquid; Q, volumetric rate of flow of gas; D, capillary diameter; γ, surface tension of the liquid; and g, acceleration due to gravity. The maximum deviation between the observed and calculated values has been found to be ± 5 per cent.

624 : 691 Building Materials

521. JAIN, L. C. & MAJUMDAR, N. C. (Central Building Research Institute, Roorkee): Production of good bricks from black cotton soils, *M.P. Ind. J.*, **11** (1963), 15

Laboratory and field scale trials have been carried out in an attempt to improve the quality of bricks from black cotton soils. The use of calcined clay as an opening material gives better bricks than those obtained by using coal ash. Calcined clay bricks cost slightly more than conventional ones.

629.19 : 521.6 Astrodynamics

522. RAJAPPA, N. (National Aeronautical Laboratory, Bangalore): Trajectories of close satellites of the moon, *Proc. Indian Acad. Sci.*, **59A** (1964), 49

Choosing the unperturbed orbit of the satellite as a Keplerian ellipse, the effect caused by the departure of the shape of the moon from a perfect sphere has been studied in detail. The equations of motion are solved for the reciprocal of the radial distance of the satellite from the centre of mass of the moon (u), the angular momentum (M) of the satellite, the longitude (Ω) of the ascending node, the inclination (α) of the instantaneous orbital plane to lunar equator and the longitude (β) of the perigee of the satellite's orbit, correct to terms of first order in $(B-A)$, $(C-A)$, A, B and C being the principal moments of inertia of the moon. It is shown that the orbital plane remains fixed in space if it coincides with one of the three principal planes of the moon and that the angular momentum of the satellite remains constant throughout the motion of the satellite if the satellite is launched at the latitude $\alpha = \sin^{-1}[(B-A)/(C-A)]^{\frac{1}{2}}$ and $\Omega = \pi/2$. The conditions for the vanishing of the rotation of the perigee of the orbit are also discussed.

66 TECHNOLOGY

66.0 Chemical Technology

523. KAPPANNA, A. N. & CHOUDHARY, B. P. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): Sulphuric acid from gypsum — A possible method, *Indian J. appl. Chem.*, **26** (1963), 91

Conditions for the production of sulphuric acid from gypsum by the reactions: (a) $PbCl_2 + CaSO_4 \rightarrow PbSO_4 + CaCl_2$ and (b) $PbSO_4 + 2HCl \rightleftharpoons PbCl_2 + H_2SO_4$, have been determined. The process should be feasible in India in places where surplus hydrochloric acid is available. Gypsum from marine solar salt works, which could be easily purified, is more suitable for the production of pure sulphuric acid by the process.

524. SHUKLA, B. K., MEHTA, D. J. & CHANDORIKAR, M. V. (Central Salt & Marine Chemicals Research Institute, Bhavnagar): Precipitated calcium carbonate from ammonia distiller waste of soda ash industry, *Res. & Ind.*, **9** (1964), 38

A process for manufacturing light precipitated calcium carbonate from waste calcium chloride liquor of soda ash industry is described. Cost estimates for a plant of 1 metric tonne/day capacity has been made and the expected return on investment is 30 per cent.

66.048 Condensation

525. VENKATARAM, T. & KULOOR, N. R. (Department of Chemical Engineering, Indian Institute of Science, Bangalore): Condensation of steam on stainless steel, *Indian J. Technol.*, **2** (1964), 73

The condensation pattern of pure steam on a clean, smooth, cooled, vertical stainless steel surface for prolonged periods has been investigated using a specially designed apparatus. It has been found that when steam generated from distilled water is condensed on a cooled stainless steel tube, polished by emery 4/0, the condensation over a large percentage of the area is of dropwise pattern. Wherever filmwise condensation occurs, it reverts to dropwise pattern after an uncertain time interval. When the direction of flow of the cooling water is from top to bottom, bigger drops are formed on the top of the surface, which grow quickly to critical size. These drops sweep down the drops at the bottom, before they grow by coalescence or by attaining critical size, thereby reducing the time of the sweeping cycle.

66.094.1 Hydrogenation

526. SUBBARAM, M. R. & YOUNGS, C. G. (Regional Research Laboratory, Hyderabad, & National Research Council of Canada, Prairie Regional Laboratory, Saskatoon, Canada): Isomerization of mono ethanoid acids during hydrogenation, *J. Amer. Oil Chem. Soc.*, **41** (1964), 150

Methyl petroselinate, methyl oleate and methyl erucate have been hydrogenated under conditions used in industry for selective hydrogenation. The resulting products were separated into saturated esters and *trans*- and *cis*-unsaturated esters on a silver nitrate impreganted silicic acid column. The positional isomers in the total hydrogenated samples and the *cis* and *trans* fractions were determined by oxidation with permanganate-periodate

and GLC analysis of the resulting dicarboxylic fragments. Positional isomers were found in both *trans* and *cis* fractions with equal shifting of the bond toward and away from the carboxyl group, regardless of whether the bond was originally in the 6, 9 or 13 position. The ratio of *trans* to *cis* form in the positional isomers in all cases was higher than the reported equilibrium proportions of 2: 1.

