

Journal of Scientific & Industrial Research

A — General



191

OSA

THIS ISSUE

GENERAL

Artificial satellite for the

Development of a simple
type equipment

Hydrogen-phosphorus

PHYSICAL SCIENCES

Experimental study of the
vibration of cantilevered
triangular plates

Radioactive emanation by
uranium in bomb

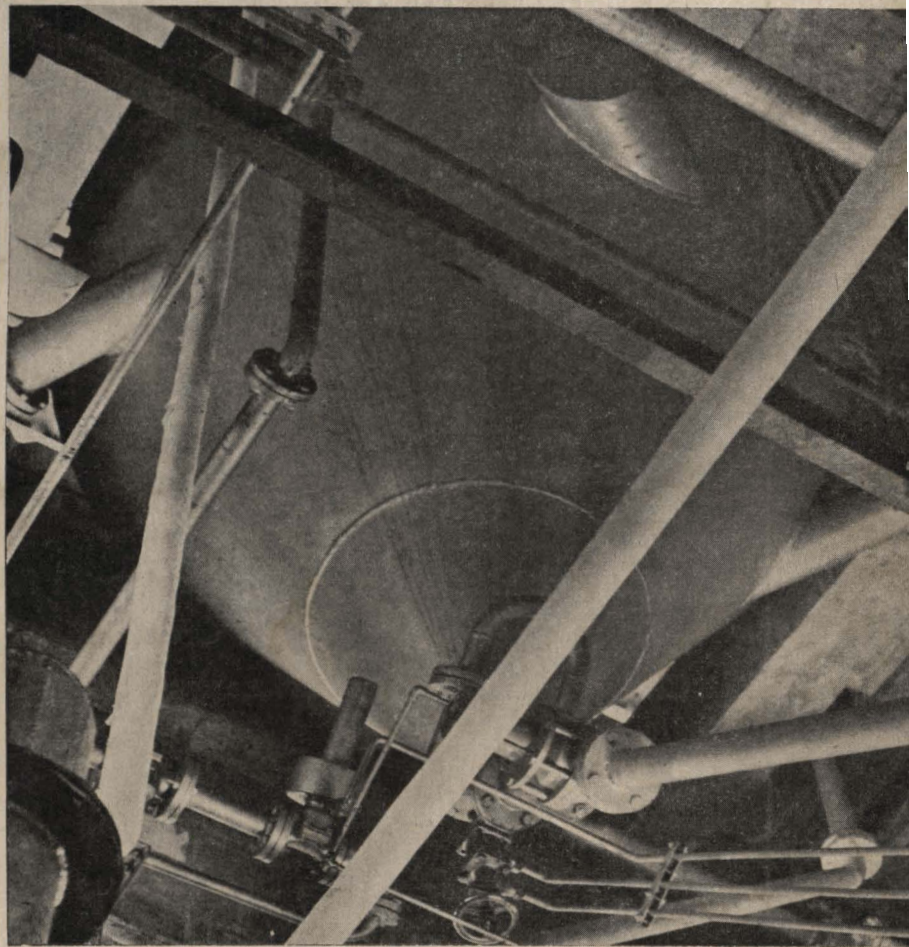
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Stability of vitamin A
in food and vanaspati



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India's first ammonium chloride plant went on stream recently at the Fertilizers & Chemicals (Travancore) Ltd., Alwaye. The picture on the cover shows one of the huge saturators (bottom view) in which direct neutralization of synthetic ammonia is effected by hydrochloric acid. The plant has a capacity of 25 tons of ammonium chloride per day (*see* page 96).

