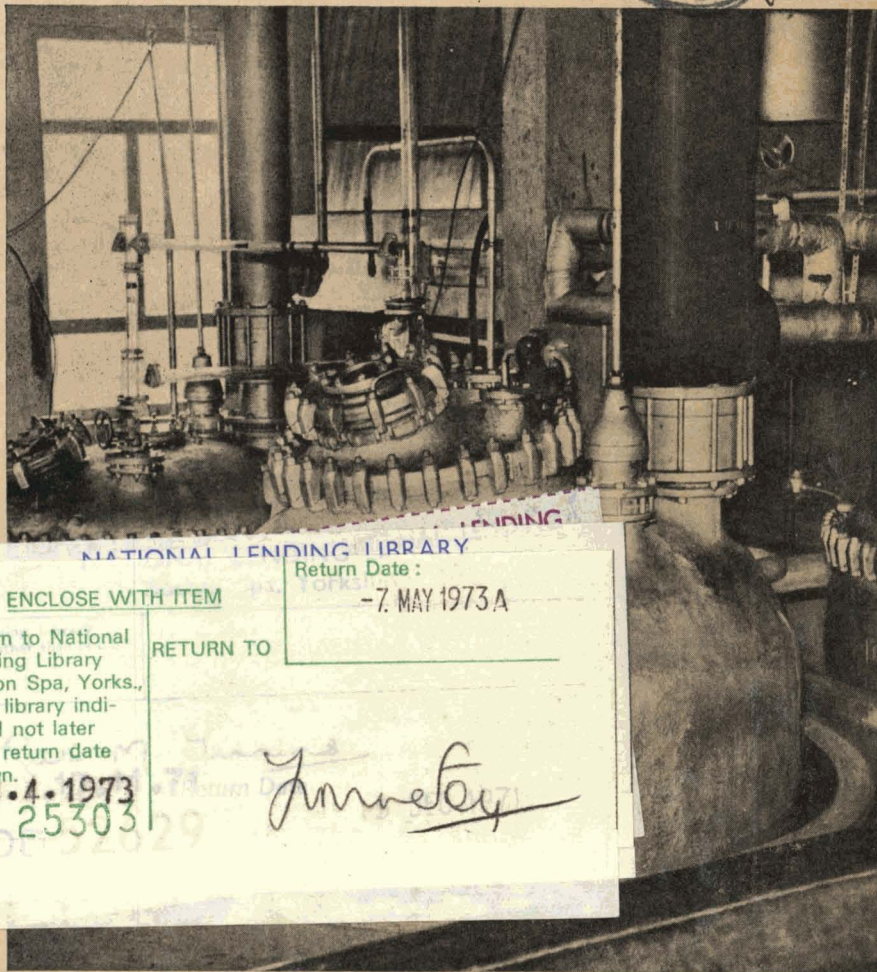


# Journal of Scientific & Industrial Research

A — General



## THIS ISSUE

### GENERAL

Metallic corrosion: cost and prevention

Magneto-hydrodynamics — A seminar

Liquids for particle size analysis

### PHYSICAL SCIENCES

Radioactive tracer study of adsorption of phosphate ions by  $Al_2O_3$

Studies in ion-exchange reactions of charcoal

A new synthesis of paranjin ketone

### BIOLOGICAL SCIENCES

Moist heat denaturation of soyabean proteins

Survey of atmospheric pollen at Lucknow

Survey of human skin fungi at Lucknow

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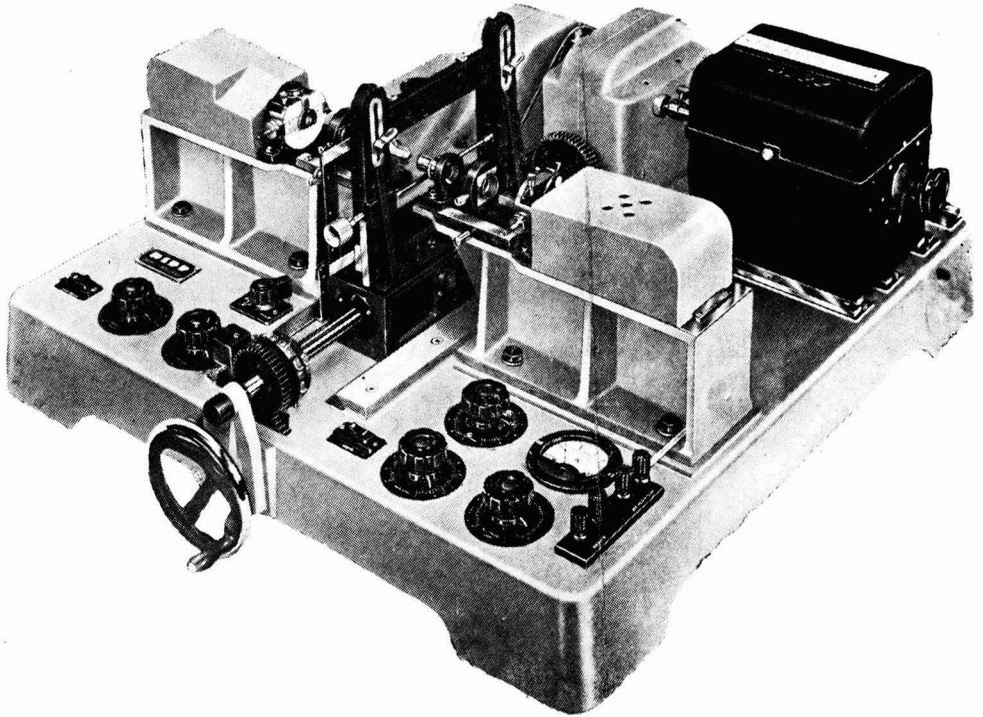
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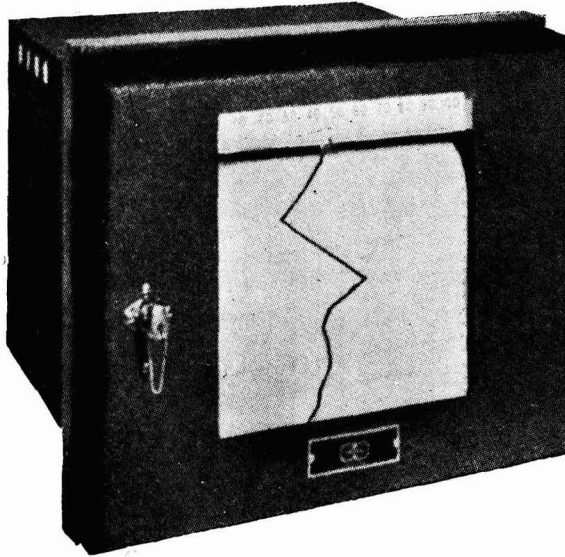
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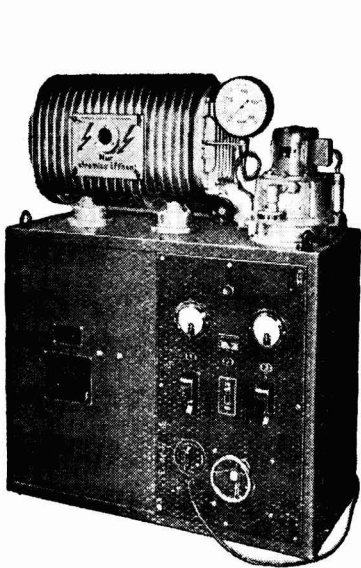


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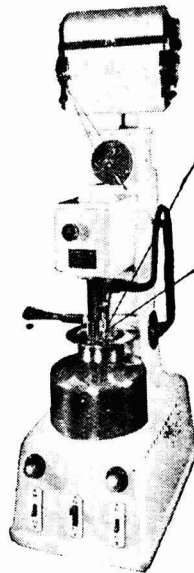
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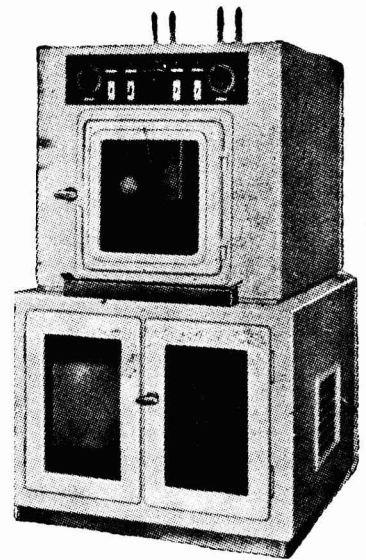
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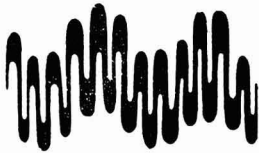
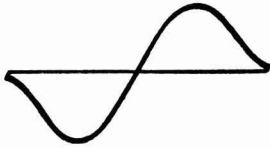
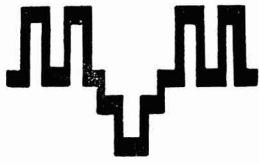
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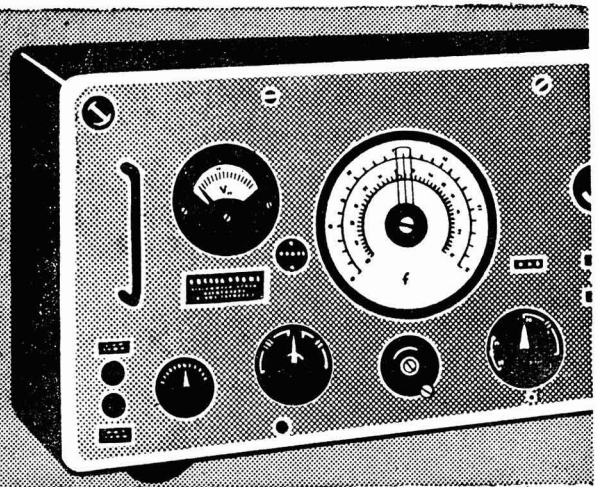
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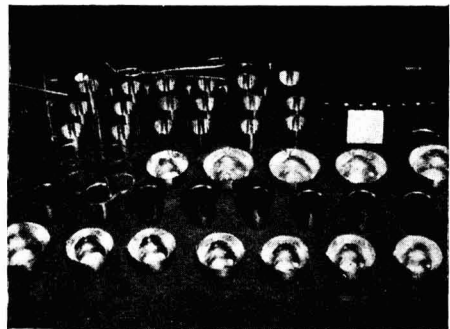
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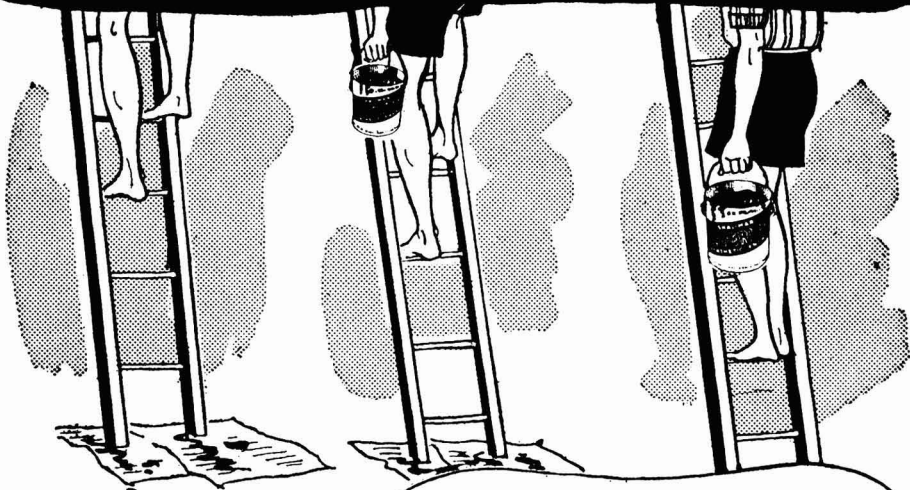
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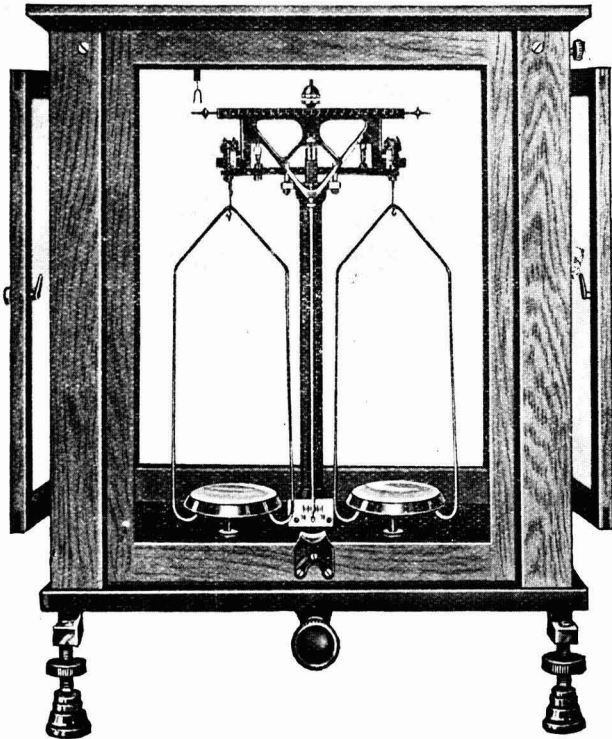
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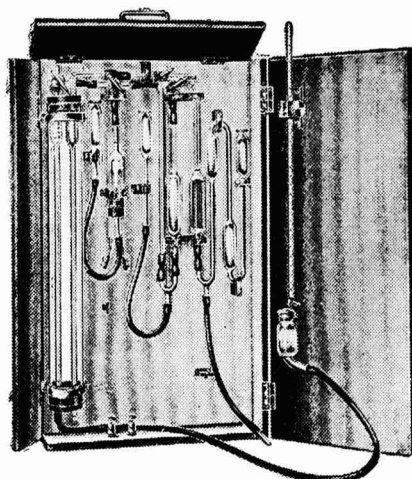
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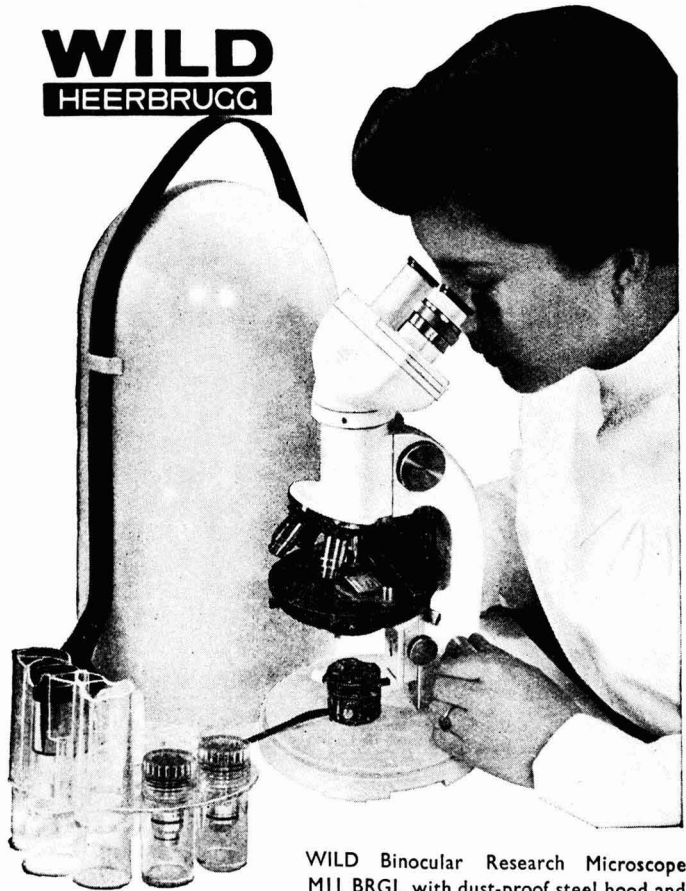
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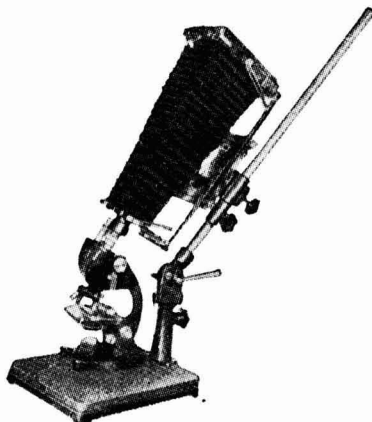
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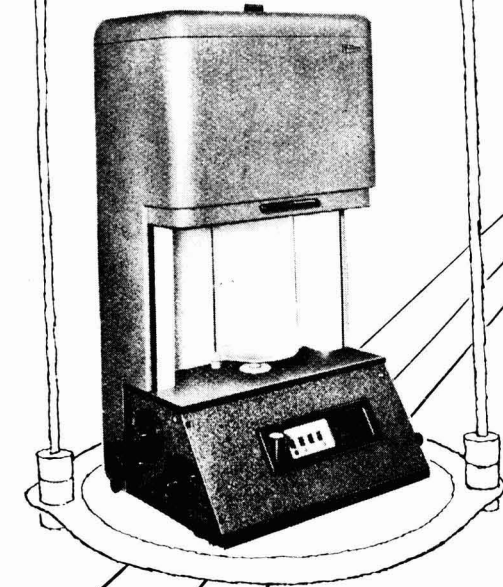
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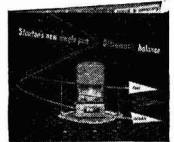
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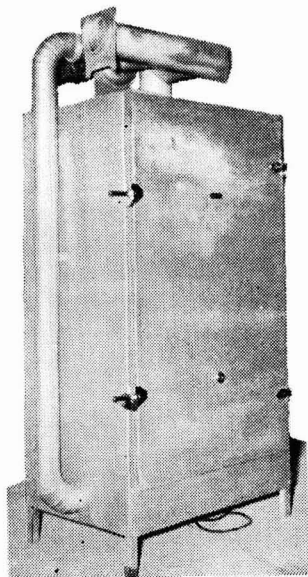
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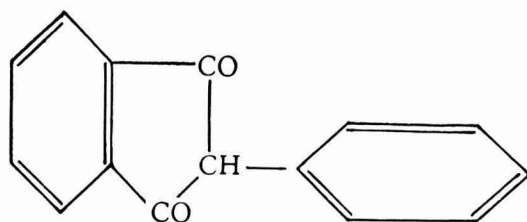
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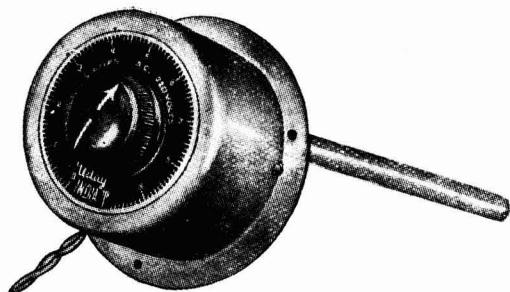


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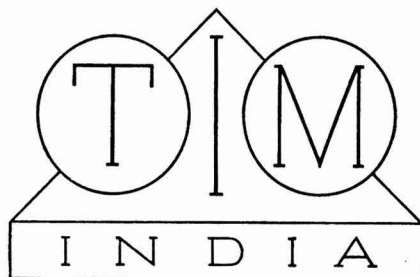
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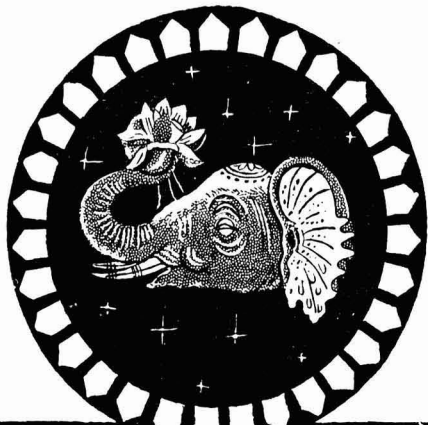
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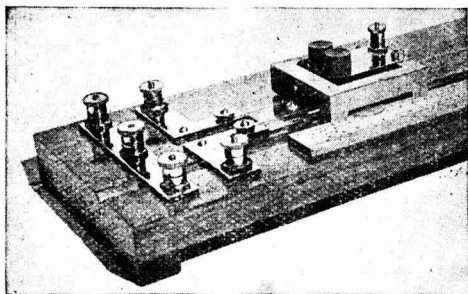
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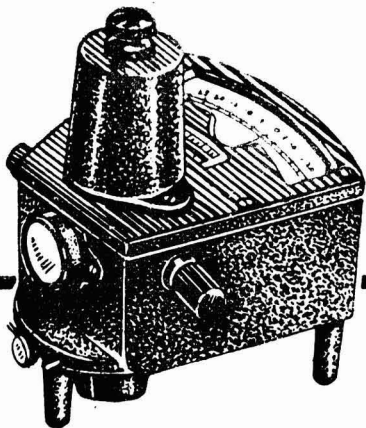


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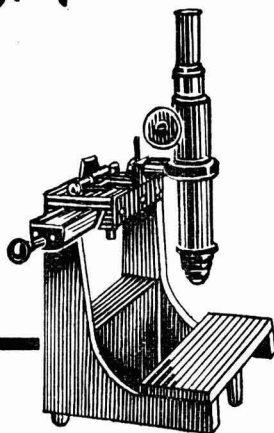
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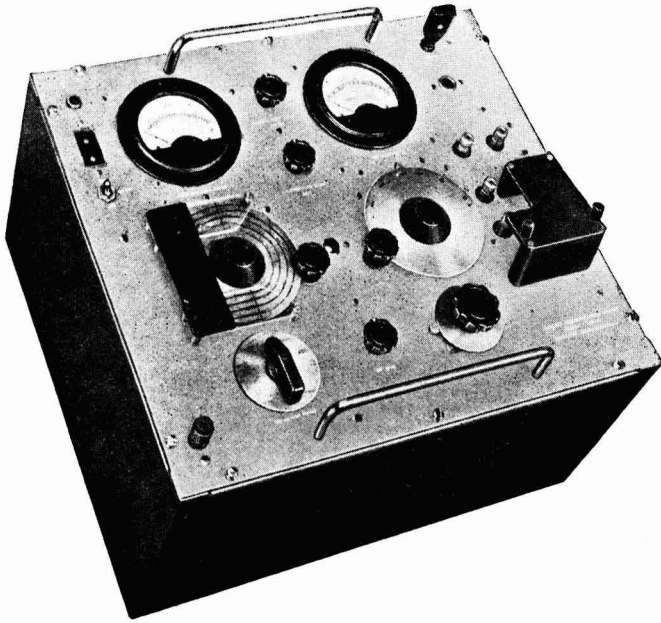
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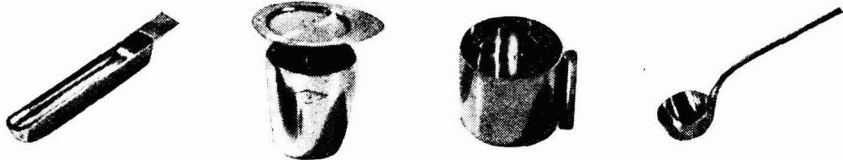
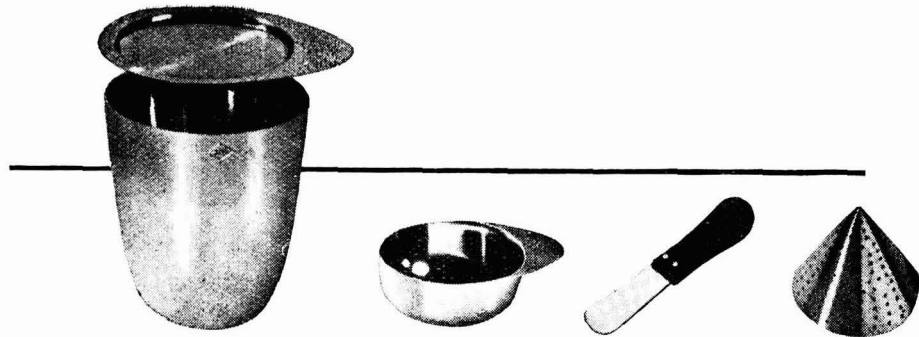
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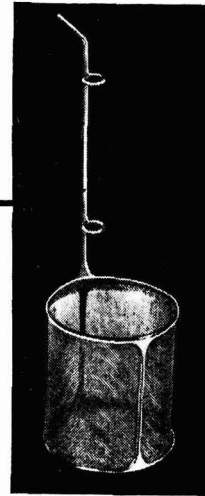
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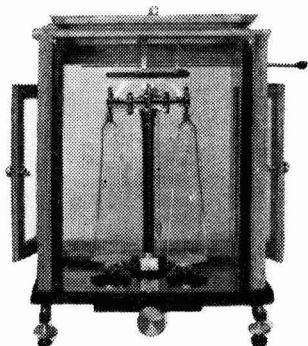
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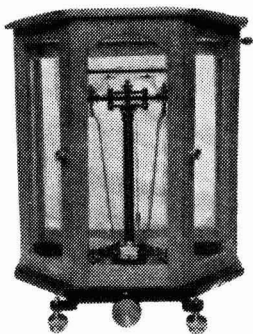
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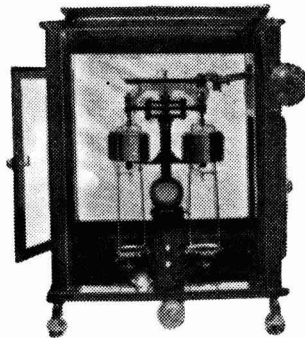
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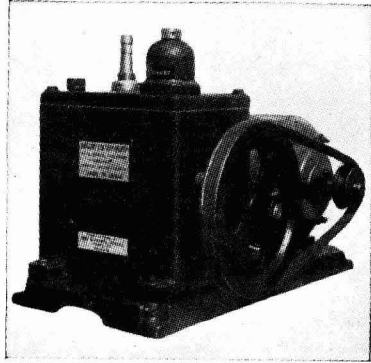
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# Metallic Corrosion: Cost & Prevention

K. S. RAJAGOPALAN

Central Electro-Chemical Research Institute, Karaikudi

WHILE rusting of iron is familiar to every one, it is not generally recognized that metallic corrosion entails colossal economic losses and that protective measures taken to minimize such losses involve expenditure of large sums of money. The term 'corrosion' is applied to the destruction or deterioration of metals by chemical and electro-chemical reactions with the surroundings. Of the metals which corrode rapidly under a wide variety of natural conditions, e.g. iron, steel, zinc, cadmium, magnesium, etc., iron and steel are the most important industrially. The agents responsible for corrosion are oxygen, moisture, salts, and acidic and alkaline materials. Corrosion of metals under natural conditions may be divided into atmospheric and underground corrosion, and corrosion due to sea water and other natural waters. There are various ways in which metals can be protected against corrosion. The surface may be covered by paints, metallic coatings and other surface coatings. The metal may be alloyed with more resistant metals. Cathodic protection, use of corrosion inhibitors, anti-corrosion packaging are some of the other methods. Control and prevention of corrosion are essential for husbanding the metal resources of a country, particularly of iron and steel, and their economic use, and the expenditure on protective measures in various countries is closely related to the output and consumption of iron and steel.

The importance of anti-corrosion measures for conserving iron and steel was emphasized at the United Nations Scientific Conference on the Conservation and Utilization of Natural Resources held at Lake Success in 1949. It was revealed at the conference

that U.S.A. alone spent \$ 5.5 billion in 1948 on measures for corrosion control and prevention; the estimate for 1956 is \$ 8 billion. The United Kingdom is estimated to be spending annually £ 600 million, Australia £ 160 million and Canada \$ 300 million. No data are available for India, but whatever be the present expenditure, it is likely to increase manifold in the next five years.

## Cost of corrosion control in India

A breakdown of corrosion-prevention costs in U.S.A., based on the materials employed, shows that of the \$ 5.5 billion spent in 1948, paints accounted for 37.7 per cent; hot-dip coatings, 8.3 per cent; electroplating, 3.7 per cent; corrosion-resistant alloys, 12.3 per cent; maintenance of underground pipelines and internal combustion engines, 11 and 19 per cent respectively; and miscellaneous items, 8 per cent. An assessment of the costs in India, on the same basis, for the year 1960-61 is presented in Table 1. The assessment

TABLE 1 — COST OF CORROSION CONTROL IN INDIA (1960-61)

	QUANTITY Tons	Cost Crores of Rs.
Paints, varnishes and lacquers*	—	40.0
Zinc for galvanizing†	22000	5.7
Tin for tinplate†	3000	11.3
Electroplating	—	10.0
Nickel and its alloys†	700	1.0
Copper and its alloys†	80000	50.8
	(brass basis)	
Lead and its alloys†	12000	3.3
Stainless steel†	1500	22.4
Aluminium†	9000	8.3
Prevention of corrosion in internal combustion engines	—	1.0
Total cost		153.8

\*Including labour cost (de-scaling, preparation of metal surface and application).