661.185 Surface Active Agents

527. KATTI, S. S. & KULKARNI, S. B. (National Chemical Laboratory, Poona): Critical micelle concentration of tetrahydroanacardol ammonium monosulphonate at 50°C., *Indian J. Technol.*, **2** (1964), 96

Electrical conductivity, surface tension, interfacial tension (against benzene), Herbig number, foam height and detergency of aqueous solutions of tetrahydroanacardol ammonium monosulphonate have been measured at various concentrations (0·001 to 0·4 g./100 ml.) at 50°C. The value of the critical micelle concentration evaluated on the basis of these determinations shows close agreement and lies between 0·0075 and 0·01 g./100 ml.

528. MALIK, WAHID U. & RIZWANUL HAQUE (Department of Chemistry, Muslim University, Aligarh): Critical micelle concentration of some surface active agents from polarographic data, *Indian J. Chem.*, **2** (1964), 35

Critical micelle concentrations (CMC) of some surface active agents, viz. sulphonated phenyl, tolyl, xylyl stearic acids, dodecyl pyridinium bromide and isothiourea dodecyl ether hydrobromide, have been studied polarographically in the presence of foreign electrolytes. Although the CMC values are not the same in the presence of different electrolytes, the same order of magnitude ($10^{-5}M$) has been found to exist for the various soap solutions used.

662.74 Coal Technology

529. BANERJEE, N. G., DESHMUKH, B. S. & MOITRA, A. K. (Central Fuel Research Institute, Jealgora): Influence of temperature of equilibration on moisture in coal at 60 per cent relative humidity, *Indian J. Technol.*, **2** (1964), 33

The procedure for determining moisture in coal specified by the Indian Standards Institution (IS: 1350-1959) stipulates equilibration of the coal sample at 60 per cent relative humidity and 40°C. during moisture determination, thereby necessitating the use of a thermostatic oven. It has been shown that variation of temperature in the range 10-40°C. has negligible influence on the moisture values and, therefore, equilibration of the coal samples can be done at room temperature without thermostatic control.

530. BHADURI, B. P., GHOSE, S. K. & MAJUMDAR, S. K. (Central Mining Research Station, Dhanbad): Rapid chelometric determination of phosphorus in coal and coke, *Indian J. Technol.*, **2** (1964), 62

A simple and rapid complexometric method for determining phosphorus in coal and coke is described. Phosphorus, which is present as phosphate in coal, is extracted by treating coal ash with perchloric acid and then precipitating it as bismuth phosphate by adding excess of standard bismuth nitrate solution. The amount of bismuth solution consumed for phosphate precipitation is calculated by determining the unconsumed bismuth nitrate by titration against ethylenediaminetetracetic acid. The results obtained show a maximum mean deviation of 0·002 per cent; in general, the deviation is less than 0·0015 per cent. The accuracy of the method is comparable to that of the British Standard method. The proposed method enables one worker to analyse six samples per day.

531. BOSE, B. N., BHATTACHARYA, K. K., DAS GUPTA, N. N. & LAHIRI, A. (Central Fuel Research Institute, Jealgora): A theoretical basis for predicting optimum proportions of constituents in coal blending, *Indian J. Technol.*, **2** (1964), 110

The yields and characteristics of cokes obtained from blends of different types of coals have been studied with the object of evolving a theoretical basis for predicting optimum proportions of constituent coals for obtaining a blend capable of giving cokes suitable for metallurgical use. It has been found that the optimum proportion of coals in binary blends can be predicted on the basis of the difference between the actual and calculated yields of semi-coke at 600°C. The maximum difference has been found to correspond to the composition giving the best coke. The implications of this finding in explaining the fissuring tendency of coke are discussed.

664 Food Technology

532. KURIEN, P. O., RADHAKRISHNA MURTY, R., DESIKACHAR, H. S. R. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Effect of parboiling on the swelling quality of rice, *Cereal Chem.*, **41** (1964), 16

The swelling rates and the expansion ratios during cooking of parboiled rice have been found to be lower than those of raw rice. Raw rice requires cooking for 15-20 min., while parboiled rice required 30-40 min. to attain a soft consistency. At this stage of cooking the average length, breadth, volume and weight of the cooked parboiled grains are generally greater than the corresponding values for cooked raw rice. The importance of an optimum steaming period to obtain a balance between swelling quality and increased yield of head rice has been emphasized. The data also indicate minor alterations in the dimensions of the milled grains as a result of the parboiling treatment.

664.38 Proteins

533. ACHARYA, U. S. V., SWAMINATHAN, M., SREENIVASAN, A. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore):

A simple and rapid procedure for the separation of serum proteins by agar-gel electrophoresis on microscopic slides, *Indian J. med. Res.*, **52** (2) (1964), 224

A simple and rapid method for the separation of serum proteins in a large number of samples at a time by agar-gel electrophoresis on microscope slides has been described. The technique can be used for the routine analysis of serum proteins in 48 samples in *c.* 6 hr.