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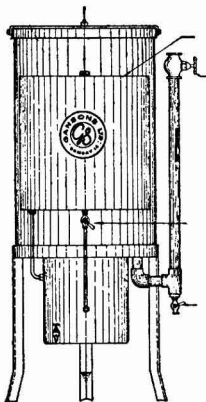
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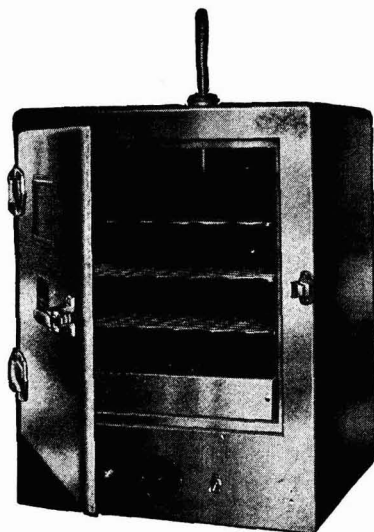
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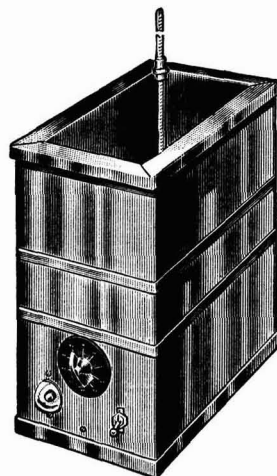
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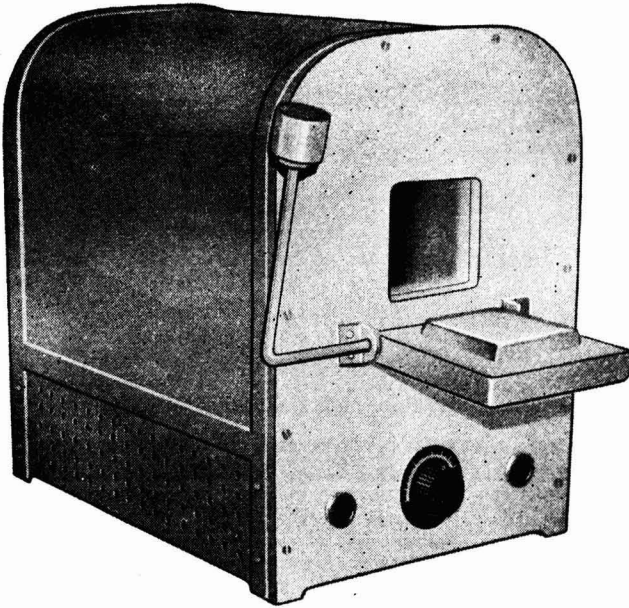
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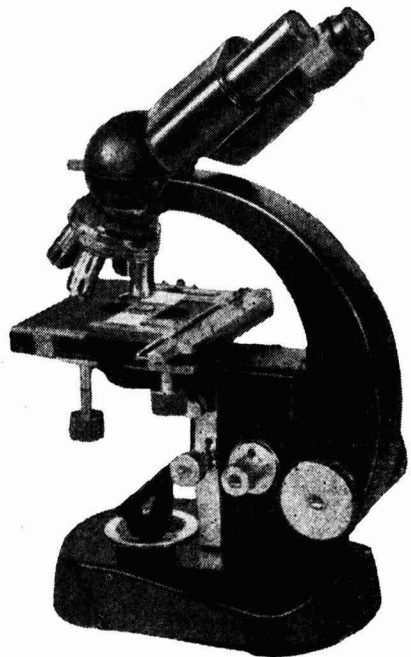
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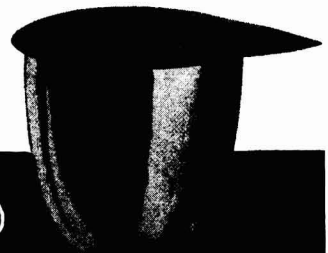
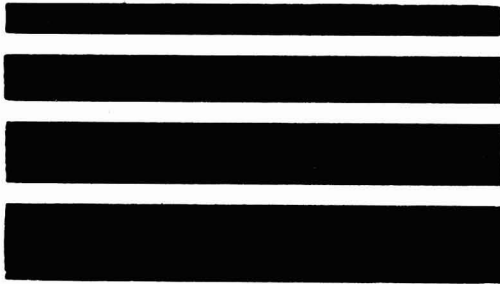
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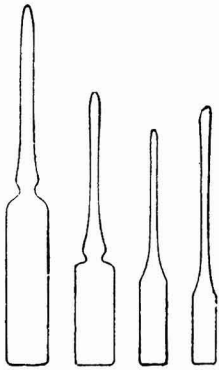
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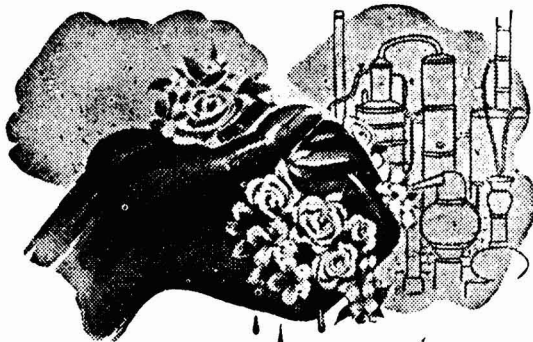


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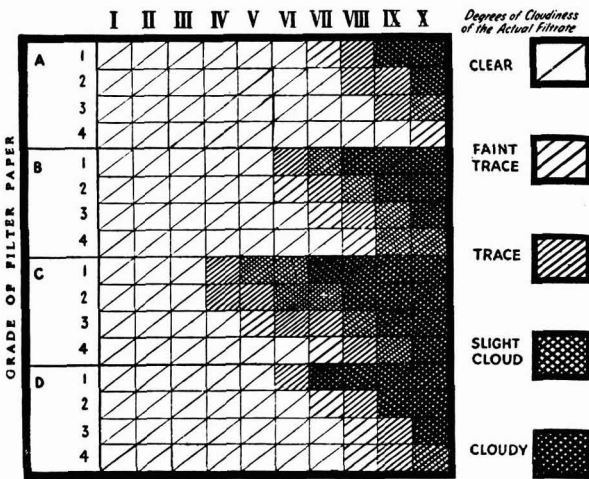
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$$V = 175000$$

However, with the relatively high concentration of electrolyte, coagulation would take place and it is, therefore, preferable to keep Q small and reduce the value of S.