†Including cost of fabrication.

must be considered conservative; for instance, expenditure on the maintenance of underground pipelines and on temporary protective measures by the Defence Services has not been taken into account. Even so, the assessed figure of Rs. 153.8 crores provides an indication of the magnitude of the problem and emphasizes the need for a proper understanding of the types of corrosion encountered and the nature of remedial measures which are best suited to combat them.

#### Prevention of corrosion

Any programme of corrosion protection should take into consideration the nature of the protective treatments, the techniques of applying them to the metallic surfaces and the environments that will be encountered. A variety of new paint formulations and primers have been developed in recent years, such as alkyd and vinyl resins and wash primers based on polyvinyl butyral and zinc oxochromate. They have to be tested under tropical conditions before adoption. That tropical climate (tropical rain forest and tropical savanna) furnishes temperature and relative humidity conditions for accelerated corrosion of metals and the inadequacy of several protective treatments under these conditions came to be realized only during the last war when strategic equipment sent to tropical theatres of war became unserviceable even before they were unpacked and items like galvanized screen turned into powder in three or four months in the tropics as against two years of use in more temperate climates. The development of effective coatings from indigenous raw materials needs to be investigated. The techniques of preparing metal surfaces for the application of paints and other protective coatings need close study. Sand blasting, pickling, phosphating, chromating and other passivation treatments which are employed widely in other countries are not yet popular here. Suitable procedures have to be worked out for their adoption in this country. Attention should be concentrated on using metallic coatings of minimum thickness and increasing their protective value by maintaining uniform thickness of coating, subsequent painting or lacquering wherever possible and by the application of passivation treatments. There is considerable scope for the develop-

ment of temporary protective agents like greases, bitumen and resin formulations, strippable coatings, vapour-phase inhibitors and anti-corrosion packaging materials. Preliminary investigations carried out at the Central Electro-Chemical Research Institute, Karaikudi, on the development of new vapour-phase inhibitors have shown that a number of organic chemicals which can be produced within the country are likely to be useful as vapour-phase inhibitors. The data necessary for the selection of paints and other protective treatments to meet particular needs and conditions have been hardly collected. Closer attention has to be paid to the design and fabrication of metal structures and parts with a view to minimize accumulation of moisture in crevices, sharp angles, etc. Galvanic corrosion, corrosion due to metal-non-metal combinations, poor finish and presence of blow holes and inclusions are factors which accentuate corrosion. Cathodic protection has proved effective for the protection of oil pipelines and submerged parts of ships in other countries. Its adaptability in India in oil refineries and shipping needs to be examined.

In view of the importance of corrosion control and prevention in the ferrous industry, a programme of research into various aspects of corrosion has been planned at the Central Electro-Chemical Research Institute. As a first step, a survey has been initiated to examine the problems of the machine tools, electrical goods, automobile, coach and ship-building, cycle and sheet metal industries. These industries (excluding sheet metal industry) consume 7 lakh tons of steel annually and produce finished steel products worth Rs. 335 crores. Calculating the cost of corrosion control and prevention measures at 10 per cent of the value of finished goods, the expenditure would be of the order of Rs. 33.5 crores. By the end of the Second Five-Year Plan (1960-61), about 43 lakh tons of steel will be consumed by these industries and on this basis the cost of anti-corrosion measures works out to Rs. 200 crores. The survey is designed to collect data on current practices with regard to the preparation of metal surfaces for painting, protection of metal parts during transfer from one shop to another within the factory, treatment of ferrous items stored in the open and corrosion-preventive packaging. The causes of rapid

corrosion at certain industrial and marine sites, corrodibility of sheet metal and forgings and prospects for the introduction of cathodic protection measures will also be investigated.

The survey is expected to provide basic data for the formulation of effective measures for combating corrosion on a regional basis in the country.

## Dr. K. S. G. Doss, D.Sc., F.R.I.C., F.Inst.P., F.A.Sc., F.N.I.

---

**D**R. K. S. G. Doss has been appointed Director, Central Electro-Chemical Research Institute, Karaikudi, from 13 February 1958.

Dr. Doss received his early education at Bangalore. He joined the Central College, Bangalore, in 1928 as a lecturer and later became Assistant Professor of Chemistry.

Dr. Doss was appointed Physical Chemist in the Indian Institute of Sugar Technology, Kanpur, in 1943, and was in-charge of the Physical Chemistry and Chemical Engineering Division of the Institute. He later became the Professor of Sugar Chemistry and Officiating Director of the Institute. He joined the Central Electro-Chemical Research Institute as Deputy Director on 1 February 1957.

Dr. Doss is the author of a number of research papers on colloids and surface chemistry; he has also published several research memoirs on problems relating to sugar technology. Among the more important contributions of Dr. Doss to the theoretical and applied aspects of electro-chemistry are the redoxokinetic effect, and the theory



Dr. K. S. G. Doss

of the electrical potential barrier. His work on the resistance heating of masse-cuites is of great practical importance to the sugar industry. Dr. Doss was awarded the Noel Deerr Medal for his work on the Electric Double Layer Capacity of the Dropping Mercury Electrode in Sugar Solutions.

Dr. Doss has been the Vice-President of the Sugar Technologists' Association of India and of the Institution of Chemists. He is the National Secretary of the Comite Internationale de Thermodynamique et de Cinetique Electrochimiques in India.

# Magneto-hydrodynamics—A Seminar

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WITH a view to stimulating research in magneto-hydrodynamics, a comparatively new but fast developing subject, a study seminar was organized by the Atmospheric Research Committee of the Council of Scientific & Industrial Research during 2-3 March 1958 in the University of Delhi. The seminar had other objectives: to co-ordinate the research activities of the universities and other research institutions in the country in this field and to focus attention on the growing applications of this branch of science.

Ten papers dealing with various aspects of the subject were presented and discussed at the seminar. The topics considered included various phenomena involving magneto-hydrodynamics in such fields as astrophysics, geophysics, dynamics of ionosphere, sunspots and other solar phenomena in relation to associated geophysical effects. Prof. Alfvén, the celebrated astrophysicist from the Kungl Tekniska Högskolan, Stockholm, who is now in India as a visiting professor at the Tata Institute of Fundamental Research, Bombay, in his inaugural speech, briefly traced the evolution and development of magneto-hydrodynamics by various workers.

In his lecture on "Magneto-hydrodynamics and Astrophysics" Prof. Alfvén briefly surveyed the various fields of application of magneto-hydrodynamics in atmospheric (earth's), solar, stellar and interstellar phenomena. He considered how such phenomena as sunspots, solar flares, magnetically variable stars, cosmic rays and cosmic radio noise, ionospheric disturbances, the earth's magnetic field, etc., can be explained by postulating the existence of a magneto-hydrodynamic coupling determined by Lundqvist's criterion. The permanent magnetic field of the earth can be considered as arising from magneto-hydrodynamic coupling being very strong in the liquid core. Bullard and his co-workers visualized a self-excited dynamo consisting of two generators working under regenerative condition. Prof. Alfvén also dwelt on the origin of the solar system in which the role of magneto-hydrodynamic effects is of decisive importance.

In a paper on the theory of propagation of hydromagnetic disturbances in a cylinder of viscous liquid, Prof. P. L. Bhatnagar of the Indian Institute of Science, Bangalore, provided a proof for the 'splitting theorem'. When the imposed disturbance in a compressible fluid is so small that the linearization of equations is valid, the wave may be split into two parts: (i) a longitudinal wave with irrotational velocity field and (ii) transverse wave with solenoidal velocity field. The problem was investigated with a view to see how far the viscosity in the presence of the cylindrical boundary affects the observed facts. By this treatment the two component waves can be studied separately and then be superposed. The problem was treated using Hankel and Laplace transforms.

Prof. N. R. Sen of the Calcutta University in his paper on "Sunspots as Hydromagnetic Phenomena" explained the origin, nature and other specific observed characteristics of sunspots. He dealt with Alfvén's theory of sunspots at length and explained how it accounts for the sunspot cycle and the motion of the spot over the surface of the sun, in terms of such concepts as a primary magnetic core (convective), recoil core, dipole field and bipolar spots.

Prof. Sen then outlined the various ideas propounded by Walen, Cowling, Ferraro and others involving a torsional oscillation of the magnetic lines of force in the solar material and discussed them. Ferraro has shown that the frozen lines of force on an isorotational surface in the sun generated by the rotation of a line of force in an azimuthal plane about the axis can give rise to a toroidal hydromagnetic wave by a slight twisting oscillation of the lines of force on the surface. The convective Unsöld layer prevents a large spreading of the lines of force outwards. The unstable convective core in which the lines of force are much twisted acquires great rigidity favouring generation of torsional oscillation. These oscillations are propagated from the boundary of the core through the stable zone towards the surface. Cowling suggested that the lines would be twisted into the shape of a girdle along parallels of latitude all



round the solar body in these layers; when a local disturbance carries a part of this girdle to the surface of the photosphere, the two sections would form a bipolar spot of opposite polarity in east-west positions. For a solar magnetic field of *c.* 2 gauss, Plumpton's estimate of the period of such a torsional wave is comparable with the observed spot period.

Prof. Sen also dealt with Parker's attempts to connect this type of phenomena with the hydromagnetic dynamo theory. A dynamo wave is supposed to start from the pole as a weak poloidal field and travels towards the equator. By the time the wave reaches the middle latitudes, due to non-uniform rotation, the field is mostly toroidal. A girdle-like magnetic band is developed which slowly migrates to the equator and vanishes ultimately. The intense strengthening of the field in the spot is explained by applying Biermann hypothesis that a field of *c.* 100 gauss produces a cocling of the girdle tube. Calculation shows that for a vertical tube which normally would expand above the photosphere, cooling by even 1°K. would cause the lines to contract greatly and the field to be magnified enormously in the upper region.

On the second day of the seminar, the forenoon was devoted to various theoretical and mathematical problems of hydromagnetic equilibrium.

In a joint paper Prof. Auluck and Prof. Kothari of the Delhi University considered the change in shape of an inviscid, homogeneous and infinitely conducting sphere under the influence of an internal ( $H_0$ ) and an external ( $H_1$ ) magnetic field. They showed that the sphere tends to a spheroidal shape, the ellipticity being given by

$$= \frac{5}{24} H_0(7H_0 + 10H_1)R^4/GM^2$$

where  $R$  is the radius,  $M$ , the mass of the sphere and  $G$ , the gravitation constant. When  $H_1 = 0$ , it reduces to the case of Chandrasekhar and Fermi and when  $H_0 = -H_1$ , it reduces to that of Gjellestad. They also demonstrated that in the case where an internal field arises due to circular currents proportional to the distance from the axis of symmetry and the magnetic field is such that it vanishes at the centre of the sphere and has a constant value  $H_0$  at large distances away from the centre, the sphere tends to become a prolate spheroid. The longitudinal

stability of an infinitely long gravitating cylinder in a magnetic field and the case of an internal field  $H_1$  and an external uniform field  $H_2$  was also considered. It was concluded that in every case the magnetic field increases the stability of the cylinder.

The equilibrium of a heavy, viscous, incompressible conducting fluid of variable density and permeated by a uniform horizontal field  $H$ , has been treated by S. P. Talwar of the Delhi University, assuming the density stratification in the vertical direction to be due to a change of temperature or composition. The characteristic equation for determining the initial growth of the disturbance has been derived and three special cases involving one or two viscous, conducting fluids of uniform or different densities as well as the case with density variation have been discussed in detail.

R. K. Jaggi of the Delhi University demonstrated in his paper that an incompressible gravitating cylinder of infinite length with a uniform axial magnetic field is in stable equilibrium. The effects of compressibility on stability were also considered.

J. N. Tandon of the National Physical Laboratory, New Delhi, described the results of investigations on the focussing of solar ion streams (which cause geomagnetic storms and aurorae) taking into account the effect of the external magnetic field. It has been observed that the streams emerging from the solar regions of large magnetic fields may get dispersed while they may come out in the form of concentrated streams from the quiet solar regions where large magnetic fields do not exist. Based on these conclusions the various features of the geomagnetic storms associated with solar regions, e.g. sunspots, chromospheric eruptions, etc., and the formation of coronal streamers around the sunspot minima have been qualitatively explained.

The early attempts of Blackett, Larmour and others to explain the origin of the earth's magnetic field were briefly reviewed by K. S. Raja Rao of the Meteorological Office, Poona. He discussed the recent theories, involving a magneto-hydrodynamic basis, to establish the dynamo maintenance of cosmic magnetic fields.

Large linear dimensions (magnetic Reynolds' number,  $R_m \gg 1$ ), low degree of rotational symmetry and convection are

essential for the dynamo action. Coriolis force produces flow patterns of the required low degree of symmetry but cannot itself create motion. The convection process conjointly with coriolis force produces the required type of radial variation in angular velocity to give a large field in the core. Convection can be attributed to the slow chemical separation in the central parts of the core. The existence of a poloidal field (corresponding to the field coil of the dynamo) of rotational symmetry is postulated and a non-uniform rotation is introduced. The non-uniform rotation draws out the lines of force along circles of latitude and produces a toroidal field (corresponding to the armature). As in the analogous case of the dynamo, a poloidal field is maintained by diversion of current from the toroidal field. The induction equation deduced from Navier-Stokes equations gives the decay time of the field which is 15,000 years for the earth's field. By incorporating the conditions for the existence of a steady dynamo in the induction equation, a result which is similar to the matrix equation of quantum mechanics is obtained. This equation has been finally solved using electronic computers.

In the afternoon session of the second day, A. K. Das of the Kodaikanal Observatory presented a paper in which he posed the question whether some solar phenomena can admit a better explanation in terms of the classical dynamics than in terms of magneto-hydrodynamics. He explained a new, simple theory proposed by him to interpret these phenomena without resorting to the complex and 'not very satisfactory' theory of Alfvén based on magneto-hydrodynamics. These phenomena are (i) the equatorward drift of sunspots and the (ii) poleward movement of prominences, established recently by M. and Mme. L. d'Azambuja. The purely dynamical considerations postulated by Das lead to the conclusion that on the photosphere there should exist a resultant acceleration directed from either pole towards the equator while on the chromosphere a resultant acceleration directed from equator towards the poles should be expected. The rates of equatorward drift of sunspots and the poleward motions of prominences at different heliographic latitudes calculated from the well-established Greenwich observational data are not inconsistent with the corresponding

velocities derived from the proposed theory. With the help of the two oppositely directed accelerations at the two levels and the general dynamical mechanism proposed by him in a number of earlier papers in dealing with a number of solar phenomena, a broad qualitative explanation has been suggested for the formation of the bipolar spots, simultaneous occurrence of opposite magnetic polarity in sunspots of the two hemispheres and the 22-year cycle of reversal of magnetic polarities of the sunspots. From the suggested mechanism it follows that sunspots should be associated with photospheric faculae and chromospheric flocculi.

S. L. Malurkar, Colaba Observatory, Bombay, examined the extent to which distinct types of solar activity like flares, eruptions, etc., can be correlated with geophysical phenomena like cosmic ray bursts and ionospheric magnetic storms, by a scrutiny of a number of notable distinct phenomena recorded in the past. The pattern of more marked events concerning cosmic rays during five historic big solar flares in the last ten years were discussed critically. The terrestrial magnetic field and the atmosphere have been found to exert considerable influence on the incoming cosmic rays. The conditions obtaining at the probable source (e.g. sun) of the cosmic radiation, such as the position of the active region, evolution history, magnetic field, type and intensity of emission, need greater stressing.

It was concluded that in the case of big geomagnetic storms the particles might not have acquired as great a velocity before emission as in the case of those affecting cosmic rays. The asymmetry in the position of solar active regions which gives rise to big cosmic ray flares and the long history of chromospheric activity have shown that particles had a definite type of charge and could not have been of too small or too large an atomic number.

The last paper, presented by K. M. Kotadia of the Physical Research Laboratory, Ahmedabad, described the results of an empirical study of data recorded at a number of stations, e.g. Ahmedabad, Bombay, Delhi, Kodaikanal, etc., relating to changes in the  $F_2$  layer of low latitudes during magnetic disturbances, the  $S_D$  variation over a number of stations and the storm-time variation of  $f_0F_2$  at Ahmedabad.

# Liquids for Particle Size Analysis by Sedimentation Method

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**W**ITH increasing emphasis on a scientific approach to the solution of industrial problems, subjects like particle size studies have attained importance. The sedimentation method is commonly employed for particle size analysis in the range 1-80  $\mu$ . One of the important considerations is the choice of a suitable liquid for dispersing the particles<sup>1-4</sup>. This is also important in particle size distribution studies by elutriation, batch extraction, centrifugal sedimentation and liquid permeability methods.

The suitability of a liquid for use in the sedimentation method is judged by the extent to which it is able to disperse the particles of a given powder. This depends upon the physical and chemical properties of the liquid and the powder. In this paper, the available data on liquids suitable for a variety of powdered materials have been presented and the various factors involved in their selection have been critically assessed on the basis of the physico-chemical characteristics of the liquids and the powders. Also, the methods commonly employed for dispersing powders in liquids have been reviewed together with the tests employed for evaluating the degree of dispersion of the particles in a given quantity of the powder in the liquid.

In sedimentation studies, the Stokes' Law is used to evaluate the size of the particles, but the conditions implied in Stoke's Law are not generally satisfied. The concentration of the particles in the suspension should be small so that the influence of other particles and of the wall of the container on the motion of each particle is negligible. In the Andreasen pipette method, the concentration of particles is about 1 per cent by volume which has been observed by the authors to be high for flaky powders like graphite. A concentration of 0.2 per cent was found

suitable. When such small quantities of powders are used care should be taken in sampling them.

## Materials

The materials that have been studied so far can be broadly classified as follows: (1) metals, (2) oxides, (3) hydroxides, (4) carbonates, sulphates, arsenates, phosphates and silicates, (5) minerals, and (6) organic materials.

These materials vary considerably in their physical characteristics. They may be hydrophilic or hydrophobic in nature<sup>5</sup>. The choice of a liquid is governed to a certain extent by the density of the material. In dealing with powders of high density, it may not in every case be necessary to select liquids of high viscosity if the powder is very fine. Some difficulty is experienced with metal powders, e.g. those of iron, cobalt and nickel and some ferro-alloys, as these are magnetized in the earth's field, the effect being more pronounced as the size gets reduced<sup>1</sup>.

The sedimentation method cannot be applied to non-homogeneous powders. In the case of certain coals, alcoholic calcium chloride solution (0.1 mol/litre) was found to be a good dispersing agent<sup>6</sup>. Higher concentration of the dispersing agent results in the coagulation of particles. Alcoholic calcium chloride is not a suitable dispersing agent for all coals. In the case of some coals which are dispersed well in alcohol without the dispersing agent, addition of calcium chloride coagulates the particles. Catephoresis test explains this peculiar behaviour of calcium chloride towards different coals.

## Choice of liquid

A number of liquids, with suitable dispersing agents added when necessary, have

been used in sedimentation studies on different powdery materials. In Table 1 are listed some materials and the dispersing liquids best suited for them.

*Effect of density and viscosity of liquids* — The density of liquids used in such studies does not vary as much as the density of solid materials. The viscosity of different liquids, however, varies considerably and often this factor would govern the choice of liquids, especially when studying the size distribution of dense powders. Viscosity variation with temperature is appreciable, and hence the temperature should be maintained constant during an experiment which usually lasts for a few hours.

*Wetting property* — Powders have a tendency to stick together, and the liquids selected should be able to wet and disperse them. Proper wetting of a powder does not take place if the powder is contaminated with greasy or oily substances, particularly when sedimentation test is carried out in aqueous solutions<sup>5</sup>. Similarly hydrophilic powders may not be properly wetted by oils. The air absorbed by the powders also affects

proper wetting of the powders by the solvent<sup>50</sup>.

If the specific gravity of the material is sufficiently high, the powder would settle at the bottom, entrapping the air. This difficulty could be overcome by keeping the powder under vacuum for a sufficient length of time.

*Volatility* — In sedimentation studies, when the concentration of particles in the suspension is to be determined the liquid used is generally evaporated by heating. This requires that the liquid should be sufficiently volatile at higher temperatures. High vapour pressure of the liquid at room temperature is, at the same time, not desirable as the liquid may evaporate during the period of experiment.

Many liquids which may be suitable from the point of their high viscosity may not be suitable in practice due to their high boiling point. Benzyl alcohol, having a high viscosity, however, vaporizes completely at not very high temperatures<sup>19</sup>. To overcome the difficulty due to high boiling point of the liquid medium the suspension may be filtered

TABLE 1 — LIQUIDS AND DISPERSING AGENTS FOR DIFFERENT MATERIALS

MATERIAL	LIQUID AND DISPERSING AGENT*	MATERIAL	LIQUID AND DISPERSING AGENT*
Alumina	Water <sup>7</sup> ; water (Calgon, 0.1% <sup>8</sup> ); water (sodium tartrate, 0.1% <sup>8</sup> ); dilute hydrochloric acid (pH of suspension adjusted to 3) <sup>8</sup> ; carbon tetrachloride <sup>8</sup>	Calcium arsenate	Ethyl alcohol-water (1:1) <sup>8</sup>
Alumina dust	Water (sodium oxalate) <sup>9</sup>	Cryolite	Glycerol-water (1:4; v/v) <sup>8</sup>
Alundum	Water <sup>10</sup>	Calomel	Cyclohexanol <sup>10</sup>
Aluminium powder (sp. gr. 2.5)	Isopropanol <sup>11</sup> ; chloroform <sup>12</sup>	Coal	Water (Aerosol OT, $\frac{1}{2}$ % <sup>16</sup> ); water (sodium linoleate <sup>16</sup> and sulphonated loral, 1% <sup>17</sup> ); ethyl alcohol (calcium chloride, 0.1 mol/litre) <sup>8</sup> ; ethyl alcohol <sup>18</sup> ; ethyl industrial absolute alcohol <sup>18</sup> ; xylene <sup>18</sup> ; alcohol-water mixture (1:1) <sup>19</sup> ; acetone or petroleum <sup>16</sup>
Anthracite	Water (Perminal BX, 0.1% <sup>8</sup> )	Clay	Water <sup>11</sup> ; water (sodium oxalate) <sup>16</sup> ; distilled water (sodium silicate, 2%) <sup>15</sup>
Barytes	Water (sodium pyrophosphate, 0.001-0.005 mol/litre) <sup>13</sup>	Copper	Water <sup>8</sup> ; acetone <sup>10</sup> ; rape oil <sup>10</sup> ; rape oil + acetone <sup>20</sup> ; soyabean oil + acetone (1:1) <sup>8</sup>
Barium carbonate (precipitated)	Methyl alcohol <sup>8</sup>	Cobalt metal	Ethyl alcohol, 95% <sup>8</sup> ; rape oil + acetone <sup>20</sup>
Barium strontium carbonate	Water-ethyl alcohol mixture <sup>7</sup>	Chalk	Water (sodium silicate, 2%) <sup>16</sup> ; water (potassium citrate, 0.1 g./mol) <sup>10</sup> ; acetone or petroleum <sup>16</sup>
Bronze powder	Cyclohexanol <sup>10</sup>	Chalk (precipitated)	Isopropanol <sup>22</sup>
Chromic oxide	Water (sodium pyrophosphate, 0.001-0.005 mol/litre) <sup>13</sup>	Cocoa	Isobutyl alcohol <sup>16</sup> ; diethyl ester of phthalic acid <sup>16</sup>
Colours (mineral)	Water (potassium citrate, 0.1 mol/litre) <sup>8</sup>	Coke	Water (Perminal BX, 0.1% <sup>8</sup> ); distilled water (tannic acid, 0.5 g./litre <sup>23</sup> and ammonia, 0.88-3.5 ml./litre) <sup>23</sup>
Carbon black	Water (Aerosol OT, 1% <sup>14</sup> ); gallo-tannic acid <sup>10</sup>		
Calcium carbonate	Water <sup>11</sup> ; xylene <sup>15</sup>		
Calcium carbonate (precipitated)	Water (sodium pyrophosphate, 0.005 mol/litre) <sup>8</sup>		

\*Where a dispersing agent is used, it is given along with its concentration within parenthesis.

TABLE 1 — LIQUIDS AND DISPERSING AGENTS FOR DIFFERENT MATERIALS — *contd.*

MATERIAL	LIQUID AND DISPERSING AGENT*	MATERIAL	LIQUID AND DISPERSING AGENT*
Cement	Water <sup>27</sup> ; kerosene (oleic acid) <sup>24</sup> ; benzene <sup>27</sup> ; isopropanol <sup>22</sup> ; ethylene glycol <sup>16</sup> (calcium chloride) <sup>24</sup> ; absolute alcohol (anhydrous calcium chloride) <sup>25</sup> ; methyl alcohol (sodium pyrophosphate) <sup>8,24</sup> ; butyl alcohol <sup>28</sup>	Mineral colours	Water (potassium citrate, 0.1 mol/litre) <sup>14</sup>
Alumina cement	Glycol (cobalt chloride) <sup>10,28</sup> ; ethylene glycol (cobalt chloride) <sup>16</sup>	Moulding sand	Distilled water (sodium hydroxide) <sup>40</sup>
Portland cement	Ethyl alcohol <sup>18</sup> ; butyl alcohol <sup>18</sup> ; benzyl alcohol <sup>18</sup> ; glycol <sup>10,28</sup> ; castor oil <sup>10</sup> ; paraffin oil <sup>10</sup>	Molybdenum powder	Ethyl alcohol <sup>8</sup> ; acetone <sup>8</sup> ; glycerol <sup>12</sup> ; glycerol + water <sup>3</sup>
Diamond powder	Olive oil <sup>29</sup> ; water (gelatine, 0.1-0.2% and sodium carbonate) <sup>8,30</sup>	Nickel powder	Rape oil + acetone <sup>20</sup>
Dicalcium phosphate	Water <sup>11,21</sup> and alcohol <sup>21</sup>	Phosphorus	Water (Daxad 23, 0.02% <sup>43</sup> and potassium silicate, 0.1%) <sup>8</sup>
Felspar	Water (sodium oxalate) <sup>9</sup>	Pigments	Water (sodium pyrophosphate) <sup>14</sup> ; isopropanol <sup>22</sup>
Flint	do	Plaster (Stucco)	Alcohol-glycol (potassium citrate) <sup>16</sup> ; water (potassium citrate, 0.1 mol/litre) <sup>8</sup>
Flours	Isobutyl alcohol <sup>14</sup> ; isobutyl alcohol + diethyl phthalate <sup>8</sup> ; diethyl ester of phthalic acid <sup>16</sup> ; petrol <sup>22</sup>	Pumicite	Water <sup>11</sup>
Fluorite	Water (gelatine, 0.1-0.25% and sodium carbonate) <sup>30</sup>	Pulp	Water (sodium silicate, 1 part in 4000 parts of liquid) <sup>21</sup>
Fluorspar	Dilute nitric acid (0.002N) <sup>8</sup> ; methyl alcohol (potassium chloride, 0.001M) <sup>8</sup>	Quartz	Water (sodium oxalate) <sup>9</sup>
Fly ash	Water <sup>11</sup>	Red lead	Paint prepared in linseed oil and dispersed in white spirit (aluminium stearate) <sup>45</sup>
Glass powder or spheres	Water <sup>33</sup> ; water + ethylene glycol <sup>33</sup> ; butyl alcohol <sup>25,34</sup> ; methanol <sup>33</sup>	Red phosphor (4% concentration)	Methylated spirit <sup>20</sup>
Graphite	Water (Aerosol OT, 1%) <sup>8,10</sup> ; ammonia, 0.880-3.5 ml./litre <sup>23</sup> and sodium linoleate <sup>18</sup> ; distilled water (tannic acid, 0.5 g./litre) <sup>8,23</sup> ; ethyl alcohol <sup>8</sup>	Sand	Water <sup>33,46</sup> ; distilled water (sodium silicate, 2%) <sup>18</sup> ; butyl phthalate + alcohol <sup>46</sup>
Glass powder (colloidal)	Lignin <sup>10</sup>	Silica	Water <sup>11,25</sup> ; water (sodium pyrophosphate, 0.133% <sup>14</sup> , 0.005 mol/litre <sup>16</sup> , sodium oxalate, N/100 <sup>8</sup> and Calgon, 0.1% <sup>10</sup> ); water + alcohol(1:1) <sup>16</sup> ; xylene <sup>42</sup>
Gypsum	Alcohol (calcium chloride, 0.1 mol/litre) <sup>8,8</sup> ; glycol (cobalt citrate) <sup>10</sup> ; ethylene glycol (cobalt citrate) <sup>16</sup>	Silicates	Water (sodium pyrophosphate, 0.005 mol/litre) <sup>16</sup> ; water + ethyl alcohol (1:1) <sup>8</sup>
Haematite	Water <sup>35</sup>	Sillimanite	Water + ethyl alcohol (1:1) <sup>10</sup> ; water (sodium pyrophosphate, 0.055 mol/litre) <sup>16</sup>
Hydrated lime	Ethyl alcohol <sup>16</sup> ; isopropanol <sup>22</sup>	Shales	Alcohol (calcium chloride) <sup>6</sup>
Ilmenite	Water <sup>37</sup>	Slag (cement)	Isopropanol <sup>11</sup> ; water <sup>11</sup>
Iron and iron alloys	Rape oil + acetone <sup>20</sup>	Starch	Isobutyl alcohol <sup>14</sup> ; diethyl ester of phthalic acid <sup>14</sup> ; isobutyl alcohol + diethyl phthalate <sup>8</sup>
Iron metal	Soyabean oil + acetone (1:1 by volume) <sup>8</sup>	Soils	Water <sup>46</sup> ; water (sodium oxalate, N/100 <sup>8,16</sup> and 2% <sup>10</sup> ); butyl phthalate + alcohol <sup>46</sup>
Kaolin	Water (sodium pyrophosphate, 0.005 mol/litre <sup>8</sup> and sodium silicate, 0.1%) <sup>8</sup> ; water (ammonia, a few drops, if necessary) <sup>10</sup>	Sugar	Isobutyl alcohol <sup>14</sup> ; diethyl ester of phthalic acid <sup>16</sup>
Lead	Acetone <sup>21</sup> ; water <sup>35</sup>	Sulphides	Water (saponin) <sup>47</sup>
Lead monoxide	Xylene <sup>15</sup>	Tin	Butyl alcohol <sup>7,8,10</sup>
Lignite	Isobutyl alcohol <sup>16</sup> ; diethyl ester of phthalic acid <sup>16</sup>	Titanium	Water (Calgon, 0.1%) <sup>10</sup>
Limestone dust	Water (sodium pyrophosphate, 0.005 mol/litre <sup>8</sup> and sodium silicate, 0.2%) <sup>18</sup> ; distilled water (sodium silicate, 2% <sup>8</sup> and potassium citrate, 0.1 mol/litre) <sup>8</sup> ; glycerol + water (1:4 by volume) <sup>8</sup>	Tricalcium phosphate	Water <sup>11</sup>
Lithophone	Glycerine <sup>38</sup>	Tungsten	Glycerol <sup>12</sup> ; acetone + rape oil <sup>8</sup> ; ethyl alcohol <sup>9</sup>
Manganese dioxide (pyrolusite)	Water (sodium pyrophosphate, 0.001-0.005 mol/litre) <sup>13</sup>	Tungsten carbide	Oil <sup>48</sup>
Magnesite (burnt)	Ethylene glycol <sup>8,16</sup>	Zinc	Ethyl alcohol <sup>10,25</sup> ; butyl alcohol <sup>7,8,10</sup> ; acetone <sup>10,21,25</sup>
Magnetite powder	Water <sup>39</sup> ; ethyl alcohol <sup>39</sup> ; methyl alcohol <sup>39</sup> ; nitrobenzene <sup>29</sup>	Zinc oxide (pigment)	Water (sodium hexametaphosphate, 0.5-1.0 g./litre) <sup>49</sup>
		Zircon	Water <sup>37</sup> ; water (sodium pyrophosphate, 0.005 mol/litre) <sup>8,14</sup> ; water + alcohol (1:1) <sup>44</sup>
		Zirconium metal	Methyl alcohol (hydrochloric acid, N/100) <sup>8</sup>

\*Where a dispersing agent is used, it is given along with its concentration within parenthesis.

or centrifuged, care being taken to see that the liquid used for sedimentation studies is completely washed out by solvents of low boiling point.