664.5 Spices

534. MISRA, B. D. & PRUTHI, J. S. (Central Food Technological Research Institute, Mysore): Studies on the physico-chemical evaluation of flavour and colour of curry powders and other spice mixtures, *Spices Bull.*, **3** (1 & 2) (1963), 5

The Farber's method for the chemical evaluation of flavour of coffee and fish products has been applied to curry powders and other spice mixtures like *Sambar* powder, *Rasam* powder, chutney *garam masala*, pickle *masala*, etc. The following optimum conditions have been standardized in respect thereof: (1) rate of air flow, 5 litres/min.; (2) time of reaction or aeration, 45 min.; (3) optimum sample size, 10 ml. of 2 per cent aqueous extract of spice mixture (strained); and (4) time and temperature of extraction or reconstitution, 60 min. in water at room temperature (25-30°C.) or instantaneous extraction in boiling hot water at 95-96°C. All curry powders and other spice mixtures except one spice mixture (i.e. *garam masala*) exhibited absorption maxima between 420 and 440 mμ, the relative intensity of absorption varying with the relative concentration of their respective components (i.e. spices, etc.), particularly turmeric and chillies which have peaks in the same region. The alcoholic extracts (0·1 per cent) of cinnamon, coriander, cloves, cumin and mustard did not depict any peak in the visible range. In the ultraviolet region, while some spices did exhibit peaks, coriander, turmeric and curry powders did not have absorption maxima. As such, unlike the visible spectra, the ultraviolet spectra were not of much use in the characterization of curry powder, although they were of considerable value in respect of some individual spices such as cumin, ginger, cloves, black pepper, chillies and cinnamon. For comparative routine colour evaluation of curry powder and other spice mixtures, the examination of 0·1 per cent alcoholic extract (filtered at 420 mμ filter in a photoelectric colorimeter) has been recommended.

535. PRUTHI, J. S. & MISRA, B. D. (Central Food Technological Research Institute, Mysore): Quality standards for curry powders and other spice mixtures, *Spices Bull.*, **2** (12) (1963), 97

The results of systematic physico-chemical analysis of *c.* 20 commercial samples of Indian as well as imported curry powders and other spice mixtures such as *Sambar* powder, *Rasam* powder, chutney and pickle *garam masala*, etc., are presented. The analysis covered the moisture, volatile oil, non-volatile, ether extract, ethanol extract, cold water extract, crude fibre, starch, salt (sodium chloride), tannins, total, acid-insoluble and water-insoluble ash, calcium, iron and phosphorus contents. The data collected have been critically examined and compared with the ISI specification for curry powders. All the samples of curry powders examined conformed to the ISI specification for (a) granularity test, (b) moisture, (c) volatile oil, and (d) lead content, but with respect to (i) crude fibre, (ii) salt content, and (iii) acid-insoluble ash, several samples did not conform to the standards. A suitable revision of the ISI specification in respect of these items has been suggested. Of the two techniques studied for the granularity, namely 'Sterckx test' and 'sieving test', the latter technique as recommended in the ISI specification has been found to be more useful and convenient, but the mesh size recommended is too coarse and as such needs revision to BS 25 mesh so as to have a finer texture similar to that of imported curry powders. The practical difficulties experienced in the use of the method prescribed in the ISI specification for the estimation of lead have been pointed out and the replacement or modification of the said method has been suggested.

536. SRIVAS, S. R., PRUTHI, J. S. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Nitrogenous substances in ginger (*Zingiber officinale* Roscoe), *Spices Bull.*, **2** (12) (1963), 61

The crude protein contents of the freeze-dried ginger rhizomes and the spent residue left after the extraction of oleoresin have been found to be 10·46 and 11·26 per cent respectively. In fresh ginger rhizomes, the albumin, globulin, prolamine and glutelins comprise 22·95, 10·92, 7·10 and 11·48 per cent respectively of the total nitrogen (1·83 per cent) and NPN content 35·51 per cent, of which 12·01 per cent is not extractable. The spent residue (200 mesh) contained albumin, 22·06; globulin, 11·76; prolamine, 8·08; glutelins, 14·71; NPN, 37·51; and non-recoverable nitrogen, 7·35 per cent of the total nitrogen (1·36 per cent). The rhizomes as well as the hydrolysate of the protein contained the following free amino acids: alanine (traces), aspartic acid (+), glutamic acid (+), aspargine (traces), glycine (+), lysine (traces), serine (+), valine (traces), arginine (+), cystine (+), histidine (traces), leucines (+), methionine (+), threonine (+), tryptophan (traces), and proline (++). The hydrolysate does not contain tryptophan. The concentrations were different in the two materials. Electrophoretically, the ginger protein isolate (from the alkali extract) at *p*H 4·5 was homogeneous in character, comprising a single component (probably albumin) which migrated to the anode indicating that it was negatively charged. Ginger flour (200 mesh) contains fair amount of protein unlike cereal and tuber flours.

664.8 Food Preservation

537. BALIGA, B. R., KADKOL, S. B. & LAHIRY, N. L. (Central Food Technological Research Institute, Mysore): Possible role of bacteria in the

physical deterioration of egg contents during storage at room temperature, *Indian J. Technol.*, **2** (1964), 69

The possible role of bacterial contamination, natural and induced, on the deteriorative changes in the contents of eggs, such as decrease in yolk and albumen indices, thinning of thick white, etc., has been investigated employing fresh eggs stored (i) without any treatment, (ii) after sterilizing the shell surface, and (iii) after artificial infection of the shell surfaces, with bacterial flora normally present on eggs, following surface sterilization. The pattern of changes in the eggs subjected to these treatments has been found to be the same and there is no evidence of bacterial putrefaction in the eggs stored for 9 days. It is concluded that bacteria are not involved in the changes occurring in the physical characteristics of the contents of eggs during storage.