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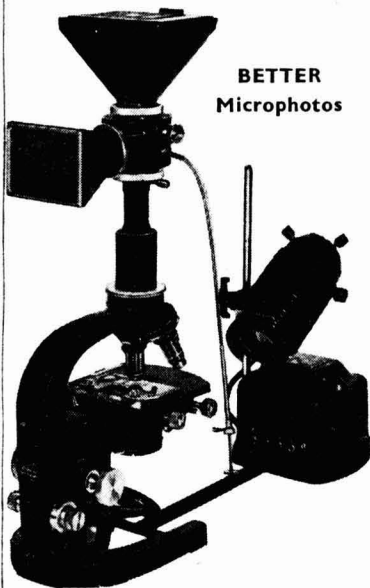
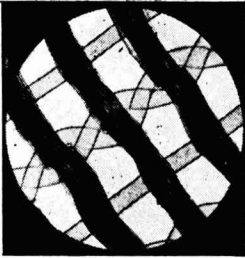
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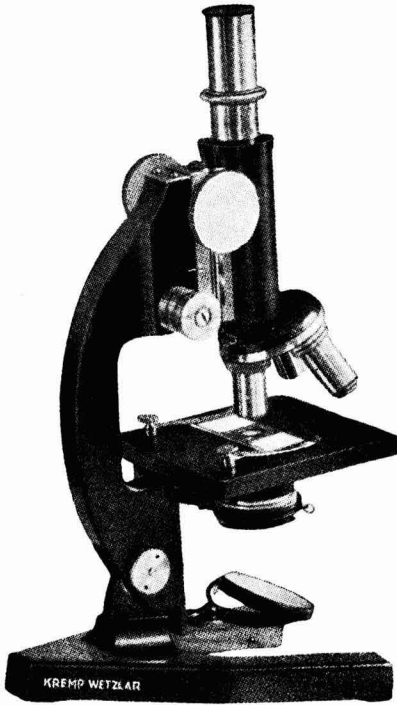
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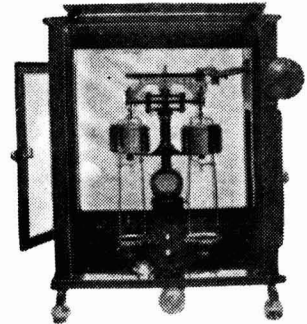
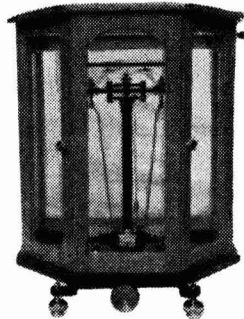
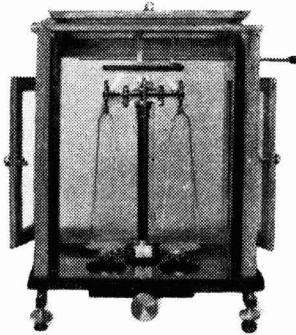
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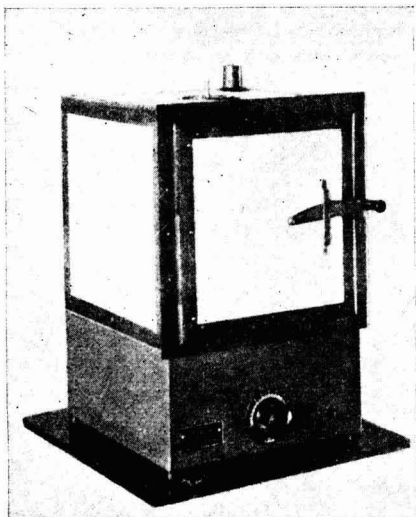
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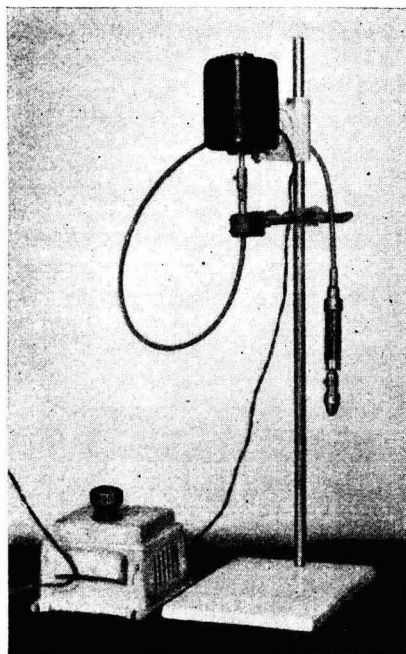
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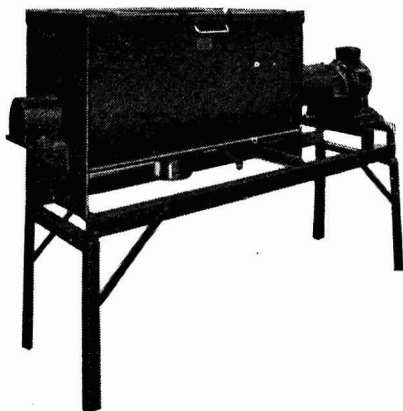
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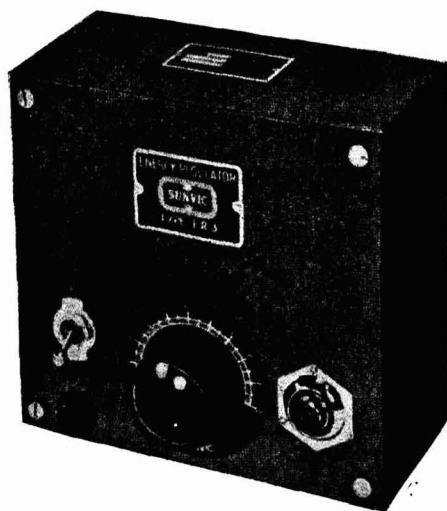