*Reactivity of liquid* — The liquid selected should not react with the powder at the working temperatures and it should not have a toxic effect on the workers.

*Transparency of liquid* — For photo-sedimentation work the liquid should be transparent to visible light and its refractive index should be significantly different from that of the powder<sup>51</sup>.

### Methods of dispersion

*Mechanical dispersion* — In rare cases only, complete dispersion is achieved. In the Wagner turbidimeter, for dispersing cement in kerosene, the suspension is kept in a test tube and stirred with a brush rotating at a speed of approximately 3500 r.p.m.<sup>52</sup>. In the method used by Parker and Nurse<sup>53</sup>, cement powder with a few drops of kerosene was rubbed out on a tile with a palette knife. The suspension was then shaken in a rotary shaker. Dispersion is sometimes effected by agitating the suspension by blowing air. This method has the disadvantage that air bubbles are formed and the temperature of the suspension rises.

Baddeley and others<sup>54</sup> found that an electrically driven stirrer disperses carbon black in toluene more efficiently than vigorous shaking by hand. Ultrasonic waves were found to be most effective.

*Surface active agents* — Surface active agents are used to obtain good dispersion but if the quantity added is more, flocculation takes place<sup>55</sup>. The dispersing agent that shows the maximum amount of fines may be considered suitable.

The way in which a surface active agent helps to disperse the powder is not well understood. In aqueous solutions, the addition of surface active agents may cause a lowering of the surface tension resulting in more complete wetting of the particles by the liquid media<sup>56</sup>. Wetting of the solid helps in displacing the adsorbed air from the surface.

Sometimes, surface active agents do not lower the surface tension to a marked extent, but still they help in dispersing the powder, perhaps due to their behaviour like a protective colloid<sup>56</sup>. In aqueous solutions ion-exchange reactions may take place and

the particles may carry electric charges and form a stable suspension. When polyvalent ions of opposite charges are added, flocculation results. Sodium hexametaphosphate is known to prevent the flocculating effect of these polyvalent ions on suspended particles. In non-aqueous media, the ionic reaction may be neglected. The dispersion of powder may be due to the lowering of the interfacial tension between the particle and the liquid media by the surface active agent.

### Tests for dispersion

For judging the dispersion of a powder the following tests have been used.

*Microscopic examination* — When a small drop of the suspension is examined under a microscope the individual particles are seen separately if the dispersion is complete. When a large variation in the particle size exists in the powder it is difficult to carry out this test as the large and the small particles cannot be focussed simultaneously.

*Rheological test* — This test, which is used for paints, was described by Daniel and Goldman<sup>57</sup> and by Amstein and Scott<sup>58</sup>. A weighed quantity of the powder is taken on a glazed tile and the liquid is slowly added to it from a burette. The powder is worked into a paste with a flexible spatula. The wet point, i.e. when the powder can be scraped into a single compact mass, is determined. Addition of more liquid makes the mass flow. This is called the flow point of the paste. The burette reading is again noted. If the dispersion is good only a small amount of the liquid is necessary for a change from the wet point to the flow point. Daniel and Goldman point out that between the wet and the flow points if the paste is tapped with a spatula, it flows in long honey-like strings if the dispersion is good, otherwise it rises on the spatula blade in a characteristic scroll-like form. When the dispersion is good the paste gives a bright appearance, while its appearance is dull with poor dispersion. However, the concentration of the suspension in sedimentation tests is much lower than that employed in the above test.

*Volume test* — This test depends upon the nature of the powder, the liquid and the dispersing agent used.

The sedimentation volume of a solid has been correlated with the different properties of liquids such as (1) interfacial tension,



(2) polarity, and (3) adhesion tension of the solids against the liquid<sup>5</sup>.

This test consists in taking a known quantity of the powder in a fixed volume of the liquid, shaking the two thoroughly and allowing all the powder to settle down. The sedimented volume of the powder is minimum in the liquid which wets and disperses the powder best<sup>59</sup>. The volume of the sediment depends upon the degree of deformation of the particles under the weight of the layers above them. If the adhesion between the particles is great and the liquid is not able to break up this adhesion, the particles offer considerable resistance to deformation under the weight of the upper layers and thus present a large sedimented volume.

Ostwald and Haller<sup>60</sup> found that the sedimentation volume is related to the dielectric constant of the liquid medium and is lower in a liquid having a high dielectric constant. Liquids having high dielectric constant are strongly adsorbed on the solid particles. This reduces the interfacial tension between the solid particles and the liquid and also the adhesion tension between the particles themselves. Thus, a low sedimentation volume is obtained.

*Viscosity determination method*—In the case of clay-water systems where maximum dispersion of the clay particles in water is desired, dispersing agents such as sodium hexametaphosphate, sodium tetrphosphate and tetrasodium pyrophosphate are used<sup>61,62</sup>. In some cases dispersion is improved by the addition of a small quantity of a strong alkali, such as soda ash or caustic soda. The flow of the suspension depends upon the freedom with which the dispersed particles move. One of the methods of judging this freedom is the measurement of the viscosity of the suspension.

The dispersion of the system depends upon the amount of the dispersing agent and is maximum for a particular value of the dispersing agent which can be determined by measuring the fluidity of the clay-water suspension. The fluidity is maximum when the dispersion is maximum with any particular dispersing agent.

Green<sup>63</sup> and Gauge<sup>64</sup> have suggested similar methods for testing the dispersion of powders. Green states that when a small amount of a deflocculated dispersion is placed on an inclined glass plate, it will ordinarily flow out and present a uniform

layer. A flocculated suspension, on the other hand, will form a streaky layer with an uneven, lumpy appearance, often described as 'poor dispersion'.

Gauge<sup>65</sup> suggests the use of a concentrated dispersion for the study of the flow properties of a powder. The adhesion tension between the material and the liquid medium is great compared with the cohesion tension between the particles which is the criterion for good wetting.

*Light extinction test*—With the light extinction sedimentometer, Heywood measured the specific surface of powders by taking a single reading when the particles are in random motion and by calculating the value from readings taken throughout the settlement time of a powder<sup>65</sup>. The ratio of the two readings was between 1.4 and 1.6 when no agglomeration occurred. A ratio greater than 2 indicated flocculation of the particles.

Skinner *et al.*<sup>59</sup> have used a method which involves taking only one reading for the determination of specific surface of a powder. Better dispersion gives a higher value of specific surface. In particle size analysis the liquid showing a greater proportion of fine powder in the results is the most suitable for dispersing the powder. Where dispersion is poor, fine particles agglomerate and the size analysis results show an excess of coarser particles.

*Specific surface by dry method*—The specific surface of powders can be determined by a dry method such as the air permeability method. If there is a large difference in the value obtained by this method and that by the sedimentation method, the dispersion is poor.

It has been noticed that some powders become more dispersed with time while others show agglomeration. This effect has been observed with a number of powders in aqueous media and in organic liquids, both polar and non-polar. In carrying out these tests the importance of this effect cannot be overlooked.

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## Studies on Varietal Suitability of Fruits for Preservation by Canning: Part I—Mangoes

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Studies on the canning of three important varieties of mangoes, viz. *Fazli*, *Langra* and *Himsagar*, available in West Bengal have shown that *Himsagar* is best suited for canning. An acceptable product, which can be stored for 6 months without deterioration, is obtained by canning the fruit in 50 per cent sugar syrup. *Langra* also gives a satisfactory product when it is canned in 35 per cent sugar syrup containing 0.25 per cent citric acid but the flavour of the canned product deteriorates after 5 months. *Fazli* is least suited for canning as the flavour of the canned product deteriorates rapidly in whatever manner it is preserved.

MANGO is the most important fruit crop in India. It has a relatively short season. Canned mango, either as slices or as pulp, is likely to have a good market, and large-scale canning of mango can help in saving a portion of the mango crop which goes waste in the glut season.

However, all varieties of mango are not suitable for canning. During processing and subsequent storage, some varieties lose their delicate colour while others develop off-flavour or get disintegrated.

Very little work has been reported on the canning of different varieties of mango in India. Siddappa and Bhatia<sup>1</sup>, working on three South Indian varieties, viz. *Badami*, *Raspauri* and *Neelum*, studied the effect of pH on processing; the effect of adding citric acid to syrup was also investigated. Dhopesharkar and Magar<sup>2</sup> have examined the loss of carotene in canned mango during processing and storage.

The present investigation was undertaken to find out the variety of mango best suited for canning with respect to flavour, colour and retention of carotene from among the three important West Bengal varieties, *Fazli*, *Langra* and *Himsagar*.

### Materials and methods

*Fazli* mangoes (av. wt. 15 oz.) were obtained through the courtesy of Malda Mango Merchants' Association and *Langra* (av. wt. 12.7 oz.) and *Himsagar* (av. wt. 7 oz.) were bought from the local market. *Fazli* mangoes do not ripen uniformly; one side of the mango ripens earlier while the other remains green. *Himsagar* and *Langra* varieties were in the firm ripe stage. The fruits were peeled, sliced to remove the stones and the slices used for canning. The processing loss in different varieties was: *Langra*, 23.8; *Fazli*, 29.5; and *Himsagar*, 30.5 per cent on the original weight of fruit. Carotene loss was negligible during processing. The fruit was canned in 310 × 309 size unlacquered tin cans. Sugar syrup, with and without citric acid, was used for covering the slices. The cans were steam exhausted, sealed and processed at 2 lb./sq. in. for 15 min.

The concentrations of sugar in syrup and of citric acid in it varied as follows:

*Langra* — 35 and 50 per cent sugar syrup, with and without the addition of 0.25 per cent citric acid.

*Fazli* — 35 and 50 per cent sugar syrup, with and without the addition of 0.25 and 0.50 per cent citric acid.

*Himsagar* — 50 per cent sugar syrup alone.

The fruit slices canned in the syrup were stored at room temperature (25°-31°C.) for 3, 5 and 6 months. A Waring blender was used for preparing pulp from the slices.

The acidity of the syrup and of the mango slices was determined by titration with N/50 sodium hydroxide solution. Sucrose in the syrup was estimated according to A.O.A.C. method<sup>3</sup>. The method followed for carotene determination was essentially the same as that recommended by A.O.A.C. except for the modifications suggested by Austin and Shipton<sup>4</sup>; aqueous alcoholic potash was used to avoid resinification.

The mango slices and the syrup from the cans were analysed after different periods of storage for their pH, acidity (in terms of citric acid), sugar (dextrose equivalent) content, before and after inversion, and carotene content.

Organoleptic tests were carried out with the stored products to determine their quality and acceptability.

The texture, colour, flavour and taste characteristics of the products were deter-

mined employing a test panel of five members of the laboratory staff.

### Results and discussion

The characteristics of fresh pulp from different varieties of mango are recorded in Table 1.

The results of analytical and organoleptic tests showed that *Himsagar* variety gives the best canned product when canned in 50 per cent sugar syrup (pH at the end of 3 months, 4.23; acidity, 0.49 per cent). Slices stored for 3 months were as firm as the fresh ones and at the end of 6 months they were only slightly softer. The colour of the product was similar to that of the fresh slices; the stored slices had a pleasing flavour and a sweet and agreeable taste. The carotene content of the slices stored for 3, 5 and 6 months was 4.64, 4.21 and 4.06 mg./100 g. respectively as compared to 5.92 mg./100 g. of the original slices; the loss was maximum (30 per cent) during the first 3 months.

In the case of *Langra* variety, canning with 35 per cent cane sugar syrup containing 0.25 per cent citric acid (pH, 4.07; acidity, 1.71) was found to give the best results. The colour of the slices was fairly well preserved and taste agreeable, but there was considerable deterioration in flavour and by the end of 5 months the product developed an off-flavour. The carotene content of slices stored for 3, 5 and 6 months was 5.13, 4.01 and 4.10 mg./100 g. respectively as compared to 8.75 of the original slices; the loss during the first 3 months was 40 per cent.

The flavour of canned product in the case of *Fazli* variety was found to deteriorate considerably in whatever manner it was canned; the syrupy flavour of the product was increasingly prominent on storage; the colour of the slices also faded slightly. The taste of the product after storage for different periods was acidic and disagreeable

TABLE 1 — CHARACTERISTICS OF FRESH PULP

(Average of 10 estimations)

MANGO VARIETY	pH OF PULP	ACIDITY (CITRIC ACID) %	SUGAR (DEXTRSE EQUIV.)		CAROTENE mg./100 g. pulp
			Before inversion %	After inversion %	
<i>Langra</i>	4.01	3.830	16.30	103.00	8.75
<i>Fazli</i>	3.61	5.520	22.04	35.20	2.92
<i>Himsagar</i>	4.24	0.825	—	94.40	5.92

and it was not suitable for consumption. The best product was obtained by canning the slices in 35 per cent sugar syrup containing 0.25 per cent citric acid ( $pH$ , 4.27; acidity, 1.08 per cent). The loss in carotene content by the end of 3 months was 40 per cent of the original. The loss in the carotene content of the fruit slices was marked during the first 3 months of storage and thereafter it continued at a slower rate. The  $pH$  and acidity of the syrup and the fruit slices in different cans did not show any significant variation when stored for different intervals.

The leaching of acids from the fruit slices takes place even when 0.5 per cent (w/v) citric acid is present in the syrup and an equilibrium is reached between acid contents of fruits and the syrup just after processing and is maintained throughout the storage

period. The same was observed in the case of sugar content.

Inversion of cane sugar in the syrup is rapid in the initial stages and continues at a decreasing rate during storage.

#### Acknowledgement

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## Index to Scientific Journals

THE *Journal of Scientific & Industrial Research* is among the 510 periodicals that are being indexed by subject and author in a new publication announced recently by the Micro-Photography Co., 97 Oliver Street, Boston 10, Massachusetts.

The primary subjects included in these indexes are solid state physics, nucleonics, radiation, optics, mechanics, astrophysics, radio, electronics, sound, astronomy, rockets, guided missiles, artificial satellites and space travel. These indexes, comprising several

hundred thousand entries, have been compiled by the Library of the U.S. Naval Research Laboratory.

The original index cards are to be reproduced in book form by offset printing, 21 cards per page, 10 × 14 in. Author and subject sections, and the monthly, quarterly and annual supplements to each, can be purchased separately.

The publication will be available only to those who subscribe in advance of printing, which will start in the third quarter of this year.

# REVIEWS

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PRINCIPLES OF THE PROPERTIES OF MATERIALS — McGraw-Hill Series in Engineering Sciences by Jacob Porter Frankel (McGraw-Hill Book Co. Inc., New York), 1957. Pp. xv + 228. Price \$ 6.00

This book is said to be the result of experience gained in preparing lectures on the properties of materials for young American engineers at the North-Western Technological Institute, U.S.A. The reader is expected to be familiar with the elements of atomic theory and to have covered about one university year in general inorganic chemistry, mechanics, and elementary calculus.

It is an unusual book: it constitutes a new approach to the rapidly expanding subject of properties of materials. Emphasis is laid on principles in order to cover the great variety of problems which the engineer now meets in the study of metals, concrete, wood, plastics, or other materials. This treatment has the advantage that with the advent of new materials — and they are continually arriving — the engineer or technologist does not enter upon an entirely new field, but is able to apply basic knowledge to the problems. It is the claim of the author that "the engineers who will break through the barriers to the solution of current materials problems will be those who understand properties first and materials second".

After an introduction dealing with materials and applied mechanics, and indicating the scope of mechanical and thermodynamic analysis, we have the two main divisions, the first dealing with 'physico-chemical foundations', and the second with the 'properties of matter'. The first division treats of such subjects as basic atomic theory, radiation, the laws of thermodynamics, distribution of energy, structure and thermal analysis, cohesion and bonding forces, metals and their general characteristics — with brief references to the indeterminacy principle and free electron energies. In the second and larger division we have chapters on conductivity, heating, diffusivity, electrochemistry, elasticity, plasticity, fracture, viscosity, and finally some general considera-

tions on isotropy, texture, grain boundaries, and structure sensitivity. There is a useful index.

Although the work is presented as an introduction to the subject for engineers and technologists, most of those who have gone through their degree course will nevertheless gain much from this book. No claim has been made by the author that his treatment is comprehensive, yet at each step it is logical and stimulating. The volume forms an excellent approach for advanced studies: it is provocative of thought, and original in outlook and conception. It is recommended not only to the serious student who plans to make the study of materials his profession, but also to all engineers who wish to have an intelligent understanding of materials — sufficient for the appreciation of the subtlety of many of the problems involved. It will require two or three readings by the engineer or technologist who wishes to gain full benefit and achieve the new outlook which the author advocates. But the effort will be worthwhile.

J.W.W.

PATENT NOTES FOR ENGINEERS by C. D. Tuska (McGraw-Hill Book Co. Inc., New York), Seventh Edition, 1956. Pp. vi + 192. Price \$ 4.00

This is a useful book for engineers, research workers and inventors generally, as well as for patent attorneys and others who have to deal with patent matters. The book will be particularly useful for Indian inventors who wish to take out patents in the U.S.A., and, therefore, need to know basic facts about patentable inventions, patent office procedure, and certain statutory and practical aspects concerned with acquiring and dealing with valuable patent rights.

The chapter on Statutory Inventions is of particular interest. U.S. Patent Law does not provide a definition of statutory invention and no one can say with certainty precisely what constitutes invention. Invention has been defined negatively by the U.S. courts. For instance, the exercise of ordinary skill does not involve invention nor

does the substitution of superior material, which is not new, for the inferior material previously employed, constitute invention. There are many such so-called 'negative rules of invention'. But more interesting are the exceptions to the 'negative rules'. "Perhaps the most famous exception to the rule that mere changes in form, proportions, degree or arrangement do not involve invention, is found in the decision involving the Edison Incandescent Lamp Patent." The earlier electric lamps had filaments having a diameter of the order of  $1/32$ nd of an inch. The Edison lamp differed from the earlier carbon filaments only in the diameter of the filament being  $1/64$ th of an inch or less. In holding the Edison lamp valid, the court remarked, "... in a sense it may be said ... that it is a matter of degree. But the degree of difference between carbons that lasted one hour and carbons that lasted hundreds of hours seems to have been precisely the difference between failure and success." Indian and English courts have also stressed the principle that mere simplicity is not necessarily an objection to the grant of a patent, though matters of ordinary skilled designing or mere workshop improvements are not inventions.

Numerous legal requirements concerning patentable invention are logically and clearly outlined in the book. Some of these constitute departures from Indian Patent Law; for instance, plant patents are granted in the U.S.A., but not in India; an invention cannot be patented in India if it has been publicly used in India or has been made publicly known in any part of India, but in the U.S.A., a patent application may be filed even after an invention has been described in a printed publication or has been publicly used or sold in the U.S.A., provided the application is filed within one year of such publication or sale. Again, after the lapse of one year from the date of filing in a foreign country, no patent can be obtained in the U.S.A. if the foreign patent is already sealed before the U.S. application is filed. Another U.S. requirement is that the inventor himself must apply for a patent, whereas in India and in many other countries, it is possible to file a patent application without mentioning the inventor as an applicant.

The author devotes considerable attention to the question of keeping adequate records of invention. These have an important bearing

on 'Interference' proceedings which are instituted under the U.S. Patent Law for determining the priority of invention between two or more parties claiming substantially the same patentable invention. Every inventor is advised to prepare promptly adequate written descriptions of his inventions, and to keep proper evidence of the conception of the invention and its reduction to practice. The legal importance of diligence on the part of the inventor in reducing the invention to practice, actually or constructively, is stressed. The Indian inventor should, however, note that before filing a patent application in India, the invention should not, except under certain special conditions, be publicly used in India or made publicly known in India, e.g. by giving public demonstrations of the invention or publishing descriptions of the invention.

The book provides valuable information on the methods adopted by organizations in dealing with inventions submitted by outsiders. Policies and regulations vary greatly throughout industry, but many of the nationally organized concerns have written policies and procedures for controlling such disclosures. Many companies have booklets setting forth their policies and a representative policy statement is reproduced in the book. A general hint is that if an outsider believes that he has made an invention, the preferred practice would be for him to consult a patent attorney, obtain a patent and then send the outside organization a copy of the issued patent.

The final chapter of the book contains a discussion of the problems connected with the ownership and use of patents. Useful information is given on employer-employee agreements dealing with the right to inventions made during the course of employment, and the RCA employee invention agreement is reproduced by way of illustration.

R. B. PAI

THE FREEZING PRESERVATION OF FOODS.  
VOL. I. FREEZING OF FRESH FOODS by  
Donald K. Tressler & Clifford F. Evers  
(The Avi Publishing Co. Inc., Westport,  
Conn.), Third Revised Edition, 1957.  
Pp. xxi + 1214

The technology of food freezing has advanced so rapidly during the decade since the publication of the last edition of this treatise in 1947 that the authors have found it necessary



not only to revise and rewrite the book but also to present it in two volumes. The current volume is devoted to the freezing of uncooked foods including fruit juices and concentrates. Vol. II, to appear, will deal with the freezing preservation of prepared and precooked foods of all kinds.

Many of the 31 chapters in the book contain information that has not been readily or completely available hitherto. Among them are those relating to dehydro-freezing of fruits and vegetables, the freezing concentration of fruit juices and the preparation and freezing of meat, poultry, fish and game. There are chapters devoted to frozen food locker plants, home food freezing and storage equipment, marketing, warehousing and transport of frozen foods, packaging materials and problems, and plant sanitation. A number of specialists in different branches of the subject have collaborated as co-authors of certain chapters. This arrangement has helped in making available information on the latest developments, methods and machinery as well as in indicating the advantages and disadvantages of different types of refrigeration procedures.

The development of freezing techniques has grown steadily with the needs of individual foodstuffs and hence most of the information that has accumulated is somewhat empirical. However, the authors have successfully attempted to derive basic generalizations. Thus, the chapter on changes occurring during the preparation, freezing, cold storage and thawing of foods discusses in detail the chemical, physico-chemical and biological changes which such foodstuffs may undergo and underlines the precautions to be observed for obtaining an ideal frozen food.

Since freezing preservation has been developed to its present enormous stature largely through work in the U.S.A., most of the research publications have come from that country. It is, therefore, natural that the book caters more to the needs of U.S. manufacturers, research workers and others interested in this field. Thus, the chapters on adaptability of fruit and vegetable varieties to freezing are based entirely on data pertaining to the American produce.

The entire subject matter is dealt with from the standpoints alike of the machinery manufacturer, the chemical engineer, the food technologist, the wholesale and retail distributors and the consumer. This treatment

has its merits which should far outweigh a possible lack of sustained interest to any one category of reader. Each chapter has a complete bibliography and the book is plentifully illustrated throughout. There is an appendix, in six parts, dealing with objective tests and methods for quality and bacterial control. The authors have undoubtedly accomplished a big task in bringing together within the confines of one volume a vast amount of valuable information on the freezing preservation of fresh uncooked foods.

A. SREENIVASAN

ELECTRICAL DISCHARGES IN GASES — Philips' Technical Library Series by (late) F. M. Penning (N.V. Philips' Gloeilampenfabrieken, Eindhoven), First Edition, 1957. Pp. viii + 78. Price Rs. 11.75

The developments that have taken place since the introduction of the Crookes' tube and the recent developments in X-ray bulbs, sodium and mercury vapour and other types of fluorescent lamps, rectifiers, photocells, welding arcs, stabilizers, high tension indicators, and the various 'counters', are manifold. This is amply illustrated by over 300 publications a year on these subjects (p. 3). The appearance, therefore, of the English edition (preceded by the German and French) of the publication *Electrische Gasontladungen*, first published in Dutch language in 1955, will be welcomed by many workers in this field. The work is valuable since F. M. Penning is one of the distinguished investigators in the field of discharge physics.

The presentation in this volume, however, does not quite follow the familiar sequence of development, nor does it review representatively the immense factual and theoretical material available. The book reflects rather the nature and the trend of investigations carried out at the Philips' laboratories at Eindhoven in which the author had an important share. Its main scope is indicated by the following titles of some of the chapters: Conduction of electricity in metals and gases; Non-self-sustaining discharges; Movement of electrons and ions through a gas; Townsend discharge and breakdown; Spark, lightning and glow discharge; Arc, and the Positive column. Everyone of these sections presents a readable and clear account, and well-selected examples and sketches illustrative of the kinetics of the chief discharge mechanisms are presented.



The classical theories of the Townsend discharge, the normal and abnormal cathode fall, the space charge distortion of the energizing field and the more recent streamer mechanism have been set forth with a remarkable combination of detail and brevity. This is pronounced in the discussion of the optical effects and the spectroscopic background of the discharge phenomena; and especially, for example, in the discussion of the ion-multiplication processes in the neon-argon mixtures. The reader, however, misses reference to the well-known Penning effect, viz. a rise of the breakdown potential of the medium due to destruction by the selective absorption of external radiation of the ionizing 'metastables' produced in the gas mixture by the operative field.

The book is clearly the result of much critical and eclectic thought, and active, first-hand experience. It is sure to prove a valuable companion alike to postgraduates and research workers in the field of electrical discharge.

S. S. JOSHI

LECTURES IN IMMUNOCHEMISTRY by Michael Heidelberger (Academic Press, New York), 1956. Pp. ix + 150. Price \$ 4.00

The book is a collection of six lectures delivered by Prof. M. Heidelberger in Tokyo in 1955 together with three others delivered earlier in Europe.

Immunochemistry has, in recent years, become a rapidly growing branch of science in its own right. It makes use of precise analytical methods drawn from biochemistry, organic chemistry and physical chemistry, and applies them in the study of immunology. It is interesting to read in the book how, in the early days, chemists were discouraged from taking any interest in immunology. However, thanks to Prof. Heidelberger and his school, this new borderline science of immunochemistry is well established.