538. SOUMITHRI, T. C., SUBBA RAO, M. S. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on brine pickles: Part I — Salt and acid ratio in Indian pickles and the incidence of microbial spoilage, *Food Sci.*, **12** (1963), 374

The analysis of samples collected from houses and hotels indicated a wide variation in their salt (8-22 per cent) and acid (1·15-4·75 per cent) contents. Pickles having a salt content higher than 17 per cent with *c.* 2 per cent or more acid remained in sound condition, irrespective of the type of fruit used. Nearly 58 per cent samples had a salt content less than 15 per cent and the incidence of spoilage was *c.* 92 per cent in this range. The critical combination of salt and acid for adequate preservation of the product has been arrived at, with reference to each raw material studied. The essential oils and polyphenols naturally present in the raw material have a supplementary preservative value, though too great a reliance on these factors cannot be placed. The spoilage organisms encountered in all cases were yeasts and moulds and varied in their salt tolerance. The maximum tolerance observed was 20 per cent salt in the nutrient medium. Moulds are more important as spoilage agents as they produce considerable softening in the product.

539. SOUMITHRI, T. C., SUBBA RAO, M. S. & JOHAR, D. S. (Central Food Technological Research Institute, Mysore): Studies on brine pickles: Part II — Isolation and identification of yeasts from Indian pickles, *Food Sci.*, **12** (1963), 377

Yeasts isolated from pickles of lime, mango and gooseberry have been identified as strains of *Torulopsis lactic-condensi*, *Debaryomyces kloeckeri*, *Candida guilliermondii* and *Candida pulcherrima*. Except one strain of *Torulopsis lactic-condensi*, all the strains could tolerate 3 per cent citric acid at 15 per cent salt content. One strain of *Candida guilliermondii* could nearly tolerate 4 per cent acid at 14 per cent salt.

540. SUBBA RAO, M. S., SOUMITHRI, T. C., JOHAR, D. S. & SUBRAHMANYAN, V. (Central Food Technological Research Institute, Mysore): Studies on brine pickles: Part III — Preservative emulsion for pickles, *Food Sci.*, **12** (1963), 381

Brown mustard powder at 1·5 per cent level has been found to have no inhibitory action for yeast or mould isolated from pickles. Yeast growth is inhibited by 0·02 per cent orange peel oil while 0·05 per cent is not inhibitory to mould. A pickle preservative emulsion has been evolved containing acetic acid, orange peel oil, brown mustard and turmeric powders. The emulsion completely prevents the growth of yeast and mould in synthetic media. The efficacy of the preservative emulsion in controlling spoilage in pickles prepared under varied conditions, using different types of raw materials has been studied. Samples of lime pickle with as low as 7·5 per cent salt and of mango pickle with 9 per cent salt could be preserved for over a year, by the addition of the emulsion. In the case of untreated samples, concentration of salt as high as 14 per cent could not check growth of yeast or mould which could tolerate 20 per cent salt in the nutrient medium. The absence of microbial growth in pickles on addition of the emulsion is not a case of inhibition due to decrease in salt tolerance of organisms but is due to their total destruction. The addition of emulsion does not significantly alter the colour, taste or flavour of the pickle.

665.3 Fats & Oils

541. APPU RAO, B., MOHAN, R., KUTUMBA RAO, S., ALLAH BAKSH, M., THIRUMALA RAO, S. D. & MURTI, K. S. (Oil Technological Research Institute, Anantapur): Pilot plant studies on the processing of Indian cottonseed: Part V — Processing of Buri cottonseed, *Indian Oilseeds J.*, **1** (1963), 79

Suitable combinations of cleaning and crushing conditions have been worked out for obtaining maximum yield of oil from Buri cottonseed. In general, the oil yields (av. 15 per cent) for this seed have been found to be higher than those obtained from other varieties of American type seed.

542. CHALIHA, B. P., BARUA, A. D., MAHANTA, D. & SIDDAPPA, G. S. (Central Food Technological Research Institute, Mysore): Mandarin orange seed oil — Physico-chemical characteristics, *I.O. & S.J.*, (29) (1963), 71

The seed oil of the mandarin orange of Assam has an extremely bitter taste, which can be removed by refining with caustic soda solution. The physico-chemical characteristics of the oil compare well with those of the seed oil of other citrus fruits like grape fruit, tangerine, sweet orange, etc. The mixed fatty acids in the oil contain 3·49 per cent linolenic, 35·97 per cent linoleic, 24·51 per cent oleic and 36·06 per cent saturated acids. The residual cake is rich in protein, phosphorus and calcium.