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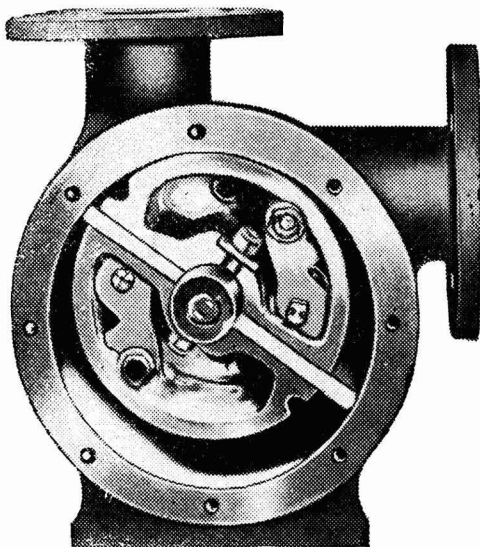
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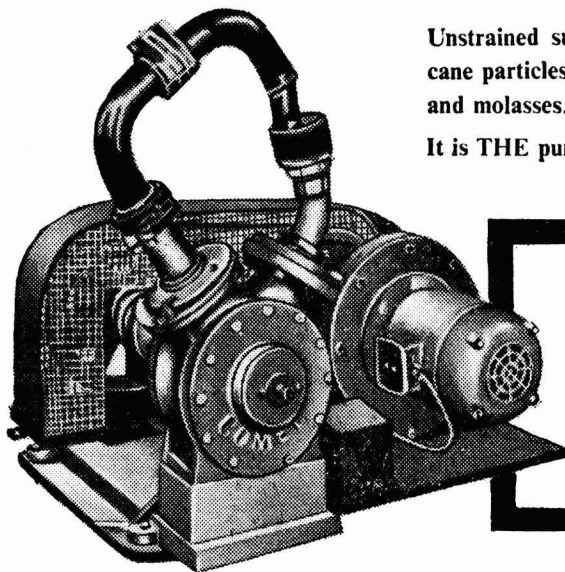
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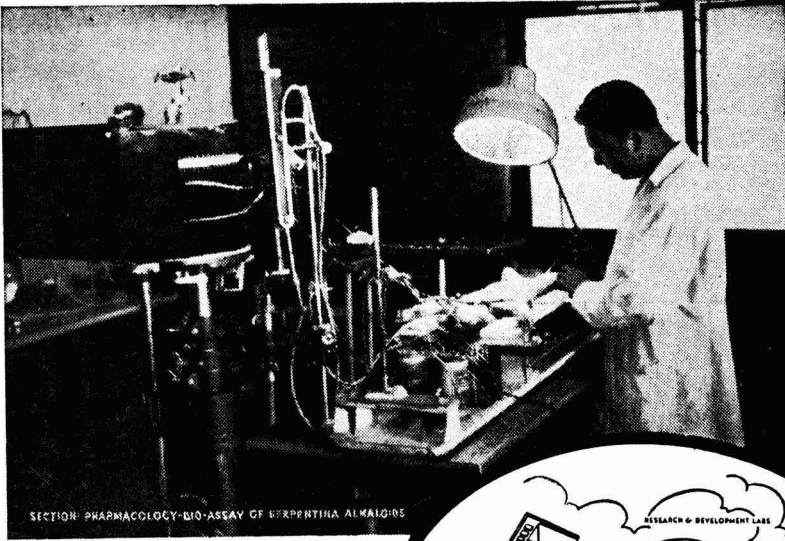
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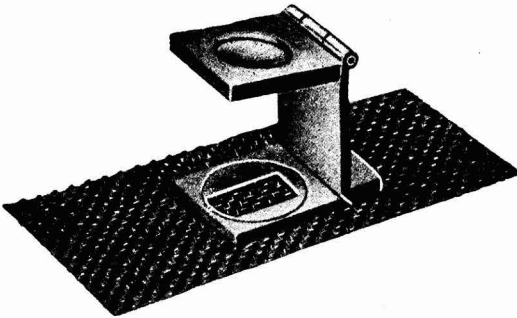
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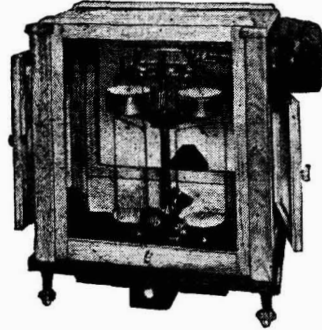
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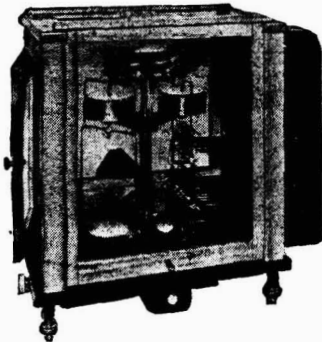
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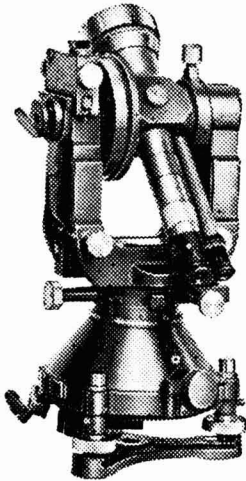
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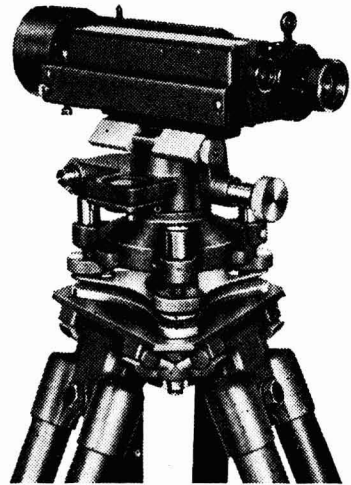
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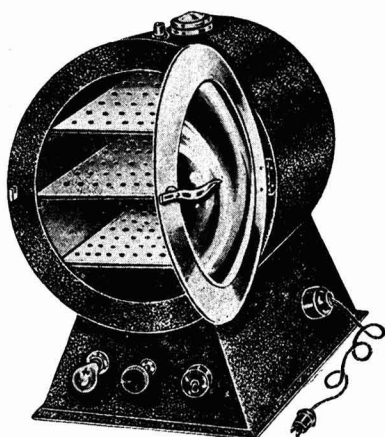
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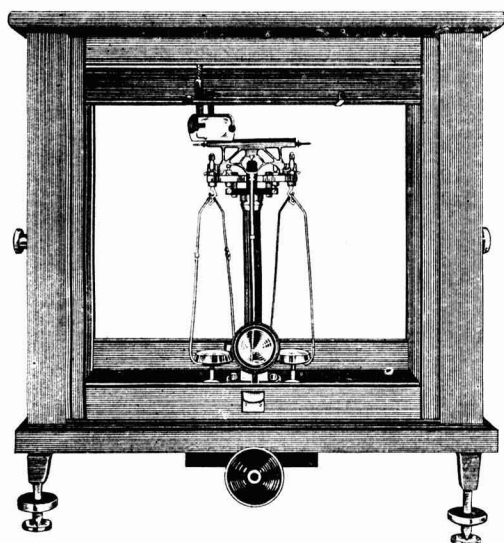
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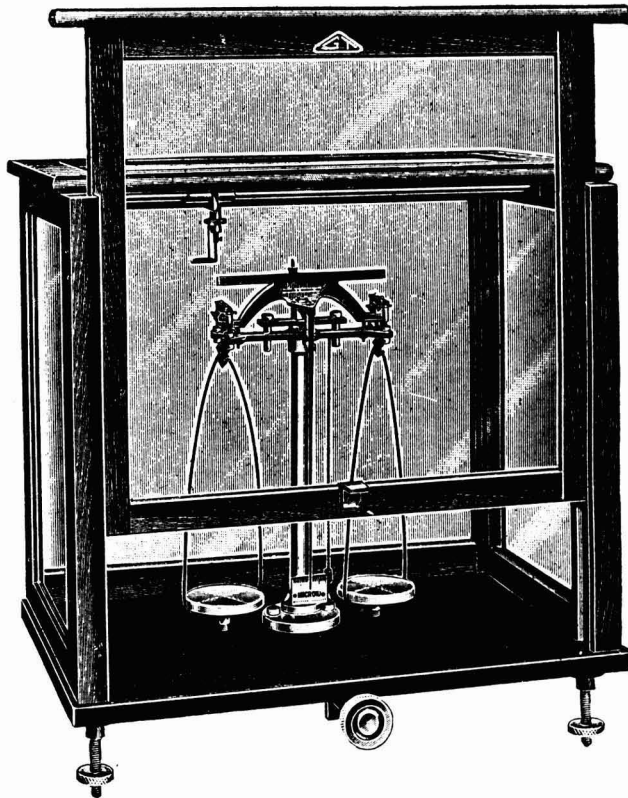
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An Artificial Satellite for the Earth