The book describes in some detail the early work of Prof. Heidelberger and his colleagues. However, the reader would be disappointed if he expects in the book a review of recent developments in immunochemistry. Chapter V, on relations between chemical constitution and immunological specificity, is very sketchy and Landsteiner's work in this field is not even mentioned. The book will be of interest to beginners since it is written by a pioneer in

the subject. For advanced research workers, the material presented is elementary.

S. S. RAO

PLASTICIZERS by D. N. Buttery (Cleaver-Hume Press Ltd., London), Second Edition, 1957. Pp. 213. Price 35s.

Since the publication of the first edition of this very useful book in 1950, considerable progress has been made in the field of plasticizers, particularly as applied to vinyl resins. Though, there is a larger number of new plasticizers developed and there is a wide choice, it is obvious that for many years to come the earlier materials will not cease to be important.

In the present edition, the author has retained in entirety, the first seven chapters as also the ninth chapter of the first edition dealing with phthalate esters, phosphoric acid derivatives, glycerol and glycol derivatives and miscellaneous esters, esters of adipic and sebacic acids, fatty acid esters, esters of abietic and ricinoleic acids, toluene sulphonic acid derivatives and miscellaneous plasticizers. There has been a slight addition to the eighth chapter dealing with diphenyl derivatives while the tenth dealing with hydrocarbons and aromatic extenders has been enlarged considerably. The eleventh chapter in the earlier edition on the function of the plasticizers has been deleted and in its place two new chapters, extending over 50 pages, on high molecular weight plasticizers and new esters and miscellaneous plasticizers have been introduced. These chapters have been admirably done and contain a wealth of data culled from trade sources. It is, however, a pity that the chapter on the function of the plasticizer should have been deleted in the present edition. While it is admitted that its value is essentially for the research worker, who could in any event consult the original papers, a well-balanced discussion of the theories which have held the field from time to time on the function of the plasticizer is most welcome to those interested in the subject. It is to be hoped that the author will consider this suggestion at the time of next revision.

The presentation is lucid and the information given is to the point. Pages 110, 111, 130 and 131, which have been duplicated, presumably cover matter introduced at a late stage. These may be numbered correctly in the next edition.

The book is recommended to technicians and research workers in the field as also to organic chemists in general.

S. K. RANGANATHAN

**MAGNETISM** (Indian Association for the Cultivation of Science, Calcutta), 1957. Pp. 232. Price Rs. 7.00

This book is not a treatise on magnetism as might be inferred from the title, but is a collection of papers and review articles on the subject presented at a symposium held in May 1954 at Calcutta under the joint auspices of the National Institute of Sciences and the Indian Association for the Cultivation of Science. There are altogether twenty-three papers excluding the introductory inaugural address delivered by the (late) Prof. M. N. Saha. The topics discussed in these pages cover a wide range of the subject and include crystal magnetism, experimental techniques, ferromagnetism, nuclear resonance, magnetochemistry, etc. The amount of research which is now being done in these branches is so vast that each one of these topics could justifiably form the topic of a separate symposium. However, the object of the organizers of collecting the largest number of active workers in the field for the symposium has been better fulfilled by keeping the scope wide.

The publication originates from one of the oldest centres of research in the country having the best of traditions. Since most of the topics discussed have been the subject of study by the Calcutta schools for a long time, the book would be useful in stimulating further work on the various fields of research. The article on ferromagnetic materials should be particularly interesting to electrical and metallurgical engineers. In the opinion of the reviewer, the publishers should have included the discussions and critical comments which followed the reading of the papers at the symposium. The views of the many eminent scientists, reported to have attended the meeting, would have been useful to the research worker who was not fortunate enough to be present at the symposium.

K. G. RAMANATHAN

**INTRODUCTION TO PRINTED CIRCUITS** by Robert L. Swiggett (Chapman & Hall Ltd., London; *Distributors in India*: Asia Publishing House, Bombay), 1956. Pp. ix + 101. Price 21s.

The need for miniaturization of electronic equipment to make proximity fuses and guided missile instruments possible, has stimulated interest in printed circuitry in recent years. When Sargrove published his pioneering article in the *Journal of the British Institute of Radio Engineers* in 1947 on a fully automatic machine using printed circuitry, there were many who did not think much of his idea. The interest in printed circuit techniques has grown since then. The National Bureau of Standards, U.S.A., undertook a comprehensive survey of the possibilities and methods of production, and have investigated as many as a hundred different ways of printing circuits. The realization that in the event of an emergency the electronic industry will be unable to cope with the demands for electronic equipment, accelerated the programme for intensive developmental work.

This little book gives, in the first three chapters, details of three of the most promising methods that have been adopted more or less extensively, namely ceramic based, etched and plated circuits. The presentation is concise and the salient points and drawbacks of each system and the economics of the methods are covered. Chapter 4 gives a brief description of other methods which are not so popular but yet hold promise. Then follows a chapter on specialized components for printed circuitry, and a description of an automatic machine for assembly. The book is rounded off with a chapter on servicing hints and "do's and don't's" for repairing printed circuits.

The book is a useful practical introduction to printed circuitry and is profusely illustrated with simple line diagrams explaining the processes and photographs of the different types of automatic machines developed so far.

The book should stimulate the interest of electronic engineers in this new art.

T. V. RAMAMURTI

# NOTES & NEWS

## Carbon atom and diamond structure

THE PRESIDENTIAL ADDRESS OF Prof. C. V. Raman to the Indian Academy of Sciences at Tirupati (delivered on 28 December 1957) was devoted to an examination of the physical and chemical evidence on the tetrahedral carbon atom and the explanation of the chemical behaviour of carbon in terms of the ultimate structure of its atoms. Based on the above, the crystal structure of diamond has been elucidated and the remarkable properties of diamond have been explained.

Experimental evidence from the vibration spectra of molecules and their electron diffraction patterns unmistakably shows that the four valences directed outwards from a carbon atom are parallel to the four axes of a regular tetrahedron. This disposition is maintained even when the four atoms combining with the carbon atom differ widely from each other. This indicates that the determining factor giving rise to the tetrahedral configuration of the valences is not the energy of formation of the bond or bonds but is an intrinsic property of the carbon atom, viz. that the quartet of electrons in the L shell, as a result of their mutual interactions, can set themselves so as to constitute a structure possessing perfect tetrahedral symmetry. Such a structure would be diamagnetic but not chemically inert, since the individual angular momenta cancel out as a result of the tetrahedral setting and not as a consequence of the internal pairing off as in the inert gas molecules.

The angular momentum of an electron and the magnetic moment associated with it should be regarded as having both direction and sign. The directions in the case of the tetrahedral carbon atom are along the four axes of a regular tetrahedron. If the quartet is to possess tetrahedral symmetry all the four vectors should have the same direction. Hence they should all be directed either outwards or inwards from the core of the atom. Thus there are two possible states of the tetrahedral

carbon atom which can be designated as the  $\alpha$  and  $\beta$  states respectively.

These considerations together with the evidence from X-ray analysis, namely that diamond consists of two interpenetrating lattices of carbon atoms, lead to the possibility that an ideal diamond may belong to any one of four types, namely  $\alpha\alpha$ ,  $\alpha\beta$ ,  $\beta\alpha$  and  $\beta\beta$ . These four types of diamond need not exhibit any significant differences in such properties as lattice spacing, energy of formation, or the atomic vibration frequency. But observable differences of a less obvious kind arise from the fact that the  $\alpha\alpha$  and  $\beta\beta$  types of diamond would possess a perfect octahedral symmetry whereas the  $\alpha\beta$  and  $\beta\alpha$  types would exhibit only the lower or tetrahedral symmetry.

Such a visualization of the tetrahedral carbon atom leads to an intelligible explanation of the differences in physical behaviour exhibited by even ideal diamonds in various respects, particularly their infrared spectra. For instance, some diamonds exhibit infrared absorption in the region of wavelength *c.* 8  $\mu$  while other diamonds do not. The diamonds which exhibit such absorption correspond to the  $\alpha\beta$  or  $\beta\alpha$  type of structure while those that do not exhibit such structure belong to  $\alpha\alpha$  or  $\beta\beta$  type. Similar considerations account for differences exhibited by diamond in respect of the presence or absence of absorption of light in the ultraviolet region which is generally accompanied by the presence or absence of infrared absorption in the region of 8  $\mu$ . No difference in piezoelectric behaviour can be expected to manifest itself due to the difference in the type of symmetry, tetrahedral or octahedral, exhibited by the diamonds [*Proc. Indian Acad. Sci.*, **46A** (1957), 391].

## Energy of endogenetic processes inside the earth

AN EXPLANATION PUT FORWARD for the probable source of energy of endogenetic processes inside the earth is based on the observation that in the minerals occurring in

superficial sedimentary rocks, aluminium is surrounded by six oxygen atoms in octahedral co-ordination, with the Al-O distances of the order of 1.9 Å, while in the minerals of the deep-seated igneous and metamorphic rocks, aluminium is surrounded by four oxygen atoms in a tetrahedral co-ordination, with the Al-O distance of the order of 1.7 Å. The contraction of this distance during the downward movement of the earth's crust is an important source of energy which produces the rise of temperature with depth, and is consequently responsible for the processes of metamorphism and magmatism. Thus, aluminium and oxygen, as well as other cations, are acting as accumulators of solar energy, the charging of this 'geochemical accumulator' taking place in the zone of weathering, and its discharge in the depth of the earth's crust. Similar conclusions have also been reached on the basis of thermochemical data [*Nature, Lond.*, **180** (1957), 1324].

## An unusual solar radio event

A SIGNIFICANT SOLAR RADIO event, of a pattern so far unknown and manifesting as a large increase in solar radio noise on a frequency of 200 Mc/s., was observed on 4 November 1957 at the Nera receiving station of the Netherlands Telecommunication Services, the Hague.

The increase started abruptly at 08.48 U.T. and lasted for more than 5 hr., the greatest intensity being reached at about 09.30 U.T., when it amounted to approximately 900 times the noise level of the quiet sun. The smoothed intensity level showed considerable fluctuations with periods of the order of a few minutes. No solar flare has been reported as occurring near the onset of the radio event, nor was a sudden ionospheric disturbance observed. The phenomenon manifested itself over a considerable frequency range in the metre wavelength band. It was also observed on a frequency of 169 Mc/s. by the observatories at Humain (Belgium) and Nancy (France), but it was altogether absent on the decimetre-centimetre wavelength range and on a wavelength near 6 metres. The radiation was 100 per cent left-handed circularly polarized. The position of its source, as determined at 11.25 U.T. with a two-

element interferometer operating on a frequency of 250 Mc/s., was about 0.1 solar radius east of the centre of the solar disk. During a period of 2 hr., centred around local noon, no systematic displacement of the source of enhanced radiation was observed.

Lack of correlation with a solar flare or associated effects, the absence of disturbances on the decimetre-centimetre wavelengths and the features of the low- and high-speed records obtained at a number of stations indicated that the phenomenon is of a new type and of exceptional rarity. The high-speed records revealed short-period fluctuations of intensity with a period of 0.2-0.3 sec., altogether different from the kind ordinarily occurring during a noise storm. These fluctuations were of two types: (1) an oscillatory type of intensity fluctuation, reminiscent of ionospheric scintillations of radio sources; and (2) a preponderance of decreases in intensity, short dips similar to fading (these are also present in records obtained at the Nancay observatory on 169 Mc/s.). The latter type differs from the 'non-selective fading' observed by Payne-Scott and Little on the 62 and 98 Mc/s. in that the intensity fluctuations have a much shorter period. During the later stages of the radio event, dips and oscillations of a longer duration (of the order of 0.1 min.) occurred. These could also be identified on slow-speed records obtained at 200 Mc/s. simultaneously at Nera and Paramaribo (Suriname) at recording instrument time constants of 1 and 0.3 sec. respectively. These observations rule out the possibility of their occurrence due to ionospheric effects. No significant ionospheric scintillation of radio sources was observed at the Jodrell Bank Experimental Station or the Mullard Radio Astronomy Observatory on 4 November 1957. Also such short period ionospheric scintillations have never been observed at Cambridge.

Thus the short-period fluctuations of intensity can only be ascribed to solar conditions. The occurrence of these intensity fluctuations suggests that under special circumstances, solar coronal gas may give rise to scintillation effects, possibly analogous to ionospheric scintillations but more varied in character. Irregularities in the solar corona may be responsible for focussing and defocussing

effects and probably also to absorption effects [*Nature, Lond.*, **181** (1958), 542].

### Detection of cascade particles

THE PHOTOGRAPHING, FOR THE first time, of the track of a man-made 'cascade' particle was reported recently at a meeting of the American Physical Society by Dr. Wilson Powell, a physicist at the University of California. The cascade particle is the only known 'strange' particle, which has not been observed till now in the laboratory. Two cascade particles have so far been trapped and photographed in the 30-in. propane bubble chamber placed in the beam of the 6 BeV. bevatron at the University of California. Cascade particles are the heaviest of the 'strange' particles and have a mass 2539 times that of the electron and a negative electrical charge with a life-time of less than  $10^{-6}$  sec. They are called 'cascade' particles because they decay or disintegrate into another heavy particle before finally breaking up again into pi mesons and protons. The cascade particle is also known as the psi meson, and is the only one yet discovered that produces another heavy particle as its first decay product [*Sci. Newslett., Wash.*, **73** (1958), 99].

### Critical temperatures of organic compounds

AN EMPIRICAL CORRELATION connecting the critical temperature ( $t_c$ ), the boiling point ( $t_b$ ) and the density at 20°C. ( $d_{20}$ ) for a number of phenolic and basic organic compounds occurring in coal tar has been arrived at as a result of studies carried out at the Research Laboratories of the Coal Tar Research Association, Leeds. The relation arrived at is useful in predicting, with reasonable accuracy, the critical temperatures, wherever they are not known, of these compounds for which the accurate equations available in the case of hydrocarbons are unsuitable. As a result of studies on 14 paraffins, 25 aromatic hydrocarbons, 4 phenols and 7 organic bases it has been found that the critical temperature values in the range 260°-530°C. are predictable with an accuracy of  $\pm 20.8^\circ\text{C}$ ., i.e. with an average accuracy of  $\pm 5$  per cent by the equation:

$$t_c = 221.6 + 1.029td_{20} \quad [\text{Nature, Lond., } \mathbf{180} \text{ (1957), 1353}].$$

### New 'fast' haemoglobin

A NEW 'FAST' HAEMOGLOBIN HAS been identified in the cord blood of a full-term infant. Through paper electrophoresis of haemoglobin solution in both barbitone and phosphate buffer, two spots were obtained: a large one, corresponding to a mixture of haemoglobins F and A, and a smaller one which migrated towards the anode. Comparison of the latter with haemoglobin H proved that H is of higher anodic mobility in both alkaline and acidic buffers. The new haemoglobin also differs from haemoglobin I in that at pH 6.5, haemoglobin I shows almost no separation from haemoglobin A, while the new haemoglobin migrated clearly away from A. Haemoglobin I, of all fast haemoglobins with the exception of H, takes a more anodic position in acid buffer. Consequently, the new haemoglobin differs from both haemoglobins J and K, which on paper resolve to a lesser degree at pH 6.5 than haemoglobin I. The new haemoglobin is not alkali resistant. At the birth of the infant it amounted to 14 per cent of the total (determined by elution), the content of haemoglobin F being 60 per cent, and of A, 26 per cent. The infant was neither anaemic nor icteric. During the next 3 months there was a progressive reduction in the amount of the fast fraction [*Science*, **126** (1957), 1119].

### Anti-tumour compound

THE DIETHYLTHIOSULPHINIC ethyl ester ( $\text{C}_2\text{H}_5\text{-SO-S-C}_2\text{H}_5$ ) prepared by incubating S-ethyl L-cysteine sulphoxide with allinase (an enzyme obtained from crushed garlic bulb) has been found to have an inhibitory effect on malignant cells. When the tumour cells are pre-incubated with equivalent amounts of a solution in which the enzyme and the substrate have been allowed to react, no growth of the ascites tumour is demonstrable, and there is no mortality in animals over a period of 6 months. Approximately 1.0  $\mu$  mol of the enzymatically prepared ethyl thiosulphinic ethyl ester present in each inoculum is sufficient to inhibit the growth of the ascites tumour cells in an inoculum containing

approximately 5 million tumour cells.

Intravenous injections of the ethylthiosulphinic ethyl ester (synthetically prepared by oxidation of diethyl sulphide with perbenzoic acid) into mice previously inoculated with sarcoma 180 ascites tumour cells delayed the onset of malignant ascites tumours and in some instances prevented their formation and the death of the mice. Both the bactericidal and tumour-inhibitory effects appear to be related to the presence of the -SO-S- linkage and may be the result of -SH inactivation by direct combination or by oxidation of -SH to -S-S- [*Science*, **126** (1957), 1112].

### A new herbicide

A NEW HERBICIDE, 1:1'-ETHYLENE-2:2'-dipyridylum dibromide has been developed at the Jealott's Hill Research Station of the Imperial Chemical Industries. It crystallizes from water as a pale yellow monohydrate, is readily soluble (70 g. in 100 ml. of water at 20°C.) and is stable in acid or neutral solutions. In alkaline solution coloured complex products are formed.

Aqueous solutions of the new herbicide with added wetter (0.3 per cent 'Agral LN'), applied as foliage sprays at the rate of 100 gal./acre, have been found to give complete kill of wheat, sugar beet, white mustard, marigold (*Calendula* sp.), red clover and cleavers (*Galium aparine*) even at dosages as low as  $\frac{1}{2}$  lb./acre. In the absence of wetter, the chemical was equally effective. Similar results have been obtained with low-volume (20 gal./acre) applications. The action of the chemical is rapid. The compound has been found to be highly effective against several common weeds at  $\frac{1}{4}$ - $\frac{1}{2}$  lb./acre. Potato haulms are effectively destroyed at 1-2 lb./acre. Rain falling shortly after application has no effect on the herbicidal activity and the storage properties of the potato tubers are unaffected by its treatments [*Nature, Lond.*, **181** (1958), 446].

### Photographic determination of reaction rates

A SIMPLE AND RAPID TECHNIQUE for measuring the rate at which a solid surface is attacked by a corrosive gas has been developed at the National Bureau of Standards.

The procedure employs time-lapse photography of the reacting solid so that a permanent record of the progress of the reaction is obtained at specified time intervals. From the photographs, an accurate measure of the dimensional changes and thereby the rate of change of mass of the sample can be obtained. The method has the additional advantage of being applicable to any of a large number of gas-solid reactions. The method also offers a convenient solution to many of the problems encountered in the reactions carried out at high temperatures. The reaction of nickel with chlorine to form gaseous nickel chloride has been studied with the help of the above technique over a temperature range of 1100°-1700°K. The reaction is carried out in a cylindrical pyrex vessel which can be viewed through windows in two side arms at right angles to each other. The reaction vessel can be evacuated to pressures as low as 10-6 mm. of mercury. The desired temperatures are obtained by mounting the sample in the form of a cylindrical wire between copper electrodes so that it can be electrically heated. An optical pyrometer focussed on the sample through one of the side-arm windows allows the temperature to be accurately measured.

Time-lapse photographs are taken through the other side-arm window. Illumination is provided by a parabolic reflector lamp or by radiation from the sample and magnification is produced by a lens system. A microswitch operated by a synchronous motor releases the shutter and advances the film at regular intervals.

Chlorine from a high pressure reservoir flows through the apparatus at various constant pressures between 0.1 and 0.5 mm. of mercury. Ten or fifteen exposures are taken at 15 or 30 sec. intervals and an analysis of the photographic data reveals that the reaction rate is proportional to the chlorine pressure and is extremely rapid [*Tech. News Bull., U.S. Bur. Stand.*, **42** (1958), 27].

### Purification of thorium nitrate

A LIQUID-LIQUID EXTRACTION PROCESS for purifying commercial, mantle grade thorium nitrate solution has been developed. The method is based on the selective extraction of thorium nitrate from an impure aqueous nitrate by tri-

butyl phosphate in a commercial hydrocarbon diluent.

The apparatus consists of three interconnected mixer-settler units, each consisting of 10 mixer-settler stages in series in which counterflowing, immiscible aqueous and organic solutions are repeatedly contacted and separated. In mixer-settler 3, thorium nitrate is selectively transferred from aqueous feed stream to the organic extractant stream, and in mixer-settler 2, minor traces of impurities are scrubbed from the resulting thorium-laden organic stream with aqueous nitric acid. In mixer-settler 1, purified thorium is stripped from the organic stream into an aqueous stream for further processing.

The mixer-settler units are of the centrifugal-pump impeller type. With these units, the pump impeller and mixing chamber design is such that liquid-liquid interface level control is automatic within each unit of 10 stages, and only the end stages need monitoring. The total liquid hold-up volume of each stage is about 2 gallons. This permits large samples of uniform product to be made without requiring extremely long times or large quantities of solutions to come to steady state operation. The product is of acceptable purity with high recoveries of both product and reagents (thorium, 99.95; nitric acid, >99 per cent) [*Industr. Engng Chem.*, **50** (1958), 144].

### Synthesis of nucleotides

THE NOBEL LECTURE OF PROF. Alexander Todd before the Swedish Academy in Stockholm, on 10 December 1957, was concerned with studies in the synthesis of nucleotides which occupy a central place in the chemistry of living cells. The slow progress in our understanding of the chemistry of nucleotides is mainly due to the physical properties of these compounds. As water-soluble polar compounds with no proper melting points, they were extremely difficult to handle by the classical techniques of organic chemistry, and were accordingly very discouraging substances to early workers. The major advances in the field have been the result of new experimental techniques, such as paper and ion-exchange chromatography, paper electrophoresis and counter-current distribution, including spectroscopic methods.



Nucleic acids are polynucleotides in which individual nucleotides are linked one to the other through phosphodiester groups. The number of individual nucleic acids is large and all those that have been discovered belong to one of the two types: (a) the ribonucleic acids and (b) the deoxyribonucleic acids. The work on the syntheses of ribonucleotides obtained by the hydrolysis of ribonucleic acids established that *a* nucleotides are the 2'-phosphates and *b* nucleotides the 3'-phosphates of the respective nucleosides. On the basis of the suggested hydrolytic breakdown of a ribonucleic acid with alkali, coupled with certain other evidence, both types of nucleic acids have been postulated as 3':5'-linked polynucleotides and it is today generally accepted. It seems probable that nucleic acids are linear rather than branched polyesters. This is certainly true of isolated deoxyribonucleic acids, since only branching on phosphorus is theoretically possible and such branching points involving phosphotriester linkages would not have the necessary alkali stability. In the case of ribonucleic acids the branching on phosphorus is incompatible with stability requirements, but chain branching on C<sub>2</sub>' of the sugar residue of the nucleoside remains a theoretical possibility although no experimental evidence for its occurrence in any ribonucleic acid has yet been shown.

The essential difference between individual nucleic acids must reside in the different sequence of nucleoside residues in them. A method for the study of this problem has been devised which involves stepwise degradation. Chemical synthesis in the polynucleotide field is in its infancy but unambiguous syntheses of dinucleoside phosphates and one dinucleotide have been achieved.

The term nucleotide coenzyme is applied to a large and growing group of substances which are vital components of many enzyme systems involved in metabolic processes. All known members of the group belong to one or other of two types: (a) monoesters of polyphosphoric acids in which the esterifying group is a nucleoside derivative, (b) unsymmetrical *p*<sup>1</sup>*p*<sup>2</sup>-diesters of pyrophosphoric acid in which at least one of the esterifying groups is a nucleoside derivative. Fully esterified pyrophos-

phates are very labile substances. They phosphorylate amines and readily undergo exchange reactions with other anions. It is this exchange reaction which is primarily responsible for the low yields obtained in the ADP (adenosine-5'-pyrophosphate) and ATP (adenosine-5'-triphosphate) synthesis. This tendency to undergo exchange reactions is less evident in the partially esterified polyphosphates. Improvements in the phosphorochloridate method (employing partially esterified polyphosphates as starting materials) of polyphosphate synthesis have led to the total synthesis of the coenzymes flavin-adenine-dinucleotide (FAD)<sup>22</sup>, uridinediphosphate-glucose (UDPG)<sup>23</sup> and uridine-diphosphate-galactose (UDP-Gal)<sup>23</sup>.

Quite apart from the difficulties caused by the occurrence of exchange reactions, the phosphorochloridate method has also the disadvantage that where nucleoside phosphorochloridates are employed, protection of the sugar hydroxyl groups by acylation or alkylation is necessary and, moreover, non-hydroxylic solvents must be used since phosphorochloridates react readily with alcohols and water. Efforts to develop reagents for synthesizing pyrophosphates from phosphates without the need for protecting groups and which might be used even in the presence of water, have been fruitful. These reagents—the one most frequently employed has been dicyclohexyl carbodiimide—react smoothly with mono- and diesters of phosphoric acid to yield respectively di- and tetraesters of pyrophosphoric acid, even in the presence of moderate amounts of water provided that excess of the carbodi-imide is employed.

In the field of nucleotide coenzyme synthesis, an ideal method for unsymmetrical pyrophosphate synthesis has not yet been found although a point has been reached where the synthesis of any coenzyme molecule can be undertaken with reasonable certainty of success. The practical interest in the field today lies very much in the methods of pyrophosphate formation and in the behaviour of pyrophosphates and mixed anhydride intermediates. For in the properties of such anhydrides lies the secret of many biological processes [*Chem. & Ind.*, (1958), 170].

## Newer preparative methods in organic chemistry

A SYMPOSIUM ORGANIZED JOINTLY by the Chemical Society and the Fine Chemicals Group of the Society of Chemical Industry on 'Newer Preparative Methods in Organic Chemistry' was held on 9 November 1957 at the Chemistry Department, University College, London. A number of papers on dehydrogenation with manganese dioxide, amine oxidations, organic oxidations with hexavalent chromium, mixed anhydrides as synthetic reagents, some reactions between metal carbonyls and acetylenic compounds and some applications of metal carbonyls in organic chemistry were presented and discussed.

When manganese dioxide is used for dehydrogenation the method of preparation and the physical form of the oxide appear to have a considerable effect on its reactivity. Manganese dioxide, prepared under strongly alkaline conditions, is a good dehydrogenating agent for unsaturated primary or secondary alcohols to  $\alpha$ : $\beta$  unsaturated aldehydes or ketones. But when prepared in strongly acidic conditions it is a better reagent for dehydrogenating unsaturated ketones (sterols). Specially active forms of the oxide find application in the oxidation, under mild conditions, of polyene or polyenyne alcohols that are difficult to oxidize to corresponding aldehydes or ketones by other methods.

Tertiary amines which are rather chemically unreactive has been found to give enamines on dehydrogenation with mercuric acetate under mild conditions in dilute acetic acid. In a heterocyclic ring system complete dehydrogenation to aromatic ring takes place, but often partial dehydrogenation also occurs. Diethyl aniline gives a mixture of ethyl vinyl aniline and ethylformanilide.

Chromic oxide is employed for both dehydrogenations and oxidations in diverse ways, but the theoretical and practical significance of the methods is not yet thoroughly understood. Oxidation with chromic oxide in acetic acid is often not stoichiometric. Chromic oxide remains behind after the oxidation is over, even in the presence of unoxidized substrate; this is because its oxidizing action is inhibited by the presence of lower valency forms of chro-

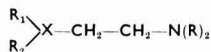
mium. One of the functions of sulphuric acid, sometimes added to these reactions, is to overcome this inhibition.

Mixed anhydrides have been used for condensations involving carboxyl groups where, because of the delicacy of either the starting materials or the final product, mild reaction conditions are required. Another advantage that mixed anhydrides have is that one of the constituents is usually derived from a small and relatively cheap molecule, and their use avoids the wasteful regeneration of a molecule of the larger and perhaps much less accessible acid. Mixed anhydrides derived from chloroformic ester, phosphoric and sulphuric acids or their esters have been found very useful in the synthesis of peptides and nucleosides.

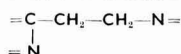
The papers on metal carbonyls described safe methods of handling metal carbonyls and acetylenes, which involve the risks of explosion, fire or toxicity. Nickel carbonyl reacts with acetylenes having a terminal triple bond to give  $\alpha$ -substituted acrylic acids, a type of compound otherwise rather difficult to obtain. The reactions are carried out in acetic acid at moderate temperature with excess carbonyl. The excess carbonyl is removed from the reaction mixture by co-distillation with ether. The reaction mixture can then be handled safely. Cobalt carbonyl catalyses the reaction of carbon monoxide and hydrogen with olefines to give aldehydes which are then reduced to alcohols. This has been adopted as an industrial method for the preparation of alcohols, though the reactions necessitate fairly high temperatures and pressures [*Nature, Lond.*, **181** (1958), 239].