543. LAKSHMINARAYANA, G. & REBELLO, D. (Regional Research Laboratory, Hyderabad, & Department of Chemical Technology, University of Bombay, Bombay): Errors in the azelaoglyceride technique, *J. Amer. Oil Chem. Soc.*, **40** (1963), 300

Arguments have been put forward to prove that the conclusions drawn on the formation of incompletely

oxidized glycerides and also hydrolysis of azelaoglycerides in Kartha's acetone-acetic acid-permanganate oxidation method for the determination of glyceride composition are not based on artifacts of the techniques used in examining his procedure [*J. Amer. Oil Chem. Soc.*, **30** (1953), 280; **37** (1960), 274; **39** (1962), 478].

544. SHRIPATHI RAO, H., NARASIMHAM, P., CHARI, K. S. & AGGARWAL, J. S. (Regional Research Laboratory, Hyderabad): Hydrogenation of castor oil: Part IV — Storage studies on nickel catalysts, *Indian J. Technol.*, **2** (1964), 21

The activities of Raney nickel catalysts prepared by two known methods (W-2 and T-2) and by wet reduction of nickel formate in castor oil medium, when stored under alcohol as well as in hydrogenated castor oil (HCO) medium have been investigated. The catalyst prepared by the T-2 method and stored in HCO medium has been found to be superior to others and its activity is not reduced even after storage for one year.

545. YOUNGS, C. G. & SUBBARAM, M. R. (National Research Council of Canada, Prairie Regional Laboratory, Saskatoon, Canada, & Regional Research Laboratory, Hyderabad): Determination of the glyceride structure of fats: Gas liquid chromatography of oxidized glycerides, *J. Amer. Oil Chem. Soc.*, **41** (1964), 218

A method has been developed for the determination of glyceride composition of natural fats, which involves oxidation of the fat by permanganate-periodate, esterification of the oxidized glycerides, and subsequent GLC using a flame ionization detector. Quantitative analyses, requiring *c.* 4 hr and 20 mg. of sample are reported. The method gives the distribution of individual saturated acids within the glycerides. Glyceride composition of four vegetable oils has been determined using the above procedure.

546. THIRUMALA RAO, S. D. & PRAKASA RAO, CH. S. (Oil Technological Research Institute, Anantapur): Splitting of Indian vegetable oils: Part III — Use of cation exchange resin in Twitchell process, *Chem. age, Bombay*, **14** (1963), 476

The cation exchange resin, Duolite C-20 (bead form, 16-50 mesh), after acid-regeneration has been found to be an efficient catalyst for Twitchell splitting of coconut oil. Reaction with 2-3 per cent of the acid-regenerated resin results in 80-90 per cent split in *c.* 12 hr. The fatty acids obtained by using resin are much lighter in colour than those obtained when sulphuric acid is used. Once-used resin can be recovered and reused after regeneration.

667.6 Paints & Varnishes

547. SRINIVASAN, S. R. & KAPUR, S. L. (National Chemical Laboratory, Poona): Modification of lac, *Indian J. Technol.*, **2** (1964), 71

The film forming properties of a varnish prepared from the reaction product of epichlorohydrin and lac have been studied. The resistance of the film to the action of different chemicals, viz. water, sodium carbonate solution, sodium hydroxide solution, hydrochloric acid and ethyl alcohol, has been found to be comparable to that of a film prepared from lac and a standard epoxy resin.

668.5 Essential Oils

548. BHRAMARAMBA, A. & SIDHU, G. S. (Regional Research Laboratory, Hyderabad): Chromatographic studies on Indian cinnamon leaf oil, *Perfum. essent. Oil Rec.*, **54** (1963), 732

The composition of the non-phenolic portion of Indian cinnamon leaf oil has been studied by gas-liquid and thin-layer chromatography. Pure linalool, *o*-methyl eugenol and caryophyllene have been separated from it by column chromatography over silica gel. Humulene, *iso*caryophyllene and benzyl benzoate have also been detected. Coniferaldehyde has been identified in the phenolic fraction. Separation of caryophyllene, *iso*caryophyllene and humulene has been achieved by gas-liquid chromatography.

668.7 Tar Distillation

549. ROY, S. N., BANERJEE, P. K. & BASU, A. N. (Central Fuel Research Institute, Jealgora, Dhanbad): Recovery of low boiling pyridine bases from crude benzole by ion exchange, *Indian J. Technol.*, **2** (1964), 59

The role of alcohol in the process reported earlier [Banerjee, P. K., Roy, S. N. & Lahiri, A., *J. sci industr. Res.*, **19A** (1960), 174] for efficient recovery of valuable low boiling bases like pyridine, picoline, lutidines, etc., from crude benzole using alcohol-swelled ion-exchange bed has been ascertained. Alcohol has been found to have a profound influence on the performance of the bed. Optimum alcohol content has been found to be sufficiently less than the quantity absorbed during normal swelling of the exchanger in alcohol and during operation there is no likelihood of the bed getting dealcoholized below the optimum alcohol level. Following this procedure, pyridine bases have been extracted from a number of commercial raw benzole samples in satisfactory yields and their compositions have been studied by chemical and spectroscopic analysis.