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Institute of Armament Studies, Kirkee

ON 29 July 1955, an announcement of far-reaching significance was made by the President of the United States of America which said that within 3 years the United States of America will launch the first artificial 'earth-satellite'*. Earth satellite, also known as ESV (Earth Satellite Vehicle) is a test-body launched from a terrestrial site and set revolving round the earth at a suitable distance from the earth. Scanning the sky through a pair of binoculars just before sunrise or just after sunset, we may hope to see in the not too distant future, a brilliant object in the sky, a new astronomical body created by man. There is to be a series of launchings of such ESVs during the period July 1957 to December 1958 so as to fit into the scheme of research projects collectively called the International Geophysical Year (IGY). It is obvious that the actual size and shape of the proposed satellite will depend on the objective of the particular shot, viz. whether it is empty or contains electronic tracking and telemetering equipment along with scientific instrumentation. The first experimental satellite is expected to weigh about 100 lb. and to be about a couple of feet in diameter. Its orbit is to be about 300 miles above the earth's surface, with an orbital period of about 90 min. The time during which the satellite will remain aloft depends on the particular orbit and the still unmeasured atmospheric density at such altitudes. As

the orbit shrinks, the missile will gradually penetrate the atmosphere and will ultimately be destroyed by heat. Thus it will not be necessary to provide a safe target area at a remote location for the safe disposal of the missile—it will literally be frittered away! The launching will be accomplished by multi-stage rocket system, but once launched, the orientation and flight of the satellite will no longer be controllable from the ground. According to the statement of the U.S. President none of the missiles will be designed to perform any military functions. Their design, instrumentation and the time, as well as the location of the launching, are to be unclassified from security standpoint. The cost of these unclassified research projects is estimated to be about \$10,000,000 and co-operation has been solicited from all the countries participating in the IGY. Following the American announcement, the U.S.S.R. has disclosed that a similar project is under way in Russia and has offered co-operation with the American scientists in this matter.

So much for the facts made public regarding the satellite project. Granting the utility of such a project (this aspect will be considered in the next section), satisfactory answers must be found to several questions before the project can be translated into a practical proposition. These questions can be grouped under two broad headings: (A) those of a general scientific nature and (B) those of a technological and engineering nature. Since the latter type of questions will be of a too technical nature, this article confines itself to a brief consideration of some questions from category A, with a

*The name 'orbital rocket' has been suggested by Willy Ley in his book *Rockets, Missiles and Space Travel*. Material assistance in the preparation of the present article has been derived from this and other sources mentioned at the end of this article.

view to illustrate the type of problems that arise and the sort of answers to be expected. Here are some of the questions that have to be decided before one can think of the design of a satellite:

- (i) What should be the height of the orbit?
- (ii) With a given height, what will be the period of revolution and the orbital velocity?
- (iii) With what velocity should the satellite be launched in order that it may describe the proposed orbit?

When reasonable answers have been found for these questions, there is still the important question of the best method of launching the satellite with the requisite velocity.