### Antihistamines — structure and activity

MOST ANTIHISTAMINIC DRUGS conform to the general structure



The essential part of this skeleton, which such drugs share with histamine itself, is the  $-CH_2-CH_2-N=$  chain. Probably also the first link of the iminazoline ring present in histamine is important in histamine antagonists; thus the desirable chain is



In the general formula above, X may stand for N, O or CH, and the simplest classification of the histamine antagonists follows this three-fold division.

Where X=N, the drugs may be considered derivatives of ethylenediamine,  $H_2N-CH_2-CH_2-NH_2$ . By far the greatest number of clinically accepted antihistamines come within this class. Where X=O, the compounds are aminoalkyl ethers, or, alternatively, ethanolamine derivatives ( $HO-CH_2-CH_2-NH_2$ ). There are few such compounds available. Where X=CH, alkylamines result. These drugs are comparative newcomers to the field.

Within the ethylenediamine series, amine substitution is normally tertiary, since the corresponding primary and secondary derivatives are only feeble antihistaminics. N-dimethylamino compounds have proved most effective, the corresponding diethyl compounds proving less active against histamine, more active in central nervous effects and anticholinergic effects, and acutely more toxic in animals.

A comparison of the two clinically useful drugs, promethazine [10-(2-dimethylamino-1-propyl)-phenothiazine] and ethopropazine [10-(2-diethylamino-1-propyl)-phenothiazine], brings out interesting points. Promethazine is a powerful and long-acting antihistaminic with marked local anaesthetic properties, whereas ethopropazine has negligible antihistamine activity but is an effective ganglion-blocking agent with an action resembling that of atropine. The acute animal toxicity of ethopropazine is roughly one and a half times that of promethazine.

Quaternization of the ethylenediamines markedly reduces their histamine antagonism. It is possible to replace the dialkylamino group by a heterocyclic ring, such as iminazoline (which exists in antazoline, 2-phenyl-benzylamino-methyl-iminazoline) or piperazine (in cyclizine, 1-benzhydryl-4-methyl-piperazine) without the loss of function.

Alpha substitution of an alkyl group within the chain increases the potency of a drug, but beta substitution abolishes the antihistamine effect altogether. Promethazine, which is methyl substituted on the alpha carbon, is remarkably potent, while its corresponding beta-methyl compound is inactive. To lengthen the

amine chain only serves to weaken the effect of the compounds, unlike the alkylamine series where the propylamines are more potent than the ethylamines.

Antihistaminic drugs apparently need a molecular weight exceeding 150, and great changes can be made in their potency by varying the heavier end of the molecule. A benzyl or substituted benzyl group enhances the effect of an adjacent pyridyl group. 2-Aminopyridine has proved useful in a range of drugs which includes tripeleennamine, N, N-dimethyl-N'-benzyl-N'-(2-pyridyl)-ethylenediamine, together with its *p*-methoxybenzyl- and *p*-chlorobenzyl derivatives, which are mepyramine and halopyramine respectively. Of the two derivatives, halopyramine is more potent and less toxic in clinical usage, owing to its lower effective dose. Compounds incorporating 3-amino- or 4-aminopyridine are comparatively feeble. Changing the pyridyl component for pyrimidyl produces a rather weak antihistaminic, though a safe one for many general purposes. Thonzylamine, N, N-dimethyl-N'-(*p*-methoxybenzyl)-N'-(2-pyrimidyl)-ethylenediamine is the clinical representative of this class. Thiazolyl in place of pyridyl similarly diminishes the potency. One such compound, methapyriline, N, N-dimethyl-N'-*a*-pyridyl-N'-(2-methylthienyl)-ethylenediamine, has found a limited place in medicine.

Among the aminoalkyl ethers the effect of N-dimethyl-substitution is not so critical as with the ethylenediamines. Replacement with piperidine has no marked effect upon potency, though morpholinyl substitution halves it and diethyl substitution reduces it to one-eighth. Any substitution in the phenyl nuclei, however, at the heavy end of the molecule seems to reduce potency. The ether structure is associated with rather pronounced central nervous depression, often with anticholinergic activity, and diphenhydramine, 2-(benzhydryloxy)-N, N-dimethylethylamine is chiefly valuable where its side effects are of definite utility. It is of interest to note that the 2-methyl derivative of diphenhydramine, mephemamine, has completely lost its antihistaminic action, is not a ganglion blocking agent, has marked acetylcholine-inhibiting properties, and is a powerful surface anaesthetic.

Alkylamine antihistamine drugs are characterized by high potency and prolonged action. The earlier compound pheniramine, 1-phenyl-2-pyridyl-3-dimethylaminopropane, has given way to the more potent *p*-chlorophenyl compound, chlorpheniramine, which is effective in only one-sixth of the dose. The side effects of the alkylamines are largely overcome on account of their low effective clinical dosage.

One antihistaminic, phenindamine, 2-methyl-9-phenyl-2, 3, 4, 9-tetrahydro-1-pyridindene, fits into no category. It is possible by opening the ring system at two points to point to a vague resemblance to the alkylamines, but the relationship is strained. Among other differences in action, phenindamine is often stimulant in small doses, whereas typical antihistamines are depressant in small and stimulant in heavy doses. Its antihistaminic potency is intermediate between that of tripelemine and diphenhydramine. The position of the double bond in the central ring is very critical. The existence of phenindamine encourages the speculation that the ideal antihistaminic drug may yet be discovered outside the conventional structure boundaries [*Chem. Age*, 78 (1957), 1047].

### Testing of opaque ceramics

A TECHNIQUE FOR THE EXAMINATION of opaque ceramic objects, e.g. a grinding wheel, by 3 cm. radio waves has been developed at the Max Planck Institut für Silikat-Forschung, Würzburg. In this method, radiation from a suitable emitter is collimated by passing it through a 'lens' consisting of flat strips of copper foil separated by slabs of foamed plastic material. The object, say a sintered alumina grinding wheel, is placed in the incident field and the emergent field is scanned by a suitable receiver-analyser and the impulses after amplification are received on an electrode moving over a filter paper soaked in starch iodine solution supported on an earthed copper plate. The browning of the filter paper gives a picture of the uniformity of the density of the wheel; if required, a photographic record of the markings on paper can be made subsequently. This procedure is of significant interest to manufacturers of abrasive wheels as it constitutes a simple method to check up the quality of firing of

their wares. An interesting fact emerging from the work was the demonstrated feasibility of obtaining interference patterns with these long waves using a lattice of metallized ping-pong balls as a grating (they have roughly the same diameter as the wavelength of the radiation).

### Flow properties of enamels

TWO NEW METHODS FOR DETERMINING the flow properties of enamels at the firing temperatures have been used at the Max Planck Institut für Silikat-Forschung, Würzburg, Germany.

The first is a modification of the flow-trough method used in America for studying the flow properties of glazes. In this method, pellets of the dry glaze are placed on a flat surface (unglazed white wall tiles have been found to be a suitable standard surface) supported on a hinged table of cast iron. The table is heated in a laboratory furnace to an appropriate temperature. The angle of melting can be observed if desired through a microscope provided with a teleobjective. The table is then released on one side so that it forms an inclined plane. The extent of flow of the samples in a measured time interval is determined. This empirical method is found useful in comparing enamels with each other and with a standard.

The second method, known as the hanging rod method, permits absolute measurement. A thin circular rod (*c.* 2 mm. in diameter) of the enamel is drawn out and suspended vertically. The rod passes through a loop of resistance wire which can be heated electrically until local melting of the glass rod occurs. The bottom end of the rod is observed through a low power microscope and the position of the loop is adjusted vertically until no movement of the end of the rod takes place as the wire is heated. When this occurs, the upward pull due to surface tension just balances the downward gravitational force due to the weight of the length of the rod below the zone of melting. At temperatures above the melting point the viscosity falls rapidly and can be measured by the damping of a rotating ellipsoid immersed in the molten glaze. This method eliminates end effects and permits the calculation of the absolute viscosity. With the help

of an iridium-wound electric furnace measurements can be made on a fused quartz base up to 2000°C. Some studies on the hysteresis in the silica transformations between one crystal form and another have been made by this method.

### New developments in transistor technology

AT A CONFERENCE ORGANIZED by the Electronics Group of the Institute of Physics at the Brunel College of Technology, Acton, England, during 27-28 September 1957, the recent progress made in various aspects of transistor technology like design characteristics, performance, transistor materials and purification techniques was surveyed. Many new developments were announced and discussed.

In evaluating the high frequency performance of alloy transistors, it has been found necessary to take into consideration the mobilities of both the majority and the minority carriers. The relative merits of *n-p-n* and *p-n-p* structures have been found to depend largely on the degree of avalanche multiplication characteristic of the carrier-depletion regions of thin collector junctions.

A typical chemical defect that can have a marked effect on the electrical performance of the semiconductor is the presence of oxygen in silicon. Defects created by particle bombardment (e.g. by means of neutrons) can be removed by annealing. Various techniques, such as etching and the use of X-rays, have been suggested for revealing the presence of dislocations in crystals. Interactions between dislocations and oxygen content have been found to affect the heat treatment properties of silicon.

In the design of power transistors, Webster's analysis of the variation of current gain with emitter current has shown how emitter efficiency, bulk recombination and surface recombination play their part. Two important practical directions in which work should be pursued are the development of new alloys possessing high emitter efficiency and the techniques to produce thin base regions. Fletcher's study of the transverse field in the base region has led to a reconsideration of the optimum geometrical arrangement in the base region. Both carrier



life-time and surface recombination velocity can show substantial variations with emitter current; these effects become important in high-power transistors.

A new high frequency germanium transistor based on the 'post-alloy diffusion' technique, using the principle of Kroemer's drift transistor, has been described. In this transistor, a gradation in the conductivity of the base region creates a drift field which reduces the transit time for minority carriers. A graded base region can be best produced by diffusing the impurity atoms into the region. The emitter is alloyed on to a base region of uniform conductivity. The emitter alloy contains known quantities of  $p$  and  $n$  impurities, the segregation and diffusion coefficients of which are carefully chosen. After alloying, the emitter is a  $p$ -type. The structure is then heated to such a temperature that diffusion takes place. The diffusion coefficients are so chosen that the diffusion is predominantly of the  $n$ -impurities. The technique enables to obtain very narrow base regions, with the desired gradation of conductivity.

The delay in the development of the silicon transistors has been mainly due to the difficulty in producing silicon of adequate purity and keeping it pure during subsequent processing. The alloy process, effective in the case of germanium, proves difficult with silicon; hence other processes like double-doping during growth, grown-diffusion, melt-back diffusion and double-diffusion have been developed. Silicon transistors have many advantages over germanium ones in high temperature applications.

The high segregation coefficient of boron renders it unsuitable for use in the purification of silicon by zone refining. A method devised by Wilson starts with the thermal decomposition of silane ( $\text{SiH}_4$ ). Crystalline silicon can be produced without using crucibles, an important advantage in view of the high reactivity of silicon with crucible material.

Another noteworthy phenomenon with promising applications in certain devices is the 'avalanche injection'. When the field across a filament of  $n$ -type germanium exceeds a critical value, avalanche multiplication gives rise to a rapid increase in conductivity; as a result, the voltage-current characteristic exhibits a negative resis-

tance region. To limit the current (and hence the dissipation), in the high-current condition, the area of one of the contacts to the germanium is made small. Another device, analogous to the thyatron, has two  $n^+$  contacts and one  $p^+$  contact to the germanium. In this the current flowing into the  $p^+$  contact controls the voltage-current characteristic at the other two.

A number of conditions are essential in making satisfactory alloyed junctions in the case of silicon. When alloying an aluminium wire to a silicon wafer and if during the cooling cycle the wire is maintained at a higher temperature than the molten region, then no regrowth occurs. The good diode characteristics obtained under these conditions are due to the diffusion taking place at the alloy/silicon interface during alloying.

When light is made to shine on a  $p$ - $n$  junction germanium diode in which the  $p$ -region is made very thin, hole-electron pairs are created. The diode under these conditions, termed 'photo-transistor', can produce substantial multiplication of the current produced by the hole-electron pairs. Their main disadvantage is that hole-electron pairs produced by thermal agitation also contribute to the output current. Ways to minimize the contribution due to thermal agitation have been suggested [*Nature, Lond.*, **180** (1957), 1329].

### Third Defence Science Conference

THE THIRD DEFENCE SCIENCE Conference was held at the National Physical Laboratory, New Delhi, during 3-5 April 1958. It was the first time since the inception of the Defence Science Organization that a large number of scientists engaged in diverse fields of activity and drawn from the national laboratories, universities, and other research institutions had assembled to acquaint themselves with the work of the defence scientists. The conference was inaugurated by the Prime Minister, Shri Jawaharlal Nehru.

Dr. D. S. Kothari, Scientific Adviser, presenting his report on the work of the Defence Science establishments referred to the work being done at the Institute of Armament Studies, Kirkee, on

the structure of explosives and mechanics of detonation, and to the researches on shaped and hollow charges being carried out at the Defence Science Laboratory, New Delhi.

Technical sessions on aeronautics, explosives, ballistics, electronics, operational research, military physiology and applied psychology were held and 50 papers were read and discussed. At these sessions a number of speakers laid emphasis on the need for early self-sufficiency in defence requirements and the importance of close co-operation between the research scientist and the service-man for fruitful defence research and development. Some of the papers presented dealt specifically with the following subjects: (1) Role of high-performance aircraft in the country's defence, (2) some problems associated with the design of transonic wind tunnel, (3) problems pertaining to ballistics, (4) importance of physiology in improving the efficiency of service personnel, (5) some problems of radar performance, and (6) operational research for increasing efficiency of equipment and arriving at optimum weapons system.

At the seminar on electronics, Shri T. V. Ramamurti presented a paper on the tropical testing of electronic equipment initiated by him at the National Physical Laboratory. The subject is of interest to the Armed Forces because of the vital necessity of reliability of equipment in tropical conditions. During the discussion, the need for establishing realistic standards applicable to conditions obtaining in India was stressed. It was agreed that collection of data and correlation of field-trial reports with those of laboratory testing on a long-term basis was essential. It was felt that better results could be achieved by collaboration between the defence organizations and research scientists.

An exhibition, open to public, indicating the scope and achievements of the Defence Science Organization was organized on the occasion. Popular lectures on 'the prospects of atomic power at competitive rates' and 'the role of science and technology as a vital social force' were delivered by Dr. H. J. Bhabha, Chairman, Atomic Energy Commission, and Prof. M. S. Thacker, Director-General, Scientific & Industrial Research.

## Symposium on phytochemistry

A SYMPOSIUM, ORGANIZED JOINTLY by the Government of the Federation of Malaya and Unesco, was held at Petaling Jaya, Kuala Lumpur, during 4-8 December 1957. It was attended by 34 delegates including 16 from foreign countries. Twelve original papers were read at the symposium. A number of articles presented by delegates from Australia, Hong Kong, India, Indonesia, Japan, Malaya, New Zealand, Philippines and Viet Nam dealt with problems associated with the collection of plants and their dispatch from field to the laboratory, the chemical and biological methods used in the screening of plants for useful products [*Nature, Lond.*, **181** (1958), 466].

## The Physics of Fluids

THIS NEW BIMONTHLY JOURNAL issued by the American Institute of Physics commenced publication from January 1958. The need for a separate periodical on the subject arose from the fact that subjects like hydrodynamics and molecular theory of liquids, normally coming under physics of fluids, are appreciated only in connection with their engineering applications. Also this publication is meant to partly relieve the pressure for space in *The Physical Review* and *The Journal of Chemical Physics*.

The journal will publish original research papers on the dynamics of flow, waves and shocks and also on the statistical thermodynamics of the fluid state. Particular attention will be given to the mutual interaction between the flow of fluids and electromagnetic phenomena, or chemical or nuclear processes. The first issue of the journal contains papers on such topics as theory of bubble chambers, the effect of radiation on the propagation of shock waves, stability in magnetohydrodynamics and the statistical mechanics of the electron gas.

The annual subscription for the journal is \$ 11.00.

## Scientific Information Centre, Japan

THE JAPANESE GOVERNMENT HAS established an Information Centre

of Science and Technology, which will collect Japanese and foreign periodicals in science and technology and prepare abstracts and indexes. The Centre will also provide a photo-copying service and English translating service, available to individuals and organizations outside Japan. Further information can be had from The Japan Information Centre of Science and Technology, C.P.O. Box 1478, Tokyo, Japan [*Chem. & Ind.*, (1958), 269].

## Announcements

■ *The Kekule Symposium on Theoretical Organic Chemistry*—A symposium, to commemorate the centenary of Kekule's celebrated paper on the constitution and metamorphosis of chemical compounds and on the chemical nature of carbon, is being organized by the Chemical Society under the auspices of the Section of Organic Chemistry of the International Union of Pure and Applied Chemistry, during 15-17 September 1958, in London. The discussion will be arranged under three main headings: (i) chemical binding and structure, (ii) nucleophilic reaction, and (iii) electrophilic and homolytic reactions. Details can be had from the General Secretary, The Chemical Society, Burlington, London W.1.

■ *Award of Doctorate Degrees*—The following have been awarded the Ph.D. degree of the University of Delhi for the theses noted in brackets against their names: Shri Mahendra Kumar Singal (*Differential geometry of sub-spaces*); Shri Gir Raj Singh Sirohi (*Physiological studies of growth and yield in crop plants*); and Shri S. K. Roy (*Embryological studies on some members of the Myrtaceae with special reference to Polyembryony*).

## INSTRUMENTS AND APPLIANCES

### NEW LABORATORY OVENS AND INCUBATORS

A new range of laboratory ovens and incubators has been recently

announced by A. Gallenkamp & Co. Ltd., London. The novel feature of these ovens and incubators is the 'Compenstat', a new hydraulic thermostat invented specially to meet the exacting requirements of accurate temperature control, together with automatic compensation for changes in ambient temperature.

The device consists of a sensing bulb connected by a capillary tube to bellows in the control head. This assembly operates a snap-action micro-switch in the heater circuit. The snap-action prevents arcing and gives a contact life exceeding 300,000 operations, so that the thermostat setting is not upset by contact wear, and there is negligible interference from neighbouring power supply lines. Extra sensitivity is achieved by a small auxiliary heater wound around the capillary tube in the control space and connected in series with the main heaters. The auxiliary heater shortens the cycle of operation, limiting the temperature fluctuation and overshoot. Automatic compensation for changes in control head temperature (which is the nearest approximation to ambient temperature) is achieved by a separate bellows system.

They are available in three sizes, with or without mechanical convection. Temperature range is up to 200°C. reached within 65 minutes. Even distribution of temperature is achieved by large area heaters and careful thermal insulation, which also keeps down running costs. Temperature variation between the middle and any other point of the working space does not exceed  $\pm 2.5^\circ\text{C}$ . and fluctuation at any one point is within  $0.25^\circ\text{C}$ . The thermostat scale-plate on the control panel gives readings in °C. The interiors, shelves and internal fittings are of high-grade stainless steel. The exteriors are finished with grey duotone enamel.

The incubators are identical in appearance with the ovens except for the addition of an internal toughened-glass door and concealed controls. They operate between ambient temperature and 70°C. with a maximum variation of  $\pm 1^\circ\text{C}$ . and maximum fluctuation of  $0.1^\circ\text{C}$ . at 37°C.

# Progress Reports

## DEPARTMENT OF ATOMIC ENERGY

THE ANNUAL REPORT OF THE DEPARTMENT OF Atomic Energy, Government of India, for the year 1957-58 records the developmental and research activities of the Department and its different units during the year. The strength of the staff increased from 300 during the previous year to 700. To ensure a steady supply of trained scientific and technical personnel, a scheme was started during the year to impart specialized training to young science graduates and engineers. The first course commenced in August 1957 with 170 trainees.

A new find of thorium and uranium containing materials was made in Bihar during the year. The deposit lying within 10 ft. of the surface is estimated to contain over 10,000 tons of uranium in a concentration of over 0.35 per cent. The known reserves of uranium in the ore containing more than 0.1 per cent amount to over 30,000 tons, while the total reserves of thorium amount to c. 500,000 tons.

The Analytical Division analysed about 1750 samples of minerals, ores, concentrates, leach solutions, pure uranium and thorium salts and a variety of other samples during the year.

India's first atomic reactor, Apsara, completed one year of operation on 4 August 1957. During this period it had been in steady operation at a power level between 1 and 1000 kW. depending on the experiment in progress. Besides short-lived isotopes the reactor produces small quantities of radio-sulphur, radio-phosphorus, radio-cobalt and radio-iodine. It has been used for activation analysis in chemical studies, for studying the effects of radiation on seeds, biological material and other organic substances and the nuclear reactions produced by tritium.

Stringent operational tests on the control system of the reactor conducted during the year have shown that the system is safe and its operation satisfactory. A new type of control rod has been devised which gives a core arrangement with a higher excess reactivity and leads to considerable saving in reactor fuel.

The work on Zerlina, the Zero Energy Reactor for Lattice Investigations and New Assemblies, and the Canada-India Reactor made considerable headway during the year. The former is expected to go into operation towards the end of 1958 and the latter, a year later.

The plants under construction include (1) a uranium metal plant for turning uranium concentrates into reactor grade uranium metal; (2) a fuel fabrication plant for producing fuel elements for the Canada-India reactor and for conducting research and developmental work on new types of fuel elements and their canning; (3) beryllium oxide plant with a capacity of producing 15 tons of beryllium oxide per annum; and (4) a pilot plant for extracting uranium from copper tailings and other ores.

The data collected by the Air Monitoring Division from sampling stations situated in different parts of the country have indicated that the general level of airborne radioactivity in India is steadily rising as a result of the various test explosions of atomic and hydrogen bombs.

A new method based on the controlled reduction of zirconium tetrachloride with aluminium metal has been developed for separating zircon from hafnium; nuclear grade zirconium salts have been prepared using this method.

Biochemical studies on radiation effects in laboratory animals have shown that the radiation affects the sulphur containing compounds most. Administration of methionine after irradiation has been found to have beneficial effects against radiation injury. New types of compounds have been evolved which show encouraging results against experimental cancer.

The Geophysics Section devised an automatic core analyser which can assay over 100 cores in 8 hr. against the normal 8 samples determined in the same time by one man with the conventional instrument. The Section assayed 2743 ft. cores, 1283 rock specimens, 3316 other samples and logged 35,983 ft. of holes during the year.

## NUTRITION RESEARCH LABORATORIES, COONOOR

THE ANNUAL REPORT OF THE NUTRITION RESEARCH Laboratories, Coonoor, for the year 1956-57 records the results of laboratory and field investigations conducted during the year. A number of research projects sponsored by the Indian Council of Medical Research under the Second Five-Year Plan were initiated during the year. These include: clinical and field trials with protein-rich foods made up by mixing defatted groundnut flour, roasted Bengal gram powder, lucerne powder, sesame powder and skim milk in different proportions; studies on human lactation; protein malnutrition survey; and studies on growth and development of children. A detailed study has been undertaken of the nutritional problems of industrial labour classes, a subject so far neglected in India.

*Nutritive value of proteins* — Investigations on the effect of vegetable protein diets, obtained from three sources (skim milk; wheat + red gram + amaranth; and *bajra* + red gram + amaranth), on the regeneration of haemoglobin and plasma proteins in protein-depleted rats have indicated that during repletion, blood protein tends to return to normal on all the three diets. The rate of regeneration in animals kept on vegetable diets is slower than those kept on the skim milk diet. The rate of gain in body weight is almost the same on the three diets.

The results of investigations on the effect of low and normal protein diets, with and without vitamin B<sub>6</sub>, on the activity of blood glutamate-oxaloacetate-transaminase (GOT) in albino rats indicate that in animals kept on adequate protein-pyridoxine diet, blood GOT activity decreases

significantly only after 28 days and when pyridoxine is supplemented to the diet at this stage only a slight increase in the enzyme activity is observed after one week. In animals kept on low protein + pyridoxine diet, the enzyme activity is decreased to nearly 40 per cent in two weeks, and after restoration of normal protein in the diet the activity returned to normal within one week. It is suggested that the apoenzyme responds rapidly to change in the levels of dietary protein whereas the changes in the intake of pyridoxine are more gradual.

*Fats*—Paper chromatography has enabled a quantitative estimation of the components obtained by the oxidation of the *iso*-oleic acid fraction of goat and buffalo milk fats and of goat and sheep liver fats. The results obtained revealed the presence of  $\Delta^{12}$ ,  $\Delta^{11}$ ,  $\Delta^{10}$  and  $\Delta^8$  octadecenoic acids in buffalo butter fat and the presence of  $\Delta^{12}$ ,  $\Delta^{11}$  and  $\Delta^{10}$  octadecenoic acids in goat's milk and goat and sheep liver fats. The presence of dodecane and undecanedioic acids in the oxidation products was further confirmed by comparison with the behaviour on chromatography of these two acids prepared synthetically.

*Indian foodstuffs*—A number of fruits and vegetables, water from coconut (10-12 months old), milk squeezed from grated coconut and sea weeds have been analysed for their chemical composition. The milk obtained by squeezing the grated coconut contains calcium in amount similar to that in coconut water, but higher amounts of phosphorus. The milk is richer in thiamine and riboflavin. Table radish leaves have been found to be a good source of carotene, thiamine, riboflavin and vitamin C.

*Clinical investigations*—The urea method for the estimation of total body water in nutritional oedema has been found to be a simple and reliable method for the determination of total body water not only in normal subjects, but also in severely malnourished and oedematous cases.

A complete haematological examination, which included the red cell count, packed cell volume and haemoglobin determinations, has been carried out on fifteen children between the ages of 2-10 and suffering from kwashiorkar. The striking absence of fibrosis in all cases indicates that in spite of profound morphological changes in the liver at the height of the disease, kwashiorkar and is not necessarily followed by permanent and progressive hepatic fibrosis eventuating in cirrhosis.

Studies on the various aspects of lactation in poor Indian communities have been carried out. The experiments on the effect of dietary protein supplementation on lactation indicate that an increase in protein intake from 60 to 100 g. daily results in an appreciable increase in the 24 hr. output of breast milk but there is no appreciable increase in the total protein output in milk.

Experimental, clinical and epidemiological study has been carried out on the role of different nutritional factors in influencing the susceptibility to tuberculosis infection, and in determining the course and prognosis of established tuberculosis infection. No significant differences could be observed between animals on the different levels of protein intake as judged by the percentage of animals infected in each group, the extent and intensity of the lesions and by the survival rate. Among rats on vitamin A-deficient diet, the percentage of animals infected and the extent and severity of the lesions were appreciably greater than in the control group. Results of the metabolic study with human cases of tuberculosis indicate that there is considerable retention of nitrogen, calcium and phosphorus.

The effects of dietary factors on serum cholesterol have been studied and the results of epidemiological study indicate that (i) the values for serum cholesterol among the poor in India are considerably lower than those reported for European and American populations; (ii) in all groups, serum cholesterol values tend to increase from the 20th to about 35th year; and (iii) after 35th year the poor groups had a stationary and declining serum cholesterol but in the well-to-do, the level tends to rise progressively with age. The results of experimental study with human volunteers and monkeys show that the type of fat has an influence on serum cholesterol levels. Those receiving hydrogenated vegetable fat show a marked rise at the end of one week; the level continued to stay above basal till the end of the experimental period. On the other hand, subjects receiving sesame oil do not show such a marked rise and the values return to sub-normal by the fourth week and continue to remain there.

*Pathology*—The study of the pathology of infantile cirrhosis has shown that the pattern of histological changes in these conditions closely resembles the several changes that occur at different stages of infective hepatitis in adults. These findings are suggestive of common viral aetiology of infantile cirrhosis and allied disorders of childhood.

Supplement

# ABSTRACTS

of Published Research Papers from National Laboratories  
and Sponsored Research Projects of C.S.I.R.

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92. FINCH, G. I., SINHA, A. P. B. & SINHA, K. P.: Crystal distortion in ferrite-manganites, *Proc. roy. Soc.*, **242A** (1957), 28

The origin of the distortion of spinels from cubic to tetragonal symmetry is examined in the case of copper ferrites and a series of manganite-ferrite systems.

The degree of distortion is found to depend on the temperature and the net fraction of cations forming appropriately orientated  $dsp^2$  bonds in octahedral sites.

Expressions derived agree satisfactorily with the experimental data.

93. KRISHNAN, S.: A contour generator for X-ray crystal structure analysis, *J. sci. industr. Res.*, **16B** (1957), 432

An electronic device has been developed for the presentation of a two-dimensional function as a contour map on the screen of a cathode ray oscillograph, to be used in conjunction with an analogue computer for X-ray crystal structure analysis. The function to be plotted is fed as an electrical voltage to one pair of plates of a cathode ray tube in front of which a system of slits and a photomultiplier are placed. The pulse output from the photomultiplier intensifies the spot on a second oscillograph whose  $x$  and  $y$  time bases are properly synchronized with the scanning of the function. The image

photographed from the second cathode ray tube is the contour map.