668.8 Dyes

550. VAIDYANATHAN, A. & SUNTHANKAR, S. V. (Department of Chemical Technology, University of Bombay, Bombay): Cellulose acetate dyes: Part VII — Synthesis of *p*-arylazophenylaminomethyleneacetoacetates and 6-arylazoquinolines as dyes for cellulose acetate, *Indian J. Technol.*, **2** (1964), 53

Several *p*-arylazophenylaminomethyleneacetoacetates and 6-arylazoquinolines have been synthesized by the condensation of aminoazobenzenes with ethoxymethyleneacetoacetate and by subsequent cyclization, and their dyeing properties have been studied. It has been found that structural modifications carried out with a view to reducing the basicity of the amino groups in the parent compounds

have favourable effect on the fastness of the resulting dyes.

551. VAIDYANATHAN, A. & SUNTHANKAR, S. V. (Department of Chemical Technology, University of Bombay, Bombay): Cellulose acetate dyes: Part VIII — Synthesis of anthraquinonylaminomethyleneacetoacetates and 4'-hydroxy-3'-acetyl-pyridinoanthraquinones, *Indian J. Technol.*, **2** (1964), 56

A series of anthraquinonylaminoacrylates and pyridinoanthraquinones have been synthesized and tested as cellulose acetate dyes. The acrylates from α-aminoanthraquinone and 1-amino-4-methoxyanthraquinone and the cyclized products have been found to possess excellent all-round dyeing and fastness properties. The improved fastness of these compounds has been attributed to the lowered basicity of the amino nitrogen in these compounds.

66 : 541.121 Equilibrium Studies

552. VENKATESHWAR RAO, M., KRISHNA RAO, V., ASGHAR HUSAIN & CHARI, K. S. (Regional Research Laboratory, Hyderabad): Vapour-liquid equilibrium studies of fatty acids, *Indian J. Technol.*, **1** (1963), 441

Vapour-liquid equilibrium data for the systems methyl laurate-methyl myristate and lauric acid-myristic acid have been determined at 4 mm. Hg using an equilibrium still designed for the purpose. The data obtained for lauric acid-myristic acid system have been found to be in good agreement with the data reported in literature. However, both the experimental data and the data reported in literature do not meet the thermodynamic requirements for consistency. When corrected in conformity with the Redlich-Kister equation, the data show good agreement with those calculated on the basis of Margules equation and are satisfactory on testing with the visual methods of Lu *et al.* [Lu, B. C. Y., Spinner, I. H. & Ho, J. C. K., *Canad. J. chem. Engng*, **40** (1962), 16].

66 : 541.183 Adsorption

553. MUTHU, M., KRISHNAMURTHY, T. S. & MAJUMDER, S. K. (Central Food Technological Research Institute, Mysore): Revivification of exhausted gas mask canisters, *Res. & Ind.*, **9** (1964), 3

Gas masks fitted with canisters are worn by operating personnel to adsorb from inhaled air toxic gases used in fumigation procedures. The canisters, imported at a high price, have a limited life and revivifying them would be profitable. A method is reported for reviving exhausted canisters. It consists in first removing the loose moisture from the canisters and then heating them under vacuum to expel adsorbed water and fumigant vapours. Tests on the revivified canisters have proved that they are as good as new ones.

66 : 549 Mineralogy

554. BANERJEE, J. C. & RAMESAM, K. (Central Glass & Ceramic Research Institute, Calcutta): Studies on Indian chrome ores, *Cent. Glass Ceram. Res. Inst. Bull.*, **10** (1963), 67

Seven Indian chrome ores have been examined for their physical and thermal properties by petrographic analysis, dta and thermal expansion methods. Serpentine (antigorite type), talc, pyrophyllite and goethite form the main secondary material of the chrome ores. Dta findings corroborate the petrographic data in most of the cases. Four chrome ores were found to contain balanced spinels. Out of the seven chrome ores, two were of lateritic type containing high amount of iron which makes them unsuitable for refractory purposes. One of the chrome ores is likely to prove to be the best ore as it contains the highest amount of magnesia spinels ($MgO.Al_2O_3$) and the lowest amount of chromite spinels ($FeO.Cr_2O_3$). The other ores also may be profitably utilized in making basic refractories even though most of them contain more silica and iron oxide than are permissible.

66 : 615.777 Insecticides

555. KATTI, S. S. & CHINCHOLE, P. R. (National Chemical Laboratory, Poona): Water dispersible DDT formulations: Solubility and interfacial tension measurements in DDT-oil-wetting agent systems, *Indian J. Technol.*, **2** (1964), 1

The solubilities and interfacial tensions of DDT-oil-wetting agent systems have been determined under different conditions of storage with a view to ascertaining the reasons for deterioration in the suspensibility of the pastes when stored at high temperatures. The solubility of DDT in oil (Shell X-100 motor oil and spindle oil) and in Lissapol NX (LNX) has been found to increase with rise in temperature, while the solubility of LNX in oil and water decreases. The decrease in solubility of LNX has been attributed to the breaking of intramolecular hydrogen bonds in the oxyethylene part of the molecules and of such bonds formed with the solvent molecule.