Height of the orbit

Consider the question of the height of the orbit. This height must be sufficient to minimize the effects of air resistance which would cause the satellite to spiral down and crash after a few revolutions. The well-known pioneer in rocket research, Dr. Hermann Oberth, was of the view that a height of 600 miles should be enough. Sanger has estimated that in an orbit at an altitude of 155 miles the satellite would make more than a hundred million revolutions before losing 1 per cent of its altitude. These and other similar calculations show that a satellite orbit need not be very high above the surface to be practically unaffected by air resistance. On 24 February 1949, a WAC-Corporal carried on a modified V-2 rocket attained a peak altitude of 389 km. (about 250 miles). At that altitude the density of the air is so small that we may say that the WAC-Corporal had almost reached empty space. Even in the absence of air, a projectile must be given a minimum velocity in order that it may circle round the earth and not fall back on the earth's surface. Of course, the farther away the orbit is from the earth, the harder it is to get the satellite into that orbit (though the orbital velocity will be smaller and the period of revolution longer). A low orbit is thus preferable, but one must stay safely outside the atmosphere. If we neglect air resistance, there is a simple relation between the orbital velocity of the satellite, its mean distance from the earth and its period of revolution. For an orbit at a height of 346

miles, the period of revolution would be about 96 min. and the orbital velocity nearly $4\frac{3}{4}$ miles/sec. In order to get the satellite into such an orbit, it must be given an initial velocity of a little more than 5 miles/sec. Thus it would appear that a height somewhat above the peak altitude reached by the V-2 + WAC-Corporal shot of February 1949 would be good enough.

Launching of the satellite

The question that naturally arises at this stage is the means whereby a satellite may be given an initial velocity of about 5 miles/sec., so as to reach an orbit at a height of some 300 miles. The idea of using rocket propulsion for the purpose of attaining great heights was first put forward by R. H. Goddard of America and H. Oberth of Germany. The latter emphasized the superiority of liquid-fuel rockets over the solid-fuel ones for this purpose. Subsequent work has confirmed this and all the high altitude rockets at present use liquid fuels. Now, with a given type of liquid fuel, the velocity attained by the rocket is determined by a quantity called the 'mass ratio', which is the ratio of the take-off mass (M_0) to the mass (M_1) remaining when the fuel is all burnt up. The actual relation is:

$$\text{Mass ratio} = M_0/M_1 = e^{v/c}$$

where v is the velocity attained by the rocket (at the instant the fuel is all burnt) and c is the exhaust velocity, which is determined by the energy content of the fuel. High performance can be realized either by working with a high exhaust velocity or a high mass ratio. The first is the concern of the field of chemistry and the second of engineering. The most effective method of increasing the mass-ratio is the step-principle, exemplified in the V-2-carried WAC-Corporal. In a step-rocket the final velocity corresponds to the product of the individual mass ratios. For a velocity of about 5 miles/sec. and with the existing types of liquid fuels, a 3-step rocket would have a mass ratio for each step which is well within the present engineering possibility. The announcement of the imminent launching of an ESV shows that the above estimates are not unduly off the mark.

Utility of earth satellite

The preceding discussion was intended to demonstrate broadly the overall reasonable-

ness and feasibility of the project. It is time now to consider the utility of the present project and the types of data it is expected to furnish.

It is generally agreed by experts in rocket research that a small unmanned satellite is the only one feasible and that it would be the first step towards more ambitious projects. The study of the utility of an unmanned earth satellite was carefully examined by a Space Flight Committee of the American Rocket Society and some of the fields of utility suggested by the Committee are mentioned below.

Astronomy and astrophysics — A satellite could overcome some of the limitations on observations made through the earth's atmosphere. For example, if optical equipment equivalent to that now available could be placed outside the atmosphere, much additional information in the form of planetary detail, new faint objects and short wavelength spectra could be obtained, leading to information of great value to astronomers and to the scientists in general.

Biological experimentation — The study of the radiation effects of primary cosmic radiations in regions entirely outside the atmosphere, with exposure times of many days, is of fundamental value for both basic research in radiobiology and the development of high altitude flight. The peculiar characteristics of the environment such as weightlessness, high vacuum, temperature extremes, etc., will suggest experiments that could not be performed elsewhere. Experiments conducted on an artificial satellite would contribute much to the solution of these problems.

Communication — A satellite might provide a broad-band transoceanic communication link. It might possibly prove useful as a relay station for radio or TV broadcasts.

Geodesy — The size and shape of the earth, the intensity of its gravitational field and other geodetic constants might be determined more accurately, with practical benefits to navigation at sea and mapping over large distances.

Geophysics (including meteorology) — The study of incoming radiation and its effect upon the earth's atmosphere might lead to better methods of long-range weather prediction. At present rockets are being used

extensively in high altitude research. These rockets are, however, one-shot missiles and furnish only a matter of minutes in which to make observations. They are not convenient for making a large number of measurements over an extended period of time. It is here that the satellite would be of considerable value. Further, such a satellite would provide an ideal space-platform for making direct solar measurements as well as for collecting data on indirect solar relationships such as magnetic storm activity.

Nothing can be said here about studies of military importance for which the satellite may be utilized. These are naturally classified and have a close connection with investigations concerned with the 'inter-continental ballistic missile' programme.

The question seems almost irresistible: What next? A manned space flight? A voyage to the Moon, perhaps to Mars? Perhaps! All these things may be achieved in the future. Some rocket experts have indeed opined that the unmanned satellite will clear the way for achieving interplanetary travel. Whatever the distant future may bring forth, the following quotation from von Karman seems to be not inappropriate for the present: "In the meantime, basic studies in aerodynamics and the physics of rarefied, ionized gases, gradual exploration of the highest altitudes reachable by sounding rockets, study of radiation effects on material and humans, study of navigation and guidance problems at high altitudes and in space, and development of unmanned rockets leading gradually to a satellite should provide the enthusiasts of space-travel enough to do."

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Indian Industries Fair

THE Indian Industries Fair, which concluded in New Delhi on 1 January 1956, is acclaimed as the largest hitherto organized in Asia and the biggest in the world since the end of World War II in area, coverage and range of products displayed. A rich variety of industrial products and equipment from as many as 21 countries was on show. During the two months it was open to the public, the Fair was visited by over 3 million people.