#### C25 : 63 Viscosity 532.13

94. KAPUR, S. L. & GUNDIAH, S.: Anomalous behaviour of polymer solutions: Part I — Non-Newtonian behaviour of polyvinyl acetate solutions, *J. Polym. Sci.*, **26** (1957), 89

The viscosity behaviour of dilute solutions of polyvinyl acetate fractions in benzene has been investigated at different shear rates and at two temperatures ( $40^\circ$  and  $-29^\circ\text{C}.$ ). The importance of the effect of shear on the various physical constants has been discussed. It is shown that the value of Huggin's constant  $k'$  at zero shear is independent of molecular weight for a given polymer and is a fundamental property associated with the inherent character of the polymer chains and their interaction with the solvent at a particular temperature.

#### C4 Heat 536

#### C4 : 14 Conduction 536.2

95. SAXENA, S. C.: Thermal conductivity of binary and ternary mixtures of helium, argon and xenon, *Indian J. Phys.*, **31** (1957), 597

The thermal conductivities of the binary gas mixtures A-He, A-Xe and He-Xe have been determined for various concentrations by using the 'hot wire' method. The experimental values of thermal conductivity are in



good agreement with the values calculated on the Chapman-Enskog theory for the Lennard-Jones 12-6 model. The experimental data over the entire range of concentration for each mixture have been formulated by means of an empirical equation containing two constants. These expressions will be of great use for gas analysis in the usual experiments on diffusion and thermal diffusion. A simple modification of the Lindsay-Bromley formula suggested by Srivastava and Saxena is found to reproduce the experimental data extremely well. The thermal conductivities of the ternary mixtures of argon, helium and xenon have also been measured. The experimental values are found to be in good agreement with those calculated on the basis of a simple formula suggested by Srivastava and Saxena and obtained as an extension of the formula suggested by Lindsay and Bromley for binary mixtures.

### C5 Light 535

#### C5:3 Spectroscopy 535.33

96. RAMAMURTY, S., JAGANNATHA RAO, M. & RAMAKRISHNA RAO, V.: Analysis of the near ultraviolet absorption spectra of  $\alpha$  and  $\beta$  fluoronaphthalenes, *Indian J. Phys.*, **31** (1957), 497.

The near ultraviolet absorption spectra of  $\alpha$  and  $\beta$  fluoronaphthalenes were found to consist of two systems: one in the region 3100-2900Å. and another in the region 2800-2500Å. The first systems were analysed on the basis of five and four upper state fundamentals in  $\alpha$  and  $\beta$  fluoronaphthalenes respectively and two lower state fundamentals in  $\beta$  fluoronaphthalene. Only one upper state fundamental could be found in system II. Both the systems correspond to allowed transitions of the type  ${}^1A' \rightarrow {}^1A'$ .

97. SURYANARAYANA, V. & RAMAKRISHNA RAO, V.: Analysis of the near ultraviolet absorption spectrum of *p*-chloroanisole, *Indian J. Phys.*, **31** (1957), 619

The near ultraviolet absorption spectrum of chloroanisole has been studied. The discrete bands were analysed as due to an allowed transition  ${}^1A_1 \rightarrow {}^1B_1$ . Out of the 100 bands observed, 88 could be explained on the basis of five fundamentals in the upper state (341, 621, 779, 1053 and 1271) and four funda-

mentals in the ground state (361, 641, 802 and 1111). The above fundamentals were correlated mutually and with Raman data and possible assignments discussed. The occurrence of  $CH_3$  bending frequency in all substituted anisoles was discussed and established.

98. SURYANARAYANA, V., ACHYUTA RAO, I. & RAMAKRISHNA RAO, V.: The fluorescence and emission spectra of the three isomeric fluorotoluenes, *Trans. Faraday Soc.*, **53** (1957), 1570

The near ultraviolet fluorescence and emission spectra of the three isomeric fluorotoluenes in the vapour phase were obtained and analysed in co-ordination with each other. The molecular vibrational frequencies obtained from this analysis are correlated with the values from Raman and near ultraviolet absorption spectra. Possible assignments are also suggested.

### C6 Electricity 537

#### C6:14 Dielectric 537.311

99. ARVIND VYAS: Microwave dielectric measurements on indigenous oils at 3 cm., *J. sci. industr. Res.*, **16B** (1957), 481

The dielectric constant and dielectric loss of several indigenous oils have been determined in a dielectric cell designed for the purpose employing the standing wave technique. The accuracy achieved in dielectric constant measurements was of the order of  $\pm 1$  per cent and in dielectric loss measurements  $\pm 5$  per cent.

### D ENGINEERING 62

#### D1 Civil Engineering 624

##### D321:32 Soil Mechanics 624.131

100. MOHAN, D. & JAIN, G. S.: Field vane shear test, *Civ. Engng, Lond.*, **52** (1957), 1387

The results of the shear strength tests of soft, sensitive clays *in situ* are compared with unconfined compression test results obtained in the laboratory. The results indicate that vane shear test gives more reliable values for shear strength than unconfined compression test; the former test is quicker and easier.



**E CHEMISTRY 54**

**E : 2 Physical 541.1**

**E : 213 Chemical Kinetics 541.66**

101. GOSWAMI, A. & TREHAN, Y. N.: The thermal decomposition of cupric oxide *in vacuo*, *Proc. phys. Soc., Lond.*, **70B** (1957), 1005

The effect of thermal treatment of cupric oxide at 350°C. at low pressures ( $\sim 10^{-2}$  mm. Hg), both in the presence and absence of metallic copper, has been studied by electron diffraction. Contrary to the view that at lower temperatures and pressures, the change from cupric to cuprous oxide occurs through the reaction  $\text{CuO} + \text{Cu} \rightarrow \text{Cu}_2\text{O}$ , it has been found that cuprous oxide is formed even in the absence of the free metal. The reaction  $4\text{CuO} \rightarrow 2\text{Cu}_2\text{O} + \text{O}_2$  is known to take place at 1050°C. at atmospheric pressure. The present results show that in accordance with the law of mass action the same reaction is brought about at much lower temperatures and at reduced pressures.

**E : 2133 Phase Systems 541 : 1201**

102. RAMAKRISHNA RAO, M.: Melting points of certain phase relationships in the system magnesium orthosilicate, magnesium orthotitanate and magnesioferrite, *J. sci. industr. Res.*, **16B** (1957), 444

The fusion points of the system forsterite-magnesium orthotitanate-magnesioferrite have been studied. Cone softening and melting determinations were made in the binary joins and in a limited area of the ternary system. The solid solution phenomenon between magnesium orthotitanate and magnesioferrite was studied by measuring the unit cell edges as determined by X-ray diffraction. The effect of the presence of iron oxide and titania in forsterite refractories has been determined in relation to the results obtained.

103. SESHADRI, K. & LOBO, J.: Polytherm of the quaternary system sodium chloride-sodium sulphate-sodium carbonate-water, *J. sci. industr. Res.*, **16B** (1957), 531

The quaternary system  $\text{NaCl}-\text{Na}_2\text{SO}_4-\text{Na}_2\text{CO}_3-\text{H}_2\text{O}$  has been studied at 10°, 5°, 0°

and -5°C. and the results plotted in a three-dimensional co-ordinate system. The data obtained indicate that all the components of the system can be separated by chilling and fractional crystallization.

**E : 232 Surface Chemistry 541.83**

104. PURI, BALWANT RAI, KHANNA, SOM NATH & MYER, Y. P.: Studies in properties of capillary-held liquids: Part III — Boiling points of liquids adsorbed on porous solids, *J. sci. industr. Res.*, **16B** (1957), 452

Elevations in the boiling points of chloroform, benzene, dioxane, acetone, ethyl alcohol adsorbed on silica gel, alumina gel and bentonite at different relative pressures have been determined and compared with theoretical values based on the theory of capillary condensation. The relative vapour pressure above which the agreement is valid varies from 0.32 to 0.54 depending upon the nature of the adsorbate. The critical capillary radius, above which the agreement holds good, depends upon the molecular thickness of the adsorbate. Capillary condensation appears to set in after the formation of an adsorbed monomolecular film.

105. PURI, BALWANT RAI, KHANNA, SOM NATH & MYER, Y. P.: Studies in properties of capillary-held liquids: Part IV — Isothermic heats of adsorption, *J. sci. industr. Res.*, **16B** (1957), 456

Isothermic heats of adsorption can be obtained fairly accurately by measuring vapour pressures of the systems at different temperatures. The heat of adsorption for an adsorbate depends upon the relative pressure at which the adsorption takes place and is almost independent of the nature of the adsorbent. It decreases with increase in the relative pressure and tends to approach, but does not equal, the heat of liquefaction.

**E : 26 Electrochemistry 541.13**

106. HIRA LAL & NARASINGA RAO, M. S.: Metal-protein interactions in buffer solutions: Part I — An electrophoretic study of the interaction of copper, zinc, cadmium and cobalt ions with native

and modified bovine serum albumins,  
*J. Amer. chem. Soc.*, **79** (1957), 3050

General concepts governing the metal-protein interactions in buffer solutions have been outlined. It has been shown that the binding data should be supplemented by mobility measurements if the interactions are to be treated as a competition between the metal and hydrogen ion for combining with a given set of sites on the protein molecule. The existing data for the binding of cupric and cobaltous ions by bovine serum albumin in an acetate buffer of  $pH$  6.5 and ionic strength 0.20, together with the corresponding mobility data reported in the present communication, have been analysed. The intrinsic constant for the association of cobaltous ion with the carboxyl groups of serum albumin remained constant over the entire binding range, and had a low value characteristic of metal-acetate complexes. The constant for the association of cupric ion with the imidazole groups of serum albumin, however, tended to decrease with the number of bound metal ions, due, possibly, to an increased interaction, in the higher binding region, with the free carboxyl groups of the protein.

- 107.** INDRA SANGHI & WYNNE-JONES, W. F. K.: Electrodeposition and dissolution of zinc in zincate solutions, *Proc. Indian Acad. Sci.*, **46A** (1957), 309

The possibility of efficient and reversible deposition and dissolution of zinc in zincate solutions has been studied. Zinc deposited from zincate baths is powdery and non-adherent in nature, and at higher current densities (i.e. 10-50 mA./sq. cm.) and higher ionic zinc contents in the electrolyte (above 2.5N KOH) high efficiencies (95 per cent) are achieved. Zincate solutions alone are not quite satisfactory to give adherent and even deposits; the presence of traces of Pb in the alkaline zincate bath greatly improves the nature of zinc deposition. Employing radio-tracer technique (thorium B) for the study of the role of  $Pb^{++}$  in improving the zinc deposition from zincate baths it was found that lead is preferentially deposited from the electrolyte.

- 108.** NARASIMHAM, K. C., NARAYANASWAMI, A. & DEY, B. B.: Electrolytic preparation of perchlorates, *J. sci. industr. Res.*, **16A** (1957), 512

Optimum conditions for the electrolytic oxidation of chlorate to perchlorate have been established with a view to designing a large-scale unit for the production of ammonium and potassium perchlorates. Current efficiencies of the order of 96 per cent have been achieved in an experimental cell ( $7.5 \times 4.0 \times 7.0$  cm.) under the following conditions: electrolyte composition (g./litre) —  $NaClO_3$  600;  $K_2Cr_2O_7$  0.6;  $K_2CrO_4$  0.6; and  $MgCl_2$  1.0; voltage 5.0-5.5; current density 40 amp./sq. dm.;  $pH$  6.0-7.0; temperature 30°C. The current efficiency dropped to 85 per cent when a larger cell ( $16 \times 10 \times 16$  cm.) was employed.

Methods for the isolation and purification of ammonium and potassium perchlorates have been described; the purity of the perchlorates achieved was 99.50 and 99.87 per cent respectively.

A simple method for the estimation of chloride, chlorate and perchlorate in the presence of one another is described.

### E : 3 Analysis 543

- 109.** RAJAN, K. S. & GUPTA, J.: Separation of zirconium and hafnium using anion-exchange resins: Part II — Influence of physical factors, *J. sci. industr. Res.*, **16B** (1957), 459

The influence of some factors on the differential elution of hafnium and zirconium on Amberlite IRA 400 anion-exchange resin was investigated to ascertain the optimum conditions for the separation of hafnium from zirconium. The data obtained from experiments on 200 mg. mixed oxide were successfully applied to 5 g. mixed oxide loads on Amberlite IRA 400 and Dowex 2 columns for preparing spectroscopically pure hafnium and zirconium oxides.

### E : 305 Photomethods 545.8

- 110.** SARMA, B.: Detection and colorimetric estimation of vanadium by tiron, *J. sci. industr. Res.*, **16B** (1957), 569

Tiron (sodium salt of 1, 2-dihydroxybenzene 3, 5-disulphonic acid) gives a highly soluble bluish violet complex with soluble vanadium salts in weakly acidic medium. One p.p.m. of vanadium can easily be detected by the colour of the complex and 0.3 to 50 p.p.m.

spectrophotometrically. Presence of alcohol increases the stability and sensitivity of the coloured complex.

111. SARMA, B.: Spectrophotometric estimation of molybdenum with tiron, *J. sci. industr. Res.*, **16B** (1957), 478

Tiron (sodium salt of 1, 2-dihydroxybenzene 3, 5-disulphonic acid) gives a highly soluble orange complex with soluble molybdates in weakly acidic or neutral medium. The appearance of the colour is immediate and there is no apparent decrease in colour intensity on long standing. Molybdenum (1 p.p.m.) can be easily detected by the colour of the complex and 0.2 to 40 p.p.m. can be spectrophotometrically estimated with an error of  $\pm 2$  per cent.

**E: 34 Quantitative 545**

112. NANAVATI, D. C., DASGUPTA, SHARDA & AGGARWAL, J. S.: Estimation of trans *iso*-oleic acids in hydrogenated fats, *J. Indian chem. Soc.*, **34** (1957), 885

The modified Twitchell lead salt-alcohol method of Cocks *et al.* has been found to provide an accurate method for the estimation of trans *iso*-oleic acids in hydrogenated fats taking the infrared absorption spectrophotometric procedure as the standard.

**E1 Inorganic 546**

**E144 Zirconium 546.831**

113. KAPOOR, R. N. & MEHROTRA, R. C.: Organic Compounds of Zirconium: III—Study of catechol derivatives of zirconium by electrometric titrations, *Z. anorg. Chem.*, **293** (1957), 92

A study of the formation of catechol derivatives of zirconium has been made by *pH* measurements. It has been shown that the extent of chelation becomes greater with increasing *pH* of the solution. In acidic range, the results indicate the formation of a mono-catecholate derivative only even though the catechol may be present in a much higher molar ratio. The results further confirm the formation of derivatives of the type  $K_2[Zr(C_6H_4O_2)_3]$  in solution and indicate

that the maximum co-ordination number that zirconium can achieve by chelation with catechol is six. The formation of another new derivative  $K[(OH)Zr(C_6H_4O_2)_2]$  is also indicated by these studies.

114. KAPOOR, R. N. & MEHROTRA, R. C.: Organic Compounds of Zirconium: IV—Study of catechol derivatives of zirconium by conductometric and precipitation methods, *Z. anorg. Chem.*, **293** (1957), 100

A study of the formation of catechol derivatives of zirconium has been made by conductometric titrations and also by directly analysing the derivatives obtained under different experimental conditions. In conformity with the conclusions drawn from a previous electrometric study, it has been found that mainly monocatecholate derivative is formed when the solution is acidic (*pH* 1.5-5.0). The results further confirm the formation of derivatives of the type  $K_2[Zr(C_6H_4O_2)_3]$  and  $(NH_4)_2[Zr(C_6H_4O_2)_3]$  in solution and conductometric studies indicate that the maximum co-ordination number that zirconium can achieve by chelation with catechol in solution is six. Two new compounds,  $(NH_4)_2[Zr(C_6H_4O_2)_3]$  and  $(NH_4)_2[(OH)Zr(C_6H_4O_2)_2]$ , have been isolated and it has been shown that the composition of the above derivatives also is in conformity with that obtained from physico-chemical measurements.

**E5 Organic 547**

**E5: 4 Organic Synthesis 547.1**

115. AGHORAMURTHI, K., SESHADRI, T. R. & VENKATASUBRAMANIAN, G. B.: Synthesis of dimethyl thamnolate and dimethyl hypothamnolate, *Tetrahedron*, **1** (1957), 310

Methyl-5-hydroxyhaematommate and methyl 5-hydroxy- $\beta$ -orcinolcarboxylate are conveniently prepared by the application of par-nuclear oxidation using methyl haematommate and methyl  $\beta$ -orcinolcarboxylate respectively. These undergo preferential acylation of the hydroxyl group in the meta (5) position and by employing this property, syntheses of dimethyl thamnolate and dimethyl hypothamnolate have been accomplished.

116. BHIDE, G. V., TIKOTKAR, N. L. & TILAK, B. D.: Synthesis of furanosteroid, *Chem. & Ind.*, (1957), 1319

Synthesis of a furanosteroid, 15-carbethoxy-14:15 dehydro-B-nor-oxaequilenin methyl ether, a key intermediate in the synthesis of furan analogue of equilenin, is reported.

117. CHATTERJEE, A., CHATTERJEE, R. C. & BHATTACHARYYA, B. K.: Synthesis of 5-keto-9-methoxy-1:2:3:4:4a:5:6:6a:11a:11b-decahydrochrysofluorene, *J. Indian chem. Soc.*, **34** (1957), 855

The condensation of 1-acetyl- $\Delta^{1:2}$ -cyclohexene with 5-methoxy-1-indanone in the presence of potassium *tert*-butoxide furnished 5-keto-9-methoxy-1:2:3:4:4a:5:11a:11b-octahydrochrysofluorene which was catalytically reduced to 5-keto-9-methoxy-1:2:3:4:4a:5:6:6a:11a:11b-decahydrochrysofluorene.

#### E6894 Cellulose 547.458.81

118. VYAS, G. M.: Chemical analysis of bamboo tissues, *Cellulose Research — A Symposium* (Council of Scientific & Industrial Research, New Delhi), 1958, 83

Cellular constituents like fibres, parenchyma cells, epidermal and nodal tissues isolated from raw untreated bamboo (*Dendrocalamus strictus*) have been chemically analysed.

#### E7 Aromatic Compounds 547.52

##### E792 Alcohols 547.593

119. GOVINDACHARI, T. R. & NAGARAJAN, K.: Chemical investigation of *Cardanthera uliginosa*, *J. sci. industr. Res.*, **16B** (1957), 511

The triterpene alcohol, lupeol, has been isolated from the roots, stem and leaves of the plant *Cardanthera uliginosa*, belonging to the Acanthaceae family.

##### E9 Biosubstances 543.9

##### E92 Alkaloids 547.94

120. GOVINDACHARI, T. R., LAKSHMIKANTHAM, (Miss) M. V., NAGARAJAN, K. &

PAI, B. R.: Structure of tylophorine, *Chem. & Ind.*, (1957), 1484

Exhaustive degradation studies have shown that tylophorine, the major alkaloid of *Tylophora asthamatica*, is 2:3:6:7-tetramethoxyphenanthro (9:10:6':7') indolizidine.

Vigorous oxidation of tylophorine methiodide gave only *m*-hemipinic acid. Treatment of the alkaloid with cyanogen bromide gave a bromocyanamide, which reacted readily with diethylamine, indicating the presence of a benzylamino group. Facile conversion of the bromocyanamide to a hydroxycyanamide, which on hydrolysis regenerated tylophorine, proved the presence of a 1:5- or 1:6-aminoalcohol system in the hydroxycyanamide. The reversion of tylophorine methine to tylophorine methohydroxide on reduction indicated that the alkaloid had the nitrogen common to two rings which are five or six-membered. Emde degradation of tylophorine *isomethochloride* to *isodihydrohomotylophorine* and dehydrogenation of the latter yielded a pyrrole derivative which regenerated the Emde base on hydrogenation; this definitely proved that one of the nitrogen-carrying rings is five-membered. Hofmann degradation of the Emde base gave a basic compound which on oxidation followed by decarboxylation gave 2:3:6:7-tetramethoxy-9-methylphenanthrene, identified by synthesis.

A synthesis of the basic ring system, phenanthro-(9:10:6':7') indolizidine, present in tylophorine has been completed.

##### E92Z Amino Acids 547.466

121. RAMACHANDRAN, B. V.: An improved method for the isolation of L-arginine monohydrochloride via the flavianate, *J. sci. industr. Res.*, **16C** (1957), 196

A comparative study has been made of some of the well-known methods for the isolation of arginine via the flavianate. By determining the losses of arginine at various steps and the conditions under which these losses occur, a method has been worked out by which arginine is obtained as the pure hydrochloride with an average yield of 88 per cent.

**E94 Fats 547.915**

122. SUBRAMANYAM, V. V. R. & ACHAYA, K. T.: Lesser known Indian vegetable fats: I — Oleic-rich fats, *J. Sci. Fd Agric.*, **8** (1957), 657

Five oleic-rich seed fats of Indian origin, viz. those derived from soapnut, papaya, *nux vomica*, sweet almond and *guara*, have been analysed for component fatty acids by ester fractionation. All are potentially capable of collections at single locations. Possible uses are suggested.

123. SUBRAMANYAM, V. V. R. & ACHAYA, K. T.: Lesser known Indian vegetable fats: II — Linoleic-rich fats, *J. Sci. Fd Agric.*, **8** (1957), 662

Four linoleic-rich seed fats of Indian origin, viz. sweet orange, coffee (Arabica variety), coffee (Robusta variety) and teak, have been analysed for component fatty acids by ester fractionation. The comparatively saturated nature of tropical seed fats over their temperate counterparts is again revealed. Family relationships between orders is discussed.

**E95 Pigments 547.97**

124. LEWIS, Y. S., DWARKANATH, C. T. & JOHAR, D. S.: Further studies on red tamarind, *Curr. Sci.*, **26** (1957), 394

Morphological studies on the flowers of red tamarind have been carried out to locate the site of pigmentation. A study of free-hand transverse sections at different regions of the pistil has revealed that pigment is located in sub-epidermal layers of the ovary.

The chemical analysis of the fully matured fruits shows higher pectin content and combined acids in the red variety as compared to the common variety.

**E96 Biochemistry 547.97**

125. PAL, P. R., BANERJEE, B. N. & GUHA, B. C.: The utilization of some *p*-aminobenzoyl peptides by *Streptococcus faecalis* and *Lactobacillus arabinosus*, *Ann. Biochem.*, **17**(5) (1957), 151

Six *p*-aminobenzoyl peptides were synthesized and their utilizability by two organisms, *Streptococcus faecalis* R. and *Lactobacillus arabinosus* 17-5, A.T.C.C. No. 8014,

has been studied. The results show that most of the *p*-aminobenzoyl derivatives investigated are not utilized by the two organisms and their utilizability is specific. It is inferred that the amino acids are not anabolized into proteins by *S. faecalis* R. and *L. arabinosus* via the formation of *p*-aminobenzoyl derivatives, though it is conceivable that they are so anabolized via other peptides.

126. SAHA, KUNAL, BHOWMIK, D. N. & CHAUDHURI, S. N.: Effect of antiserum on bacterial adaptation: Part II — Rate of lactose utilization by antiserum treated cells, *Ann. Biochem.*, **17**(6) (1957), 193

Utilization of lactose from the adapting medium during  $\beta$ -galactosidase induction by *Escherichia coli* (strain AB, IBEM/02) has been studied. The utilization was greatly accelerated by the bacteria when it was pre-adapted with lactose before the utilization experiment. Dinitrophenol (DNP) and sodium fluoride were almost completely inhibitory to such utilization both in the non-adapted and pre-adapted bacteria. But DNP was seen to stimulate methylene blue reduction by the pre-adapted bacteria while fluoride was inhibitory. Exposure to the specific antiserum against this strain would markedly retard the rate of lactose utilization by such bacteria after it is pre-adapted with lactose, as compared to the control sets treated with rabbit's normal serum.

**E9G922 Proteins 547.96**

127. BANNERJEE, A.: Variations in protein and amino acid contents between smooth and rough forms of certain serological types of *Escherichia coli* and their relation to DNA contents, *Ann. Biochem.*, **17**(6) (1957), 199

Four serotypes of *Escherichia coli*, 0111B4, 026B6, 055B5 and 086B7, which are widely considered to be pathogenic in the production of infantile diarrhoea, were investigated for their protein and amino acid contents during both the smooth (S) and rough (R) phases. The protein content was found to diminish appreciably (5 to 12 per cent) in all strains during S-R variation, except in the case of 026B6 where it showed a slight relative increase in the R phase. Lysine, histidine,

valine and phenylalanine were found to diminish consistently in the R phase whereas aspartic acid content decreased in all R phases except 055B5 and tyrosine in all except 026B6.

The DNA contents of these strains were also examined and found to diminish in the R phase except in the case of 026B6 where it remained stationary, thus showing some relation to protein contents. The stable rough variants of the strains were obtained by repeated passages through broth containing specific antiserum, about 35 to 45 passages being required for the different strains.

- 128.** DATTA, JYOTIRINDRA, BHATTACHARYA, K. R., SEN, ARATI & ROY, D. K.: Oxidation of methionine with hydrogen peroxide vapour: Its application in paper chromatographic analysis of the amino acid, *Ann. Biochem.*, **17**(6) (1957), 211

A method for the estimation of methionine and valine in protein hydrolysates has been standardized. It consists in converting methionine to methionine sulphoxide by exposing the 'spots' to hydrogen peroxide vapour, under mild conditions, and separating the valine spot by multiple development in *n*-butanol-acetic acid-water solvent (4: 1: 1). In a parallel sheet, with the omission of hydrogen peroxide treatment, combined methionine plus valine spot is obtained by the same procedure. From the ninhydrin colour readings of these spots the amino acids are determined. The accuracy of the method is of the order of  $\pm 5$  per cent.

#### E9G982 Enzymes 577.25

- 129.** APTE, USHA & SOHONIE, KAMALA: Trypsin inhibitors in Indian foodstuffs: Part IV — Effect of double bean (*Faba vulgaris* Moench) trypsin inhibitor on the *in vitro* digestion of proteins by trypsin, *J. sci. industr. Res.*, **16C** (1957), 225

The trypsin inhibitor present in double bean has been shown to markedly affect the rate of tryptic hydrolysis of proteins of skim milk and wheat flour. The release of some amino acids is selectively inhibited; the inhibition gradually decreases with the progress of digestion. The purified inhibitor fed to

rats at 0.265 per cent level of the diet does not, however, inhibit their growth.

- 130.** CHATTERJEE, G. & SARKAR, N. K.: Studies on the mechanism of blood coagulation by proteolytic enzymes: Part I — Effect of calcium on the clotting and proteolytic activities of papain and trypsin, *Ann. Biochem.*, **17**(6) (1957), 179

Decalcified papain does not coagulate decalcified rabbit plasma without the addition of calcium ion. Decalcified trypsin can coagulate decalcified rabbit plasma in the absence of calcium, though its presence greatly increases the clotting activity of trypsin. Calcium ion has also no effect on the proteolysis of decalcified plasma by decalcified papain or decalcified trypsin. The clotting and proteolytic properties of papain and trypsin are not identical, in so far as their dependence on calcium is concerned.

- 131.** CHATTERJEE, G. & SARKAR, N. K.: Studies on the mechanism of blood coagulation by proteolytic enzymes: Part II — Optimum *pH* for the proteolytic and clotting activities of papain and trypsin, *Ann. Biochem.*, **17**(6) (1957), 183

Decalcified trypsin and decalcified papain coagulate decalcified plasma optimally at *pH* 6.1 and 6.3 respectively. The *pH* optima for the proteolysis of decalcified plasma by decalcified trypsin and decalcified papain are 8.04 and 5.6 respectively. The *pH* optima for clotting and for proteolysis by either papain or trypsin are different. Since *pH* optimum of each enzyme for the clotting differs from that for their proteolytic activity, it is reasonable to assume that these two properties of each enzyme are not similar.

- 132.** GUPTA, P. S. & CHATTERJEE, J.: Quantitative histochemical determination of alkaline phosphatase activity, *Ann. Biochem.*, **17**(5) (1957), 129

A simple microphotometric method for the quantitative histochemical determination of alkaline phosphatase has been evolved. Sections of the guinea-pig kidney were stained according to modified Gomori's technique and incubated in glycerophosphate substrate media (i) of varying *pH* ranging from 7.5 to 9.4 and (ii) for varying duration from  $\frac{1}{2}$  to 4 hr. The gradation of stains in the series of



slides was measured photometrically through an ordinary microscope and with the help of a film exposure meter, giving the relative stain intensities in terms of relative exposure times.

- 133.** SIDDAPPA, G. S.: Effect of processing on the trypsin inhibitor in jack fruit seed (*Artocarpus integrifolia*), *J. sci. industr. Res.*, **16C** (1957), 199

Raw jack fruit seed contains a powerful trypsin inhibitor which can be extracted with phosphate buffer or dilute hydrochloric acid. The activity of the extract is destroyed almost completely by autoclaving it for about 30 min. and also by boiling the seeds in water or salt solution, or by baking.