66 : 620.193 Corrosion

556. SHAH, Y. C. & DESAI, M. N. (Chemistry Department, University School of Science, Gujarat University, Ahmedabad): Inhibition of corrosion of brass in acids by furfuraldehyde, *Indian J. Technol.*, **2** (1964), 31

The efficiency of furfuraldehyde as an inhibitor of the corrosion of brasses by different acids has been investigated. In the presence of furfuraldehyde (17·4 ml./litre 0·2*N* acid), the corrosion of brass by hydrochloric, nitric, sulphuric, acetic and phosphoric acids is retarded by 80-87, 40-69, 52-71, 70-82 and 50-58 per cent respectively. Furfuraldehyde has no influence on the dezincification of α-β (59/41) brass, but retards it in the case of α (60/40) brass. Dezincification of 60/40 brass in sulphuric acid is completely inhibited by furfuraldehyde. The retardation of dezincification in phosphoric acid by furfuraldehyde is more with 60/40 brass than with 59/41 brass.

557. SUBRAMANYAN, N. & SUNDARAM, M. (Central Electrochemical Research Institute, Karaikudi):

Corrosion of commercial aluminium in some organic acids, *Indian J. Technol.*, **2** (1964), 64

The extent of corrosion of 2S aluminium in 6 organic acids, viz. acetic, butyric, lactic, tartaric, oxalic and citric, when present alone or in admixture with sodium chloride, has been investigated. The polarization behaviour of the metal in the various solutions has also been studied with a view to understanding the mechanism of corrosion. It has been found that the corrosion rate in organic acid-sodium chloride mixture is considerably higher than that in the acids or sodium chloride individually. Cathodic polarization in organic acid-sodium chloride mixtures is the same as that in the acids alone, with the exception of (i) tartaric and lactic acids where it is lower with the mixtures than the acids alone and (ii) oxalic acid where it is 3 times more in the presence of sodium chloride than in its absence. In all cases, the anodic polarization is negligibly small in acid-sodium chloride mixtures as well as in the individual acids.

66: 621.3 Electrotechnology

558. SHENOI, B. A., GOPAL, S. & NARASIMHAN, K. R. (Central Electrochemical Research Institute, Karaikudi): Electrolytic refining of gold employing rotating cathode, *J. electrochem. Soc. Japan*, **31** (1963), 42

In the Wohlwill process which is an established electrolytic method for refining gold, large amounts of gold are locked up in the electrolyte. In order to reduce the gold hold-up in the electrolyte it is desirable to employ high current density and high current concentration. It has been found that rotating cathode could be successfully employed for this purpose.

559. SHENOI, B. A., VIJAYALAKSHMI, (Mrs) K. & INDIRA, (Miss) S. (Central Electrochemical Research Institute, Karaikudi): Electropolishing aluminium — Optimum conditions for alkaline baths, *Met. Finish.*, (1963), 1

An experimental study has been made on the electropolishing of superpurity aluminum, 99·8 per cent, and 98 per cent purity metal in an alkaline bath and the optimum electropolishing conditions have been determined for minimum diffused reflectivity. The bath composition and operating conditions are adjusted according to the purity of the metal. This alkaline bath containing various amounts of sodium carbonate and trisodium phosphate works at a constant voltage cycle. Best results are obtained even at room temperatures, at low voltages with a modified solution containing sodium hydroxide and phosphate. The relationships between (i) cell voltage and diffuse reflectivity, (ii) diffuse reflectivity and time of treatment, (iii) diffuse reflectivity and temperature of the bath, etc., and (iv) specular reflectivity and purity of the metal, etc., are represented graphically.

560. SUNDARARAJAN, K., RAJAGOPALAN, S. R. & REDDY, K. N. (Central Electrochemical Research Institute, Karaikudi): The transition from microthrowing power to macrothrowing power in electrodeposition from a cyanide copper bath, *Electrochim. Acta*, **8** (1963), 831

Cylindrical cathodes containing microgrooves of various widths and depths have been electrodeposited with copper from a cyanide copper bath. The uniformity ratio, h_r/h_p (where h_r is the thickness of deposit on the recess of a groove, and h_p, a similar parameter for the peak), was measured in a microscope with an eyepiece micrometer. The ratio was found to vary with groove width (at constant depth), with groove depth (at constant width), and also with current density and bath temperature. The results demonstrate a transition from poor 'microthrow' to good 'macrothrow' when the groove width is of the order of the thickness of the diffusion layer. Rotation of the cathode during electrodeposition leads to levelling on wide grooves (0·008-0·009 in., 0·2032-0·2286 mm.), probably due to greater turbulent transport inside the grooves.

66: 621.89 Lubricants

561. KHANNA, MOHAN LAL (National Physical Laboratory, New Delhi): Studies on pour point depressants for lubricating oils, *Indian J. Technol.*, **1** (1963), 466

The effectiveness of some high molecular weight substances, soaps, substituted amides and products isolated from oxidized waxes as pour point depressants for wax-bearing motor and medium spindle (MS) lubricating oils has been investigated. Among the high molecular weight substances tried, chlorophyll at 5 per cent concentration has been found to bring about satisfactory reduction in the pour points of both motor and MS oils; at the same concentration, opium wax is effective only in the case of MS oil. Compared to soaps, anilides show maximum lowering of setting point at a particular concentration and are able to withstand heat ageing test. However, they give rise to scum formation at the surface when left overnight. This has been overcome by the addition of stearylamine in the case of stearic anilide and *p*-methoxystearic anilide in the case of aluminium stearate, resulting in permanent lowering of setting point of the oil. Among the products isolated from wax oxidized in the presence of different catalysts by (i) solvent extraction, (ii) vacuum distillation, (iii) steam vacuum distillation, and (iv) sweating, a product obtained from boric acid-oxidized match wax subjected to steam vacuum distillation has been found to have the maximum pour point depressing action.