Spread over an area of 75 acres, the effective exhibition area was about 1 million sq. ft. Two thousand five hundred tons of steel, 2,000 tons of cement and huge quantities of other building materials were used. More than 20,000 Indian and foreign technicians worked round the clock for a few weeks to complete the work. Electrical substations with a total capacity of 3,000 kW. were installed to provide the power needed for the Fair. The overall expenditure incurred on the Fair, excluding the products and equipment displayed, is estimated at Rs. 5 crores.

The aims of the Fair, as set out by the organizers — the Federation of Indian Chambers of Commerce and Industry — were: to present a comprehensive picture of the economic progress achieved by India; to establish and promote contacts between consumers, manufacturers and traders; to promote economic relations between India and foreign countries by interchange of ideas in the industrial and commercial fields; and to afford an opportunity to Indian manufacturers to organize a show window for Indian industry and at the same time to make a first-hand study of design, quality and performance of foreign capital equipment.

The Fair brought into focus the best that a large part of the world has to offer in the fields of industry and technology. The products on show ranged from handicrafts and products of small and medium-sized industries to giant engineering equipment and precision tools. Foreign manufacturers displayed mostly capital goods and scientific equipment. Developments in the harnessing of atomic energy for peaceful uses were exhibited in the U.S.A. and the U.S.S.R. pavilions. Television demonstrations were organized by

R.C.A. and Philips. Working models of production techniques, graphs and charts served as aids to the understanding of what may be looked upon as an exhibition of the achievements of modern industry.

The Indian Section of the Fair was planned on an industry-wise basis, and as much as 95 per cent of India's organized industry was represented. There was much in evidence to show that the country has made rapid progress in engineering industries since 1939. The progress, especially from the point of view of diversification of production, is indeed remarkable. Manufacturing capacity has been established in locomotives, boilers, automobiles, transformers, electric motors, electric fans and lamps, cables, radio receivers, sewing machines, bicycles, typewriters, diesel engines, textile machinery, power-driven pumps, ball-bearings, machine tools, small tools, etc. The products displayed by the Small-scale Industries Corporation, the All-India Handloom Board, the Coir Board, the Central Silk Board, Indian Coffee and Tea Boards, etc., provided an indication of the contributions of light industry to the nation's economic development. New processes and products developed in some of the research institutions were exhibited in the National Research Pavilion, organized by the National Research Development Corporation of India.

The Indian Industries Section presented an impressive picture of the economic advancement of the country since independence. The targets fixed under the First Five-Year Plan have been achieved and the Fair afforded for the first time an opportunity to the people to measure their own progress in terms of the progress achieved in industrially advanced countries.

The progress of industrial production since 1946 is indicated by the following figures: 100 in 1946; 105 in 1950; 146.5 in 1954; the index in April 1955 being 167.2. The engineering and chemical industries have made rapid progress. From locomotives, ships and automobiles to sewing machines and machine tools, Indian production is growing both in range and quality. Sizable increases have been recorded in the production of caustic soda, soda ash and sulphuric acid.

Indigenous production of rayon and staple fibre is well established and the dyestuffs industry is making rapid progress.

The Fair provided a good perspective of the industrial development of the country, the progress achieved so far, the gaps in our economy, the essentially supplementary and complementary nature of industries, big and small, and also of private and public sectors. It provided opportunities for industrialists,

manufacturers and traders from all parts of the world to establish personal contacts and discuss questions of interest. The evidence of what has been and is being done in other countries should act as a spur to industrialists in this country to venture into new fields. As observed by Shri B. M. Birla, the Fair will have served its purpose if it encourages new ideas, new business plans and new openings for enterprise.

Indian Society for the History of Science

IN ORDER TO PROMOTE THE STUDY OF HISTORY of science in India, the establishment of an "Indian Society for the History of Science" has been proposed by a group of prominent scientists and educationists. The object of the society, according to the sponsors, will be to promote the study of the History of Science in India through: (1) creating interest by arranging lectures, discussions and symposia on different aspects of the History of Science; (2) eliciting support of various national institutions and universities to sponsor research on different aspects of the History of Science and Technology in India; (3) disseminating results of research by arranging meetings for reading and dis-

cussions of papers and publication of relevant material in suitable journals; and (4) drawing the attention of the universities to the importance of teaching the History of Science.

Sponsors of the Society are: Dr. A. C. Ukil, Dr. Zakir Husain, Prof. M. S. Thacker, Dr. R. C. Mazumdar, Prof. D. S. Kothari, Dr. S. Husain Zaheer, Prof. D. P. Mukherji, Prof. S. N. Hasan, Prof. Bisheshwar Prasad, Prof. A. C. Banerji, Dr. S. Basu, Dr. B. D. Laroia, Prof. P. Ray, Dr. P. K. Gode, Shri S. N. Sen and Mr. A. Rahman.

Further particulars may be obtained from Mr. A. Rahman, Central Laboratories for Scientific & Industrial Research, Hyderabad.

Summaries of Addresses of Presidents of Sections, Forty-third Session, Indian Science Congress

TEACHING & RESEARCH IN ZOOLOGY

IN his presidential address to the Section of Zoology and Entomology, Dr. M. L. Bhatia examined in detail the causes responsible for the present low standard of teaching and research in Zoology in the country and suggested ways and means of raising the standard and stimulating interest in the subject.

Dr. Bhatia observed that one of the main causes of the low standard of teaching was lack of enthusiasm for the subject on the part of the students, and this was because the students had little opportunity to study the subject at school. The existing practice of laying greater stress on post-mortem studies of animals rather than on the study of general phenomena of animal life failed to stimulate the interest of the student in the subject.