- 134.** JANAH, (Mrs.) SOVA & CHAUDHURI, S. N.: A preliminary report on the cholinesterase activity of red cells in systemic anaphylaxis in rabbits, *Ann. Biochem.*, **17**(5) (1957), 135

The acetyl cholinesterase present in red blood corpuscles was measured in cases of systemic anaphylaxis in experimental animals by a colorimetric method. The activity of this enzyme showed a definite fall in such cases. This inhibition was found to be counteracted by the administration of 'Antistin', an antihistaminic compound, prior to the experiment.

- 135.** SRIKANTAN, T. N., AGARWALA, S. C. & SHRIVASTAVA, D. L.: Studies in the enzyme make-up of *Pasteurella pestis*: Part V—Dehydrogenase activity of virulent and avirulent strains, *Indian J. med. Res.*, **45** (1957), 567

Resting cells of *P. pestis* were found to be capable of dehydrogenating a large number of substrates in the presence of phenyl tetrazonium chloride. Glucose showed maximum activity. Lactic acid, succinic acid and cysteine were next in order. Glycerol showed no dehydrogenation. The optimum pH for dehydrogenation of lactate was found to be 7.0 for both virulent and avirulent strains. Using 8 virulent and 8 avirulent strains of *P. pestis* no general correlation could be found between virulence and dehydrogenation in this organism. Succinic dehydrogenation was almost completely inhibited by chlorotetracyclin, and only partially by oxytetracyclin, tetracyclin, chloromycetin, neomycin and dihydrostreptomycin. Since

chlorotetracyclin has been found to be a good inhibitor of the oxidative metabolism, the possibility of its being useful as a therapeutic agent in the treatment of plague has been suggested.

### E9G986 Hormones 577.17

- 136.** BANIK, U. K.: The effect of female sex hormones on the distribution of alkaline phosphatase in the uterus of sexually immature rabbits, *Ann. Biochem.*, **17**(5) (1957), 145

The distribution of alkaline phosphatase in the uterus of sexually immature rabbits, either normal or treated with female sex hormones, is reported. Oestrogen (150 I.U./3 days) and progesterone (0.5 mg./4 days) in sesame oil were administered by the intramuscular route. The experimental animals were sacrificed 24 hr. after the last injection. Sections of each corner of uterus were prepared according to the standard technique of Gomori for cytochemical studies. Very weak activity of the enzyme was noticed in the endometrium of these animals. Oestrogen induces a mobilization of the enzyme in all parts of endometrium but progesterone reduces its concentration in general and in the epithelial lining in particular. The pattern of distribution of alkaline phosphatase in rabbits resembles that of Rhesus monkeys and rats.

- 137.** BANIK, U. K. & CHAKRAVARTI, H. S.: Effect of *m*-xylohydroquinone on the peripheral action of progesterone, *Ann. Biochem.*, **17**(5) (1957), 139

The effect of the active principle, *m*-xylohydroquinone, of the common garden pea (*Pisum sativum*) on the peripheral action of the progesterone and also on the distribution of alkaline phosphatase in the uterus of immature female rabbits has been studied histologically and cytochemically. Oestrogen (150 I.U./3 days) and progesterone (0.5 mg./4 days) were administered by the intramuscular route. *m*-Xylohydroquinone was dissolved in warm distilled water and was given on the same day along with progesterone but at a different site. The influence of progesterone was evaluated from the degree of proliferation of the endometrium of the rabbit previously primed with oestrogen, and also from the antagonistic action of progesterone in the increased alka-



line phosphatase activity of the cells of endometrium induced by oestrogen.

By both the methods it is found that *m*-xylohydroquinone fails to inhibit the action of progesterone on the uterus of rabbit. This finding is contrary to the claim that *m*-xylohydroquinone inhibits the peripheral action of progesterone in rat and is an effective oral contraceptive.

## F TECHNOLOGY 66

- 138.** KRISHNASWAMY, N., GOVINDAN, K. P. & PANDYA, R. N.: Studies on cation-exchange resins: Part I—Preparation and properties of cation-exchange resin from cashew nut shell liquid, *Chem. & Ind.*, (1957), 1456

Commercial cashew nut shell liquid has been condensed with formalin under acidic conditions and the resulting polymer has been sulphonated with sulphuric acid to yield a stable cation-exchange resin with good capacity. The properties of the resin have been studied.

- 139.** NARASIMHA RAO, T. L. & DATAR, D. S.: Activated charcoal from groundnut hull: Part III—Comparative study of activated carbon from groundnut hull and teakwood sawdust, *J. Indian chem. Soc., industr. Edn.*, **20** (1957), 75

Comparative studies of activated carbon prepared from groundnut hull and teakwood sawdust have been made. Tests have been conducted for caramel decolourization and bleaching of vegetable oils and of adsorption of methylene blue, iodine and vapours in organic liquids.

## F191 Metallurgy 669

- 140.** DAS, B. N. & SANI, G. D.: Impact fatigue resistance of structural steels, *Trans. Indian Inst. Metals*, **10** (1956-57), 103

The impact fatigue properties of some structural steels were studied using transverse impact stressing on rotating unnotched test pieces. In the steels tested curves showing the kinetic energy/number of impacts exhibit the characteristic of S-N curves based on conventional fatigue tests, indicating a limiting value of kinetic energy (K.E.), i.e. a

definite endurance limit under impact. Using an ingenious electronic set-up of electrical resistance strain gauge and measuring units, it has been possible, for the first time, to find the stress criterion for failure under repeated transverse impact which provides data of fundamental value for designs based on impact stresses. It is further shown that endurance fatigue limit in transverse impact is slightly less than endurance limit under alternate bending; probable reasons for this slight difference have been discussed.

- 141.** GOSWAMI, J., CHATTERJEA, A. B. & NIJHAWAN, B. R.: Use of fusite in desulphurizing off-grade pig iron, *J. sci. industr. Res.*, **16A** (1957), 522

Off-grade pig iron was desulphurized with fusite in acid and basic lined ladles. Desulphurization in acid lined ladles was erratic due to the interaction of iron and/or manganese sulphide from the acid lining; the efficiency of desulphurization in basic lined ladle is determined by the initial sulphur content. Desulphurization improves the physical properties of pig iron.

- 142.** GUPTA, P. K., BHATNAGAR, S. S. & NIJHAWAN, B. R.: Phosphorus dilution of iron in small experimental cupola, *Trans. Indian Inst. Metals*, **10** (1956-57), 61

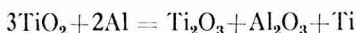
A small experimental iron cupola has been designed to work with the Indian high ash containing cokes. The cupola was successfully operated to obtain metal at sufficiently high temperatures suitable for nodularizing operations.

- 143.** MOHAN, J., GUPTA, P. K. & NIJHAWAN, B. R.: Direct reduction of iron ore to yield usable steel, *Trans. Indian Inst. Metals*, **10** (1956-57), 73

Further work on direct reduction of Sulaipat ore has been described. The ore has been electromagnetically treated to reduce the gangue material and extruded in the shape of bars with different binding agents. These bars are given varying reduction and sintering treatments to study the density of the reduced product. The reduced product is further forged and rolled. With the treated ore a good crack-free product could be obtained which could be forged and rolled easily to obtain steel comparing favourably with steel manufactured by normal processes.

- 144.** SHARMA, R. A., KAPOOR, A. N. & CHATTERJEA, A. B.: Preparation of titanium-aluminium alloys by aluminothermic reduction: Part I — "Modified aluminothermic", *Trans. Indian Inst. Metals*, **10** (1956-57), 169

Modified aluminothermic has been applied to the preparation of titanium-aluminium alloys by the reduction of titanium dioxide by aluminium. Theoretical calculations based on the equation given below indicate that a temperature of 1600°C. could be attained which, however, is not high enough to melt the reactants and products. Consequently preheating was adopted.



It was observed that an intimate mixture of titanium dioxide and aluminium powder reacted at about 660°C. but without any metallic separation. A comprehensive study of various factors like addition of cryolite, cryolite and fluorspar, holding time, preheating temperature, and method of mixing the reactants, has been made. Cryolite helped in getting better titanium content in the alloy. Addition of calcium fluoride to cryolite as a flux did not show any improvement. The reaction and the separation were favoured by a definite time given for the reaction. Higher temperature gave higher titanium contents in the alloy, but different mixing techniques did not have any pronounced effect.

- 145.** SHARMA, U. C., KRISHNAN, R. M. & NIJHAWAN, B. R.: Moulding characteristics of Allahabad sand, *J. sci. industr. Res.*, **16A** (1957), 517

The moulding characteristics of a pale grey sand from Allahabad have been studied. The sample, as received, had poor mechanical grading. Even after bonding with Bihar bentonite it exhibited poor moulding characteristics. Washing in a hydro-classifier yielded a fairly clean and well-graded product.

Mixtures suitable for making green sand moulds and baked cores for steel castings are obtained by adding suitable bonding materials, e.g. bentonite, dextrine, Kordek, double-boiled linseed oil and silica flour, to washed sand.

- 146.** SOMAYAJULU, B. V. & NIJHAWAN, B. R.: Moulding characteristics of Hardwar sand, *J. sci. industr. Res.*, **16A** (1957), 566

The moulding characteristics of a sand sample from Hardwar have been examined. As received, the sand exhibited poor refractoriness (Pyrometric Cone Equivalent — P.C.E. value 1570°C.) and low sintering range (1250°-1300°C.). The addition of Bihar bentonite to the sand at 5 per cent level imparted satisfactory green and dry compressive strength values, but the permeability and shatter index values were poor. The mixture, however, possesses satisfactory casting characteristics but few castings are of such simple shape and design as to warrant drawing a conclusive evidence in favour of declaring the sand as suitable for the steel foundry purpose.

#### F4414 Glass & Ceramics 666.3

- 147.** RAGHAVAN, A. S. & HARIHARAN, S.: Effect of block working on surface of optical quality, *J. sci. industr. Res.*, **16A** (1957), 574

The behaviour of the surface of a 6 in. optical disc when in and when taken out of a block of plaster of Paris-lime compound is described. The results indicate that the quality of the surface of optical disc when final figuring is done in the block is liable to alter when it is removed from the block. In such cases the final figuring of the surface is best done when it is out of the block.

- 148.** RAMAKRISHNA RAO, M., MOORTHY, V. K. & RABINDRA SINGH: Production of forsterite refractories using serpentine and dunite as raw materials: Part I — Development of suitable refractory composition using serpentine and dunite as raw materials, *Trans. Indian ceram. Soc.*, **16** (1957), 57

The investigation aims at developing forsterite refractories, using serpentine and dunite as raw materials. Serpentine from Ramla and Talagutu mines, Singhbhum district, Bihar and dunite from Chalk Hills, Salem district, Madras, have been used. The mineralogical changes taking place in the raw materials at various temperatures have been studied, without and with additions of magnesite, to determine the amount of magnesite and the firing temperature necessary for the complete conversion of the magnesium silicate rocks to forsterite. The refractory properties of various compositions were also determined.

On the basis of the data obtained from mineralogical studies and the refractory properties, suitable compositions were selected and grogs prepared for use in further studies.

### F55 Fuel 662.6

#### F551 Coal 662.66

149. CHAKRAVARTI, A. K., SARKAR, G. G. & LAHIRI, A.: A study of the operation of a 6 in. diameter cyclone washer, *J. Inst. Fuel*, **30** (1957), 612

The influence of various designs and operating factors on the performance of a 6 in.-diameter cyclone washer is described. The 6 in.-diameter cyclone has an average throughput capacity of 2.5 tons/hr. at a feed pressure of 15 lb./sq. in. The optimum size range of feed is  $\frac{1}{4}$  in. to 36 mesh (B.S.). The underflow and overflow nozzle diameters are among the important factors determining the yield and quality of clean coal. A comparative study of the operation of 3 in.- and 6 in.-diameter cyclone washers shows that both the units possess almost identical cleaning characteristics, but the chief differences between the two lie in their throughput capacity and the top size of the feed coal that can be treated in the cyclones of different diameters.

150. MAZUMDAR, B. K., ANAND, K. S., ROY, S. N. & LAHIRI, A.: Mechanism of oxidation of coal, *BrennstChemic*, **38** (1957), 305

The progressive variation of elementary composition and the formation of reactive oxygen groups, e.g. hydroxyl and carboxyl, in the course of low temperature oxidation in air at 170°C. in the case of two ranks of coal have been studied. It is shown that at any stage of oxidation practically all the incoming oxygen appears as reactive, the major part being from carboxyl. The unaccounted oxygen originally present in the coals appears to remain intact throughout the course of oxidation. Further, a rigorous calculation of ring indices (R/C) of the two coals and their final oxidized products indicates that the rings are not ruptured under the conditions of oxidation employed. In the light of these findings the mechanism of oxidation has been outlined.

151. MAZUMDAR, B. K., CHAKRABARTY, S. K. & LAHIRI, A.: Action of aqueous alkali on lignite, *J. sci. industr. Res.*, **16B** (1957), 519

The action of alkali on lignite has been studied under various experimental conditions. The elementary composition of the products, obtained when lignite is treated with 5 per cent caustic soda solution at room temperature for 20 min., revealed that the percentages of carbon in humic acid as well as in the residue are considerably lower than in the parent lignite. Further, oxygen groups analysis has shown a considerable formation of additional groups such as —OH and —COOH groups in the products. It has been suggested that the phenomena indicate a hydrolytic fission type of reaction brought about in lignite by alkali. The presence of flavone, lactone or similar structures in lignite may possibly account for the observed loss in carbon balance.

152. MUKHERJEE, P. N., BHOWMIK, J. N. & LAHIRI, A.: Mechanism of oxidation of coal with special reference to the products of oxidation, *Fuel, Lond.*, **36** (1957), 417

The mechanism of oxidation of coal in air (200°C.) is described with reference to the formation of active groups like —OH and —COOH. In low rank coals —COOH groups are mainly developed whereas for high rank coals both types of groups are formed on oxidation. With the progress of oxidation the humic acids get degraded and the equivalent weight, basicity, molecular weight, etc., gradually decline. It is shown that as the oxidation proceeds, the percentage of oxygen in the form of —COOH and —OH increases, but the total percentage of oxygen in the humic acids remains practically constant. As for the alkali-insoluble fraction of the oxidized coals, it is observed that there is little difference between them and the humic acids as regards elemental composition and distribution of —OH and —COOH groups. It is suggested that the alkali-solubility of the oxidized coal can be determined by its —COOH content as well as by the size of the ultimate units.

153. SARKAR, G. G.: New approach to coal cleaning efficiency, *Min. Engng, N.Y.*, **9** (1957), 1361

A comparison of washing units with revised evaluation of sharpness index has been made and the results are recorded. There is no strict correlation between sharpness index and cleaning efficiency which can specify the overall coal washing operation. The values of the sharpness index (as developed by the present study) are fairly independent of the densities of separation and of the characteristics of the coal treated; hence they may be used to define the efficiency or precision of separation of any washer. Vanderwall's efficiency equation with minor modifications is considered the most suitable for expressing the washing efficiency. The results obtained by the study on determination of sharpness index of pilot washing plants have also been included.

- 154.** SARKAR, S., RAO, V. V., DAS GUPTA, S. C. & DAS GUPTA, N. N.: Dilatometric properties of Indian coals, *J. sci. industr. Res.*, **16B** (1957), 539

The dilatometric properties of some Indian coals have been studied with a Sheffield Laboratory Coking Test apparatus. The characteristic temperatures, the percentage of expansion, etc., have been correlated with the rank of coal. On the basis of dilatometric behaviour, a classification has been suggested for Indian coals, with respect to their coking properties. The influence of test conditions, artificial oxidation and inert contents of coals on the dilatometric behaviour has also been studied.

#### F94 Oils & Fats 665.1

- 155.** ROY, B. R. & GUHA, B. C.: Stability of vanaspati containing different proportions of hydrogenated palm, linseed and mustard oils blended with hydrogenated groundnut oil, *J. sci. industr. Res.*, **16C** (1957), 231

The stability of vanaspati made up of a mixture of hydrogenated groundnut oil and hydrogenated red palm, linseed or mustard oils in varying proportions has been investigated and compared with that of hydrogenated groundnut oil under different storage conditions.

When stored in sealed tins, vanaspati samples containing different proportions of mustard oil do not exhibit any difference in their peroxide and acid values. In samples

containing linseed oil, the peroxide value rises markedly with higher proportions of linseed oil in the blend whereas only a slight increase is observed in acid value. Higher proportions of palm oil increase the acid value of the samples markedly but the peroxide value varies only slightly.

In samples stored in loose cover cans, higher proportions of linseed and mustard oils induce more peroxide formation whereas higher proportions of palm oil reduce it. A slight increase in acid value is observed in all samples, the increase being directly proportional to the proportion of the oils present in the sample.

Ethyl gallate suppresses peroxide formation markedly and acid value slightly in most cases.

Vitamin A is more stable in samples containing more of palm oil than in vanaspati made of groundnut oil alone but its stability is lower in samples containing linseed or mustard oil.

#### FJ3 Food 664

- 156.** BOSE, A. N. & AYAN DUTT, J. M.: Average bacterial load in vegetables at different stages during canning, *J. sci. industr. Res.*, **16C** (1957), 241

The average bacterial loads on certain vegetables (potato, cabbage and peas), at different stages of canning process were determined. Peeled and blanched potato had low bacterial count. Although two types of bacteria were isolated from raw potato, after blanching, the load of one type was low, indicating that major contamination in potato is due to a low heat-resistant bacterium. Higher bacterial load observed with blanched cabbage was probably due to contamination in blanch water.

- 157.** CHANDRASEKHARA, M. R., SWAMINATHAN, M., BHATIA, D. S. & SUBRAMANYAN, V.: Infant food from buffalo milk: I — Effect of different treatments on curd tension, *Food Sci.*, **6** (1957), 226

A simple curd tension meter for determining the curd tension of milk has been described. The effect of heat and addition of phosphates and citrate on the curd tension of buffalo milk has been studied and it has been found that the curd tension of buffalo milk

is reduced to a very low figure as a result of heat processing and addition of phosphates or citrate.

- 158.** CHANDRASEKHARA, M. R., SREENIVASAMURTI, V., SWAMINATHAN, M., BHATIA, D. S. & SUBRAHMANYAN, V.: Infant food from buffalo milk: II—Standardization of conditions for the preparation, *Food Sci.*, **6** (1957), 228

Infant food having a low curd tension, good solubility and palatability and low bacterial count has been prepared from buffalo milk collected from a dairy in Mysore. An infant food having a low bacterial count (35,600/g. of powder) could be prepared from liquid milk having high bacterial count (3-4 millions). When milk is collected in sterilized vessels and transported in a chilled condition, the bacterial count of the raw milk as well as that of condensed milk and infant food has been found to be very low. Collection and storage of milk for 1 and 3 hr. in brass vessels has been found to increase the copper content of the infant food to 8.3 p.p.m. and 14.1 p.p.m. respectively while infant food prepared from milk collected and stored in aluminium vessels had a low copper content (4.4 p.p.m.).

- 159.** CHANDRASEKHARA, M. R., SWAMINATHAN, M., BHATIA, D. S. & SUBRAHMANYAN, V.: Infant food from buffalo milk: III—Shelf life of the product, *Food Sci.*, **6** (1957), 232

The keeping quality of infant food prepared from buffalo milk using Niro spray drier and packed in air and in nitrogen has been studied. The food prepared from milk collected in aluminium vessels under average prevailing conditions in the dairy, and packed in 8 oz. cans under nitrogen (7.5 per cent O<sub>2</sub> in head space gas) had a shelf life of 8 months at 37°C. and about 16 months at 27°C. An infant food having a low bacterial count (4000/g.) and satisfactory shelf life could be prepared from dairy milk having a high bacterial count (4-5 millions). Contamination of milk with copper, caused by keeping the milk in brass vessels, affects adversely the shelf life of the infant food. Fair agreement was observed between the development of off-flavour assessed organoleptically and the peroxide value of the fat in the powder.

- 160.** CHANDRASEKHARA, M. R., DORAISWAMY, T. R., SWAMINATHAN, M., BHATIA, D. S., SANKARAN, A. N. & SUBRAHMANYAN, V.: Infant food from buffalo milk: V—Infant feeding trials, *Food Sci.*, **6** (1957), 241

Feeding experiments with an infant food prepared from buffalo milk were conducted in three centres under strict medical supervision on about 75 infants. The infant food contained 22 per cent protein and 14 per cent fat and was fortified adequately with vitamins A and D. Records regarding the growth and general health of the infants and the digestibility of the food were maintained. The results showed that all the infants digested the food readily. The infants consumed the reconstituted milk with great relish and there were no cases of vomiting after the ingestion of the milk. The average rate of growth of the infants was quite satisfactory, comparing well with the average rate of growth of Indian infants.

- 161.** KRISHNA MURTHY, K., NARAYANA RAO, M., SWAMINATHAN, M., BHATIA, D. S. & SUBRAHMANYAN, V.: Studies on the composition, storage and nutritive value of palm oil, *Food Sci.*, **6** (1957), 248

The results on the relative stability and nutritive value of refined and deodorized palm oil and palm oil blend as compared to hydrogenated groundnut oil have been reported. The keeping quality of the palm oil blend was found to be nearly the same as that of hydrogenated groundnut oil. Addition of butylated hydroxyanisole and propyl gallate with citric acid enhanced the keeping quality of the different oils. No significant difference was observed in the growth-promoting value, digestibility and effect on calcium and phosphorus metabolism of the three different fats.

- 162.** PINGALE, S. V., KADKOL, S. B., NARAYANA RAO, M., SWAMINATHAN, M. & SUBRAHMANYAN, V.: Effect of insect infestation on stored grains: II—Studies on husked, hand-pounded, milled raw rice and parboiled milled rice, *J. Sci. Fd Agric.*, **9** (1957), 512

Husked, hand-pounded, milled raw rice and parboiled milled rice obtained from the same strain of paddy (Halubbulu) were infested with *Calandra oryzae* for a period of 8 months and the changes brought about in



the different samples due to infestation have been studied. The results show that husked rice was infested to a greater extent than the other samples and developed an unhealthy appearance within two months of infestation. Parboiled and raw milled samples of rice were found to be least susceptible to infestation. Infestation of the rice grain increased the loss of starch in the gruel during cooking, the loss being maximum in the case of husked rice. An appreciable increase in the acidity of fat and a decrease in the thiamine content due to insect damage were observed. Some correlation was observed between the weight/volume ratio of uncleaned grain and the proportion of dust, loss in total weight, loss in thiamine and insect population.

- 163.** ROY, B. R.: Stability of vitamin A in vanaspati enriched with Vanitin, *J. sci. industr. Res.*, **16C** (1957), 236

The stability of vitamin A acetate in vanaspati enriched with Vanitin (Hoffmann-La Roche) used under different conditions of storage has been studied. The loss of vitamin A in the stored samples is rapid in the early stages after which it slows down. The protection afforded by the addition of ethyl and propyl gallates, nordihydroguaiaric acid (NDGA), butylated hydroxyanisole (BHA) and Tenox II (Eastman Kodak) is not appreciable in loose-cover cans.

Heating enriched vanaspati at 110°-50°C. for 2 min. does not result in a great loss of vitamin A, but heating at higher temperatures (200°-50°C.) for longer periods (5 min.) causes considerable loss.

During cooking there is appreciable loss of vitamin A, particularly when the same vanaspati is used for preparing successive batches of food. BHA offers some protection to vitamin A in the process of cooking.

- 164.** SUBRAHMANYAN, V., LULLA, B. S., JOHAR, D. S. & SWAMINATHAN, M.: Investigations on the medical properties of banana: Part I—The chemical composition and nutritive value of banana, *Ann. Biochem.*, **17**(5) (1957), 155

The drum-dried banana powder (*Poovan* variety) has been chemically analysed. Inclusion of the banana powder in synthetic or rice diets resulted in a lower absorption of nitrogen. Incorporation of the banana powder

in synthetic or rice diets resulted in three-fold increase in the faecal weight. The significance of the results is also discussed in the light of therapeutic properties of banana in diarrhoeal conditions.

### FM97 Leather 675

- 165.** BHASKARAN, R. & SEN, S. N.: Studies on insect damage to hides and skins: Part II, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 121

The nature of damage caused by the larval forms of *Attagenus gloriosae* to hides and skins is described. The larval forms of this beetle were noticed on flint and dry-salted cow hides and skins, and also on chrome-tanned leathers finished with hair on, on which they were found on the hairy side. In the process of feeding, which was mostly restricted to the hairy side, the epidermal tissue was eroded off, involving the grain layer also.

- 166.** BOSE, S. M. & MADHAVA KRISHNA, W.: Studies on proteases and amylases as unhairing agents for skins and hides with particular reference to reactions of skin mucoids with amylases, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 157

Using the latex of madar plants (*Calotropis gigantea*) and the water extract of germinated ragi (*Eleusine coracana*), which are rich sources of protease and amylase respectively, two new processes of enzymic unhairing have been developed.

The effect of certain antiseptics and preservatives on the activity of madar latex protease and 'ragi' amylase has been investigated and the results indicate that there is no inhibition of the protease and amylase activity when toluene or merthiolate is used as preservative. Antiseptics like phenol, iodine, etc., completely inhibit the protease or amylase activity.

The optimum conditions for the hydrolysis of skin mucoids by  $\alpha$ -amylase of 'ragi' have been investigated with particular reference to the effects of pH, temperature, enzyme and substrate concentrations, period of hydrolysis and addition of certain salts. It is observed that the optimum pH for the hydrolysis of skin mucoids by the total amylase of 'ragi' is 4.5 whereas the pH optima for  $\alpha$ -amylase and  $\beta$ -amylase are 5.0 and 4.5 respectively. Although both

$\alpha$ - and  $\beta$ -amylases are capable of hydrolysing mucoids with the production of reducing sugars, the  $\alpha$ -amylase activity has been found to be comparatively higher than the  $\beta$ -amylase activity. The optimum concentration of  $\alpha$ -amylase required for hydrolysis of 5 ml. of 5 per cent suspension of mucoids is 2 ml. of 4 per cent enzyme solution. The maximum hydrolysis of mucoids by  $\alpha$ -amylase takes place at 55°C., when the period of digestion is 30 min. The addition of certain salts, e.g. NaCl, MgCl<sub>2</sub>, to the  $\alpha$ -amylase preparation increases the enzyme activity only very slightly. Sodium chloride, however, has been reported to increase the activity of animal amylase appreciably.

The proteolytic activity of madar latex stored at 4°C. is significantly higher than that of the other samples stored at higher temperatures. Temperatures of 50°C. and above have been found to inactivate the enzyme at a very rapid rate. The storage property of the madar latex protease is higher at the neutral pH than at the natural pH of the latex (c. 5.0). Highly acidic or highly alkaline pH appears to inactivate the protease at a very rapid rate.

167. GHOSH, B. N. & GHOSH, S.: Swelling and shrinkage temperature of tanned collagen, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 176

From a consideration of the shrinkage phenomenon in the light of Flory's theory of the viscosity of high polymers, a relation has been obtained between the shrinkage temperature and isoelectric swelling of leathers having different degrees of cross-linking. Experimental data on the swelling and shrinkage temperature of formaldehyde and chrome-tanned leathers of different degrees of tanning have been shown to be in keeping with the above relation.

168. NANDY, S. C., SEN, S. N. & DAS, B. M.: A note on the yellow colouration of curing salt in the presence of sodium silicofluoride, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 91

It was observed that when sodium silicofluoride is mixed with common salt, containing iron salts as impurities, to increase its bactericidal value, the surface of experimental hide pieces cured with such salt develops yellow colour after some days. Evidences so far obtained are suggestive of

the formation of a complex probably of the composition ferrous mono ferri fluoride, FeF<sub>2</sub>, FeF<sub>3</sub>, 7H<sub>2</sub>O, which has a distinct yellow colour.

169. RAO, J. B. & NAYUDAMMA, Y.: Survey of the indigenous tanning materials of the Madras State: Part IV — *Dhawa* leaves (*Anogeissus latifolia*), *Bull. cent. Leath. Res. Inst.*, **4** (1957), 79

The utilization of *Dhawa* leaves in East India tannage has been studied. The material by itself has not been found to be useful as it imparts greenish tinge to the leathers tanned with it. However, blends of the leaves with *Goran* and *Karada*, which are by themselves unsuitable for E.I. tanning, have been found to yield leathers of good quality similar to those produced with imported wattle bark.

170. RANGANATHAN, S., BOSE, S. M. & NAYUDAMMA, Y.: A note on the tanning properties of hexamethylenetetramine-phenol complexes, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 127

While the molecular complexes of hexamethylenetetramine with resorcinol, catechol and pyrogallol are good tanning agents, the complex of hexamethylenetetramine with phenol has no tanning action. The difference in the tanning property of resorcinol-hexamethylenetetramine and phenol-hexamethylenetetramine has been investigated.