562. PATHAK, K. D. & SUBBA RAO, B. C. (National Chemical Laboratory, Poona): Lubricants from cashewnut shell liquid, *Indian J. Technol.*, **1** (1963), 433

Attempts have been made to prepare viscous stable liquids suitable for use as lubricants starting from the monophenolic component of cashewnut shell liquid. The derivatives obtained by introducing branching at the double bonds in the side chain of anacardol have, in general, low viscosity indices and their pour points are not sufficiently low as to warrant their use as low temperature lubricants.

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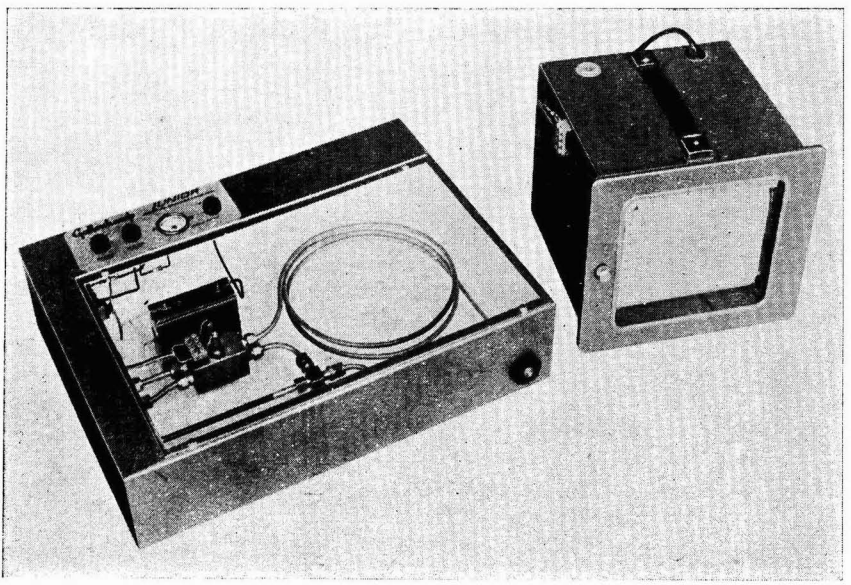

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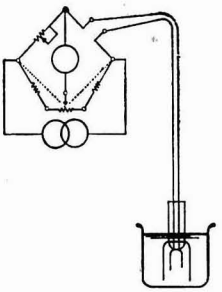

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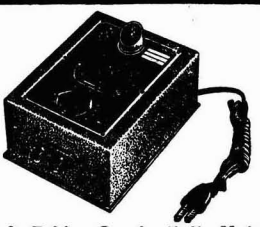

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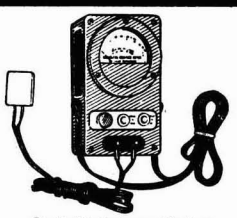

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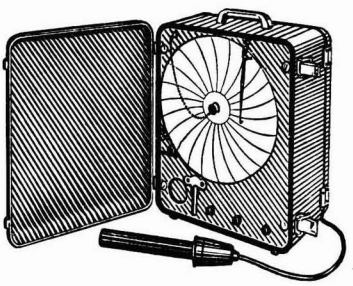

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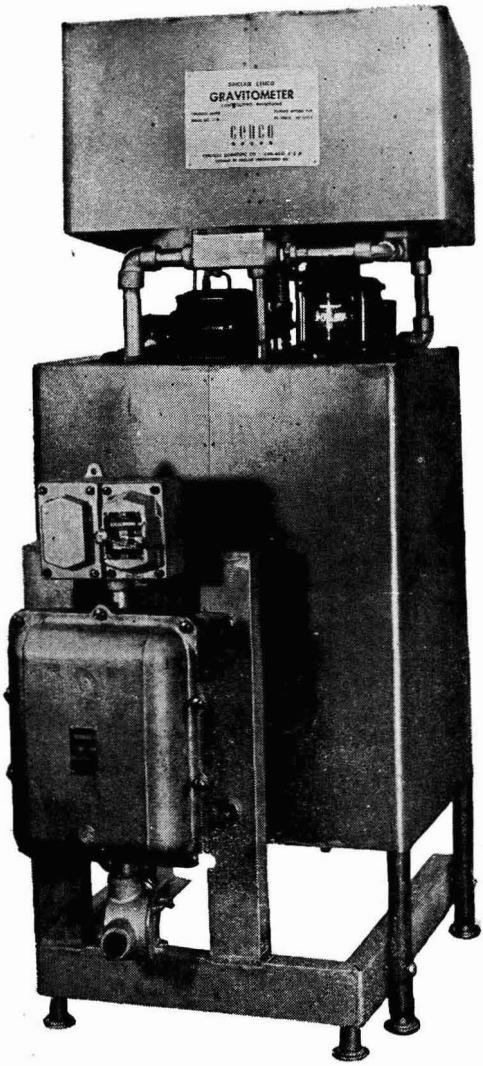

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