## H GEOLOGY 55

### H2 Petrology 552

171. MAHADEVAN, C. & SASTRY, A. V. R.: Distribution of radioactivity in the rocks of South India: Part IV — Fluorine-bearing granites of Podilikanigiri area and associated rocks, *Proc. Indian Acad. Sci.*, **46A** (1957), 333

The results of studies on the distribution of radioactivity in fluorine-bearing granites and associated rocks confirm that the metasomatically formed granites have higher radioactivity than the normal batholithic type of granites and granitization enhances the radioactivity of the country rocks. Radioactivity increases with increase in feldspathization of the country rocks.



I BOTANY 58

123 Fungi 582.28

172. SRIVASTAVA, O. P.: *Trichosporon cutaneum* from the foot-skin of man and the effect of antifungal drugs on it, *J. Indian bot. Soc.*, **36** (1957), 268

A detailed morphological and physiological study of a fungus isolated from the interdigital skin of the foot of a man has been made. It has been identified as a strain of *Trichosporon cutaneum*. This is the first record of this species from India. The fungus is non-pathogenic to laboratory animals and is more susceptible, *in vitro*, to undecylenic acid than to nycil and quinine compounds.

L MEDICINE 61

L : 3 Physiology 612

173. BEHKI, R. M., RAZDAN, M. & NATH, M. C.: Effect of acetoacetate on reduced glutathione and dehydroascorbic acid of the tissues of the scorbutic guinea-pigs, *J. sci. industr. Res.*, **16C** (1957), 193

Intraperitoneal injection of sodium acetoacetate to scorbutic guinea-pigs brings about further decrease in the ascorbic acid content of the different tissues, e.g. adrenals, kidney, liver, spleen, the decrease being proportional to the amount of acetoacetate injected. There is also a marked increase in the dehydroascorbic acid content of the tissues which is practically absent in normal tissues. The glutathione (GSH) contents of tissues of normal as well as scorbutic animals diminish as a result of acetoacetate injection. The mechanism by which acetoacetate causes depletion of blood GSH and gradual development of experimental diabetes has been discussed.

174. GHATAK, S., BROACH, C. W. & SINHA, B. N.: Studies on experimentally produced fracture in dogs: Part I—Changes in vitamin C metabolism, *Indian J. Physiol. Pharmacol.*, **1** (1957), 257

In view of the importance of ascorbic acid in osteoblastosis and the known decrease in various tissues and organs in experimentally produced fracture, changes in the concentration of this vitamin were studied, for both

oxidized and reduced forms, in circulation as well as at the site of fracture. The results indicated no significant day to day variation in the total ascorbic acid (ASA) content of normal blood samples of dogs kept under animal house diet over a period of 10 days. Ether anaesthesia was also found to have no effect on the reduced ascorbic acid (ASA), dehydroascorbic acid (DHA) and total ascorbic acid (ASA) content of blood. The total ASA, reduced and oxidized forms, of blood decreased progressively after femur fracture, though in certain cases, the value for reduced ASA half an hour after fracture was higher than the normal level. The level of reduced ASA of the exudate, soon after fracture, was much higher than the normal level; thereafter there was a gradual decrease. The DHA levels were more or less constant throughout the period of experiment.

175. INDERJIT SINGH & ACHARYA, A. K.: Excitation of unstriated muscle without any ionic gradient across the membrane, *Indian J. Physiol. Pharmacol.*, **1** (1957), 265

The stomach muscle of the frog, *Rana tigrina*, responds to direct current, acetylcholine and adrenaline in the absence of any ionic gradient across the membrane. The muscle becomes inexcitable if the sodium of the saline is replaced with potassium all at once, recovering its excitability after 2-3 hr. due to accommodation and responds to direct current for about 24 hr. This sudden loss of excitability can be prevented by gradual replacement of sodium with potassium. Calcium is essential for the recovery of excitability of the muscle and the optimum Ca concentration is 0.007M. The contractions of the muscle are increased when the osmotic pressure of the surrounding solution is increased due to increase in the concentration of the potassium inside the fibres. The muscle acts best in unbuffered solutions and at a temperature of 30°C.

176. INDERJIT SINGH & ACHARYA, A. K.: Excitation, inhibition, contraction, action potentials and conduction in unstriated muscle in the absence of any electrolyte in the external medium, *Proc. Indian Acad. Sci.*, **46B** (1957), 285

The stomach muscle of the frog, *Rana tigrina*, shows powerful contraction accompanied by

action potentials when immersed in electrolyte-free solution (0.112M sucrose). The mechanical response as well as the action potential of the sucrose acclimatized muscle are inhibited by sodium. Calcium causes tonic contraction at low and inhibition at high concentration. Barium and strontium cause contraction in high concentrations. Potassium, magnesium, sodium bromide, nitrate, iodide and thiocyanate produce inhibition in high concentrations. Ammonium produces temporary inhibition in high concentrations; the muscle recovers after a few minutes. The muscle responds to adrenaline and acetylcholine by inhibition and contraction respectively.

#### L: 4 Diseases 616

**177. BAL KRISHNA, CHAKRAVARTI, R. N. & MUKERJI, B.:** Effect of lipid intake on the serum protein and lipo-protein pattern in experimental atherosclerosis, *Indian J. med. Res.*, **45** (1957), 549

Rabbits fed with coconut oil, groundnut oil and cholesterol, alone and in combination, for ten weeks were examined in detail. Coconut oil feeding caused slight increase in serum alpha 2 and beta globulin together with increase in alpha lipo-protein. Groundnut oil produced similar protein changes but caused an increase of 0 + beta lipo-proteins. Cholesterol alone and in combination with coconut and groundnut oils, respectively, showed progressive increase in serum alpha 2 and beta globulins together with marked increase in 0 + beta lipo-proteins. The significance of these changes in relation to atherogenesis in the rabbit has been discussed. It has been clearly demonstrated that a marked lowering of the ratio of the alpha/0 + beta lipo-proteins is related to atheroma formation.

**178. CHATTERJEE, A. N. & GHOSH, J. J.:** Transaminases of *Leishmania donovani*, the causative organism of kala-azar, *Nature, Lond.*, **180** (1957), 1425

While investigating into the role of different amino acids in the nutritional requirements of *Leishmania donovani*, strong transaminase activities were detected in the cell-free extracts of this protozoal organism. Both  $\alpha$ -ketoglutaric and pyruvic transaminase activities with a number of amino acids and

amino acid amides were demonstrated. The presence of a very high transaminase activity between pyruvate and several purines and pyrimidines, viz. adenine, guanine and cytosine, suggests a new mechanism of formation and interconversion of purines and pyrimidines in this protozoal organism. Among the various known inhibitors and drugs examined, only potassium cyanide, hydroxylamine, mercuric chloride, silver nitrate, *p*-chloromercuric benzoate and 2, 4-dinitrophenyl hydrazine were found to have the most striking inhibitory effects on this system. Urea stibamine, isoniazid, sulphone, etc., had no effect on the activity of this protozoal enzyme.

**179. GHOSH, S. N., ROY, M. K. & CHAUDHURI, S. N.:** Studies on the nature of renal damage by nephrotoxic serum: Part IV — Sulphydryl content of nephropathic kidneys of guinea-pigs, *Ann. Biochem.*, **17**(6) (1957), 205

Estimation of thiol (SH) in anti-kidney serum-treated guinea-pig's kidney has been carried out. Both non-protein and protein SH were measured amperometrically and it was found that although the total SH remained the same, there was rise of non-protein thiols and diminution of protein thiols, indicating that there was some underlying disturbances in the overall thiol metabolism in nephropathic kidney.

**180. GUPTA, S. K. & MUKERJI, B.:** The combined therapeutic action of *isobutyl* sulphone (S.N. 47), dihydrostreptomycin (DHS) and isoniazid (INH) in experimental tuberculosis of guinea-pigs, *Indian J. Tuberc.*, **1** (1957), 14

The combined effect of administration of 6, 12, 18 and 24 mg./kg./day of *isobutyl* sulphone (S.N. 47) and DHS 1.5 mg./kg./day or INH 0.4 mg./kg./day were compared with that of S.N. 47 alone in comparable dosages in experimental tuberculosis of guinea-pigs. As judged macroscopically and histopathologically, the combined effect of S.N. 47 with DHS and INH was merely additive and no synergism could be demonstrated.

**181. MUKERJEE, S., GUHA, D. K. & GUHA ROY, U. K.:** Studies on typing of cholera by bacteriophage: Part I — Phage typing of *Vibrio cholerae* from

Calcutta epidemics, *Ann. Biochem.*, **17**(5) (1957), 161

Investigation on phage typing of *V. cholerae* is reported. Thirty strains of cholera bacteriophages isolated from the stools of cholera patients were differentiated into four groups by their patterns of lysis of the strains of *V. cholerae*, thermal death points plaque morphology, reciprocal cross reaction on their resistant growths, latent periods of generation and neutralization tests by their anti-phage sera. Two hundred strains of *V. cholerae*, also isolated from the same sources, were classified according to the patterns of their sensitivity to these four groups of phages. Four of the strains were found insensitive to only group I phages. They were classed as type 2 vibrios. Type 2 was further subdivided into 3 sub-types by phage adaptations. The 22 strains insensitive to group II phages could be classified into three types (3, 4 and 5) by testing further their sensitivity to group I and III phages. The remaining 174 strains were found to belong to the universally lysable type 1. Type 1 was thus found to be the predominating phage type of vibrios in Calcutta during the period under observation. The other six types and sub-types formed the minority groups some of which might have been developed as a result of mutation or imported from outside.

**L : 4 : 56 Immunology 615.37**

**182.** GUHA, D. K., RUDRA, B. C. & MUKERJEE, S.: Studies on cholera infection and cholera immunization: Part II — Attempt for demonstration of precipitinogen in the serum of cholera patients, *Ann. Biochem.*, **17**(6) (1957), 203

Experiments have been carried out to detect cholera precipitinogen in the sera of cholera cases by precipitin reaction with immune serum. The tests gave negative results.

**183.** SAHA, KUNAL, BHOWMIK, D. N. & CHAUDHURI, S. N.: Studies on the somatic antigen of *Salmonella typhi* extracted by different methods, *Ann. Biochem.*, **17**(6) (1957), 187

Somatic antigen of *Salmonella typhi* (Tyo-901) has been extracted by different methods,

e.g. (i) tryptic digestion, (ii) urea extraction, (iii) trichloroacetic acid (TCA) extraction and (iv) glycol extraction. The extracted antigens have been found to differ in their chemical composition as also in their pyrogenic and toxic effects, the TCA extract being most toxic and least pyrogenic.

**L : 573 Nutrition 613.2**

**184.** SUBRAHMANYAN, V., JOSEPH, K., DO-RAISWAMY, T. R., NARAYANA RAO, M., SANKARAN, A. N. & SWAMINATHAN, M.: The effect of supplementary multipurpose food on the growth and nutritional status of school children, *Brit. J. Nutr.*, **11** (1957), 382

A feeding experiment extending over a period of 5 months was carried out to evaluate the effect on the growth and nutritional status of children between 4 and 12 years of age of supplementing their poor vegetarian diet with 2 oz. daily of a multipurpose food composed of groundnut flour and Bengal gram flour, fortified with certain vitamins and calcium phosphate. Data on the weight, height, nutritional status, haemoglobin and red blood cell count were obtained at the beginning and at the end of the experiment for children in the control and in the experimental groups. The results showed that there was a significant increase in height, weight, red cell count and haemoglobin levels of the children receiving the supplemented diet.

**185.** JOSEPH, K., NARAYANA RAO, M., SWAMINATHAN, M. & SUBRAHMANYAN, V.: The effect of a supplementary multipurpose food on the metabolism of nitrogen, calcium and phosphorus, *Brit. J. Nutr.*, **11** (1957), 388

The metabolism of nitrogen, calcium and phosphorus was studied in five pairs of girls aged 8-11 years and comparable in age, height, weight and nutritional status. Five of them were fed on a poor vegetarian diet based on rice (control) and the other five on the same diet supplemented with 2 oz. of a multipurpose food (experimental) daily. The girls fed on the experimental diet retained more of nitrogen, calcium and phosphorus than the girls fed on the control diet, the results being significant at 5 per cent level.

## U25 Oceanography 551.46

186. GANAPATI, P. N. & SUBBA RAO, D. V.: On upwelling and productivity of the waters off Lawson's Bay, Waltair, *Curr. Sci.*, **26** (1957), 347

A series of bathythermograph readings were made during the period January to April 1956 at a fixed station in the 10 fathom line in Lawson's Bay to find out whether upwelling takes place in the inshore waters and if so, how far it influences the productivity of plankton. The observations were divided into five periods based on their physico-chemical and planktological conditions. During the period 9-16 March the first definite indication of upwelling was seen by the influx of small quantities of colder waters at the bottom which were not, however, appreciable enough to influence the surface waters. Again during the period 4-8 April intense upwelling of the subsurface cold waters was observed. During periods of upwelling the waters are characterized by the increase in salinity, phosphates and silicates and rich phytoplankton content.

187. SASTRY, A. V. R. & MAHADEVAN, C.: Radioactivity of sea-floor sediments off Visakhapatnam, *J. sci. industr. Res.*, **16B** (1957), 429

From the radioactivity and carbonate content data of some representative sea-floor sediments off Visakhapatnam, it has been inferred that the high carbonate content corresponds to low radioactivity of the sediment. The data also support earlier work on zonal distribution of these sediments.

## U296 Ionosphere 551.510.535

188. KOTADIA, K. M.: The intermediate layer of stratification  $F_{1.5}$  between  $F_1$  and  $F_2$  at Ahmedabad, *Proc. Indian Acad. Sci.*, **46A** (1957), 349

An ionospheric layer between  $F_1$  and  $F_2$ , called  $F_{1.5}$ , is often observed during solar eclipses at low latitudes where the magnetic dip is less than  $20^\circ$ . At Ahmedabad, which is situated on a latitude near the peak of noon  $foF_2$ ,  $F_{1.5}$  has been regularly observed since March 1956 when the sunspot number rose to greater than 100. The phenomenon starts daily with a decrease in the rate of increase of  $foF_2$  and an increase in the slope of

$h'f$  curve; the  $F_2$  trace then develops a bend giving rise to an intermediate cusp indicating a clear stratification of  $F_{1.5}$  layer. The variations in heights and vertical frequency of this layer with increasing sunspot number are illustrated by diagrams which also show corresponding changes in the  $F_1$  and  $F_2$  layers.

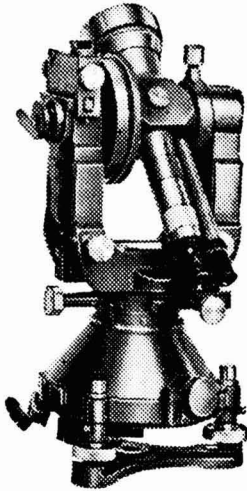
$foF_{1.5}$  varies from 9.0 Mc/s. to about 6.5 Mc/s. It reaches its maximum value within an hour or two of its appearance and generally before noon; it then falls gradually. The height of the base of  $F_{1.5}$  remains more or less constant at 250 km. with a slight increase in summer. It is a daytime phenomenon occurring from 09.00 to 16.00 hr. and its maximum frequency of occurrence is at about 1 hr. after noon in winter, at noon in the equinoxes and an hour before noon in summer. These are approximately the times of daytime maxima in the height of the  $F_2$  layer.

It is suggested that  $F_{1.5}$  appears as a result of physical stratification when the  $F_2$  layer has large electron density and is deep. It is most probably due to a rapid change in the rate of recombination of electrons with height.

189. RASTOGI, R. G.: Vertical ionospheric soundings at Ahmedabad during total solar eclipse on 30 June 1954, *Proc. Indian Acad. Sci.*, **46A** (1957), 422

The results of vertical ionospheric soundings at Ahmedabad during the total solar eclipse on 30 June 1954 are discussed. As expected, the ionizations of the lower layers E and  $F_1$  decreased during the eclipse period. Half an hour before the eclipse, the  $F_1$  layer traces showed a sharp cusp with a number of multiples and M reflections. The  $F_2$  layer critical frequencies as well as the total ion content during the eclipse were above normal. The semi-thickness of the  $F_2$  layer increased during the eclipse due to the lowering of the base of the  $F_2$  layer whereas the level of maximum ionization was not affected by the eclipse. It seems the lower portion of the  $F_2$  layer was more affected by the withdrawal of solar radiations than the level of maximum ionization. Multiple splitting, range duplication and other effects on the  $F_2$  layer due to the curvature of the ionospheric surface were observed during the eclipse. These observations confirm the redistribution of ionization during a solar eclipse similar to that during the passage of a travelling disturbance as suggested by Munro and Heisler.

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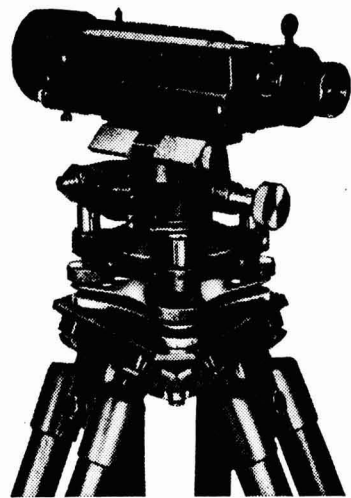
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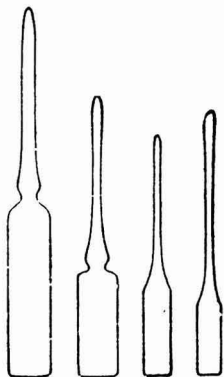
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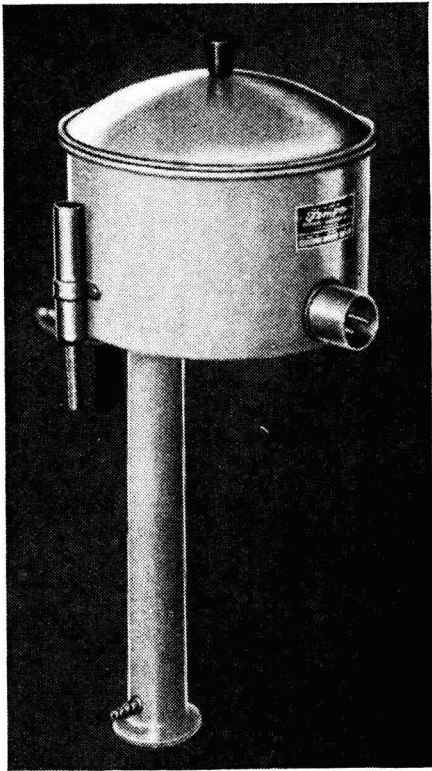
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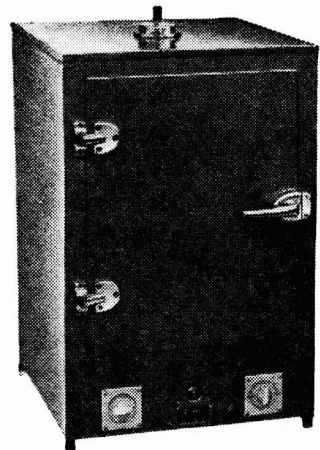
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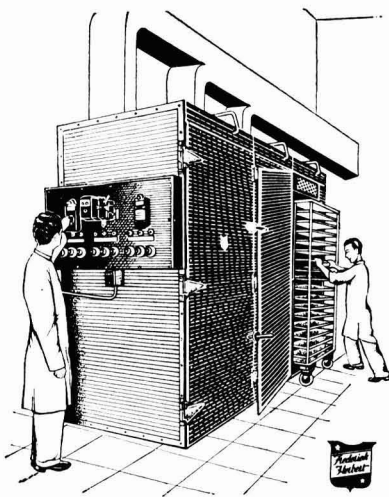
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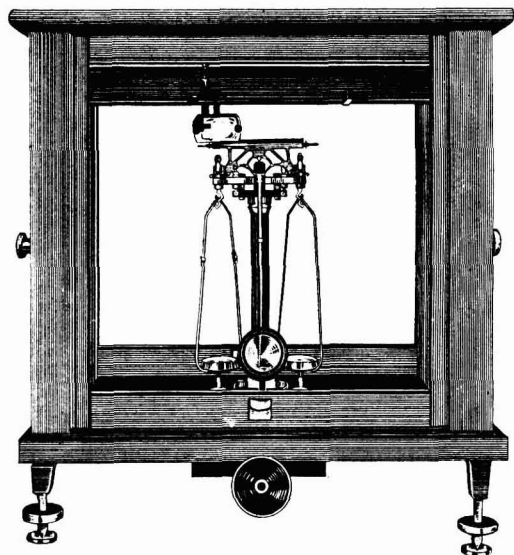
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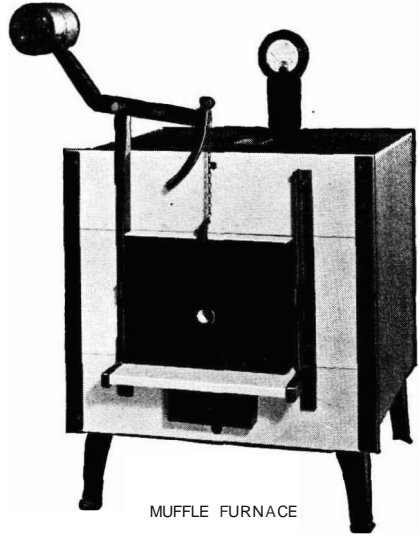


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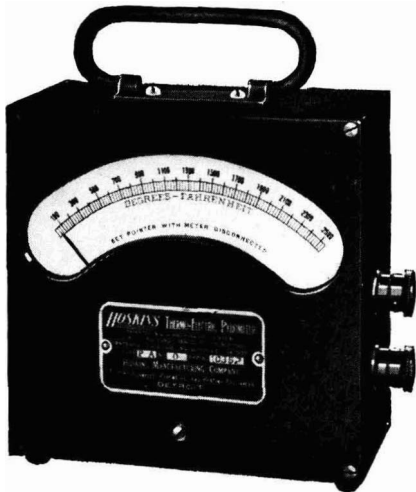
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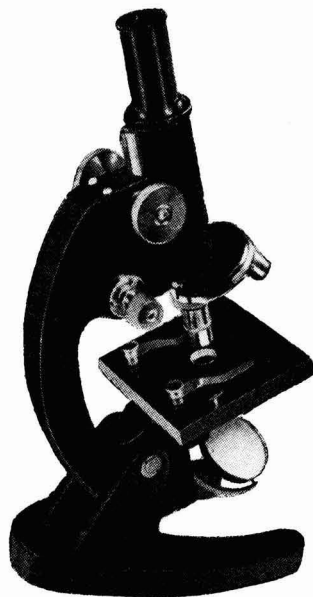
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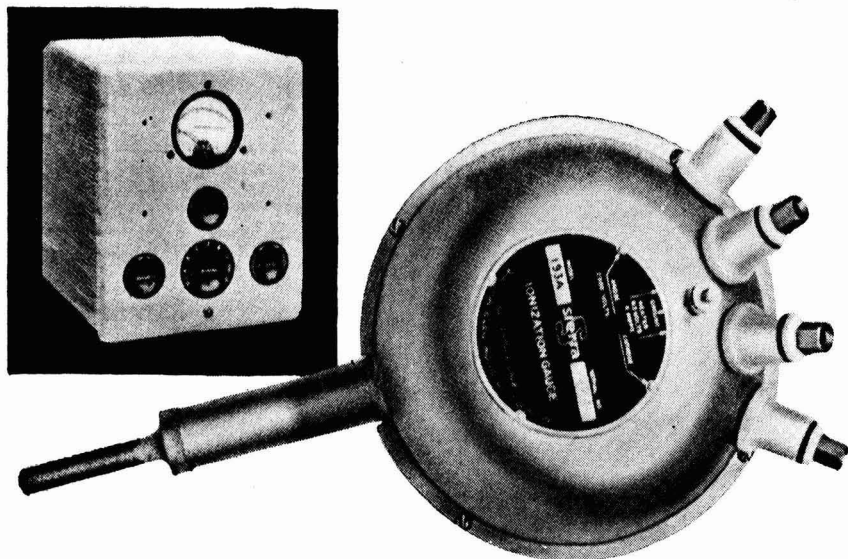
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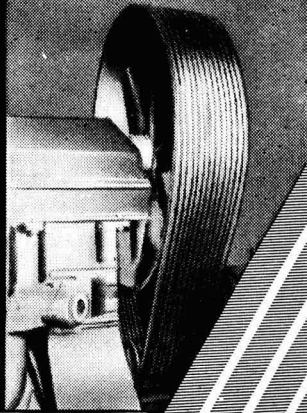
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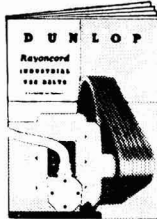


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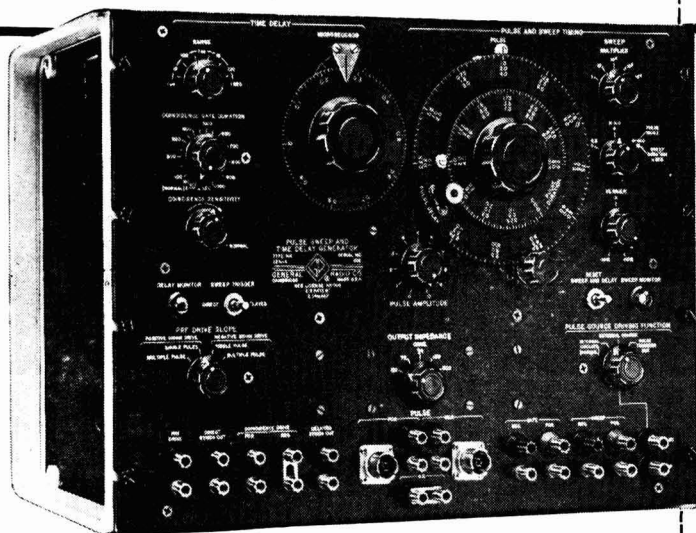
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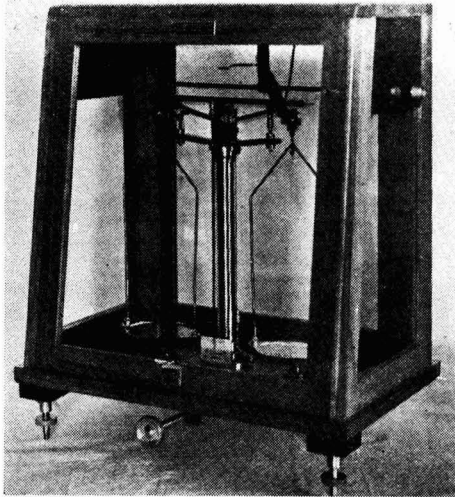
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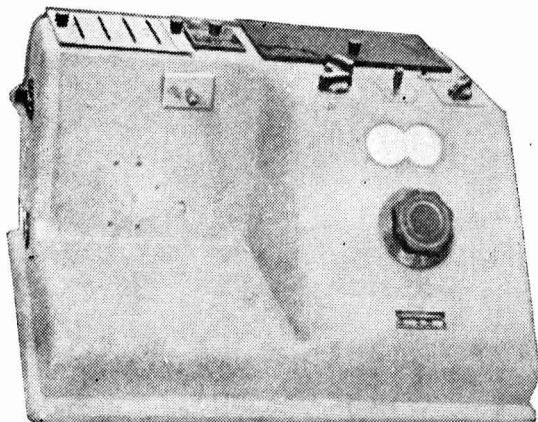


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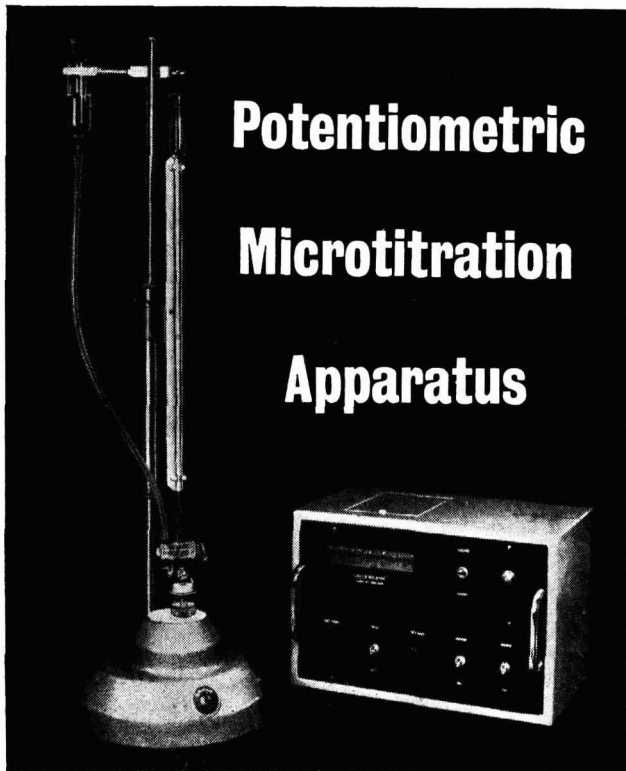
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