Zoology has grown into a vast science and a major problem that confronts a teacher of Zoology is to select a suitable course of studies which could conveniently be undertaken during undergraduate and postgraduate course. In some places the teaching of Zoology is confined mostly to morphology and little effort is made to emphasize the functional significance of various structures. This gives the students a half-baked idea of the subject. Most colleges devote little attention to the study of living animals with regard to their locomotion, feeding, social behaviour, natural habitat, growth, response to various stimuli, etc. In several places where the teaching of Zoology has been recently introduced, there is shortage of equipment due to inadequate funds and lack of properly qualified teaching staff.

There are at present few universities and institutes engaged in a properly planned programme of research. Inadequate finances, equipment, library and other facilities are to a large extent responsible for the poor standard of research in the universities. Young zoologists have few opportunities

for proper training in research within the country and those sent abroad for such training do not stay there long enough to acquire sufficient experience to enable them to carry on the work with confidence on their return to the country.

In order to promote research in Zoology and teaching of Zoology in India, collective and sustained effort is required in several directions. Introduction of Zoology as a compulsory subject in schools, establishment of natural history museums, zoological gardens, aquaria, and organization of bird-watching, natural history and other societies are some of the measures that may be adopted to stimulate interest in the subject. The present system of teaching needs to be revised and greater stress has to be laid on the study of animals in their natural environments. Independent research work should give place to schools of zoological research where young zoologists could benefit by the work and experience of distinguished zoologists.

SURVEY & CLASSIFICATION OF INDIAN SOILS

IN his presidential address to the Section of Agricultural Sciences, Dr. S. P. Raychaudhuri reviewed the work done in India regarding survey and classification of Indian soils, and indicated some future lines of work in soil science and agricultural chemistry.

Referring to soil fertility, Dr. Raychaudhuri said that Indian soils were primarily deficient in nitrogen. The production and application of nitrogenous fertilizers, therefore, demand high priority. Besides, ammonium sulphate to which most Indian soils respond well, the use of fertilizers like urea, ammonium nitrate, ammonium sulphate-nitrate is also being considered. Their performance is being studied at Government farms and cultivators' fields in different soil type regions. Phosphates have also been tried on neutral and alkaline calcareous soils. In the case of paddy, dicalcium phosphate

has given results comparable to superphosphate. Manurial trials with plant food elements in the form of simple mineral salts have indicated great possibilities of increasing crop production. A model scheme for these trials on cultivators' fields has been initiated by the Indian Council of Agricultural Research under the Second Five-Year Plan.

Soil testing forms an integral part of advisory services offered to farmers, inasmuch as specific nutrient deficiencies must be detected and remedied in time in order to maintain productivity of the soil at the optimum level. Twenty-four soil testing laboratories are going to be established in different regions of the country for this purpose.

Soil surveys serve as a basis of proper utilization of the results of manurial trials, cultural practices and agronomic operations. Studies on the origin and classification of soils based on morphology, physical, chemical and mineralogical compositions are comparatively recent developments in India. Extensive soil studies have been undertaken in connection with irrigation projects in order to determine water relation of soils and to classify them according to their suitability for irrigation. Soil conservation surveys including soil erosion and land utilization have also been undertaken in different States. There is an urgent need for evolving a suitable procedure for survey work so as to ensure rapid progress in soil conservation work without involving elaborate experimentation and research. In the light of information available in India and other countries, a procedure suitable for Indian conditions has been evolved. A Central Soil Conservation Board has been set up to initiate and co-ordinate research in soil conservation, arrange training of technical personnel and to render financial assistance.

Soil survey and classification work is now receiving increasing attention in India. Forty centres throughout the country are engaged in this work which is planned on a soil-climate basis. A great deal of field research is, however, necessary to correlate soil characteristics as determined by morphological studies in the field, and chemical, physical and mineralogical studies in the laboratory with the geomorphological characteristics of the landscape.

There is an urgent need for evolving suitable system of soil classification and nomen-

clature according to well-defined units. These units should be based upon external and internal characteristics of soils with special emphasis on detailed morphological studies. Since development of soils is of vital interest to several countries in tropical and equatorial regions, international co-operation and agreement on broad soil groups and nomenclature will have obvious advantage for the countries concerned.

DEVELOPMENT OF PHYSIOLOGY IN INDIA

THE presidential address of Dr. D. V. S. Reddy to the Section of Physiology dealt with the importance of the study of physiology at all levels of education, the reasons for its stunted growth as a separate discipline, and the steps to be taken to foster the development of the subject so that it could stand on an equal footing with other sciences. Dr. Reddy observed that a knowledge of physiology is not only essential for the understanding and the practice of medicine but also for the welfare of the individual and the community in general. He hoped that improved teaching facilities would be made available at all levels of education and research work encouraged, to bring the science of physiology to a status equal to that of other sciences.

In India, during the last one hundred years, physiology, as a separate subject, was mostly taught in medical colleges but the medical men did not attach much importance to it although all scientific medicine is built on a knowledge of physiology. This was responsible for the stunted growth and development of the subject. Physiology is taught as part of the elementary science course in the high school; at the intermediate stage, it forms a part of the study of zoology, and is mostly taught by a zoologist with emphasis on zoological aspects. It is taught as a separate subject only in a few universities, and facilities for post-graduate study and research are available only in a small number of institutions.

Text-books on physiology produced in the country are of a poor standard. This has to be remedied. Suitable text books should be produced both in national and regional languages. Most of the apparatus for teaching, demonstration and research in physiology is imported. Steps should be taken to

manufacture the necessary apparatus and equipment in the country. To encourage and facilitate experimental work, animal farms and breeding centres must be set up for the supply of experimental animals. Finally, the study of physiology in India must be made 'respectable' to attract promising young talent. Some of the methods employed in U.S.A., U.K. and other countries may be adopted with advantage in attracting talented and promising young men and women to the study of physiology and also for nurturing their development.

PSYCHOLOGY AS A PROFESSION

SUGGESTIONS for promoting the healthy development of psychology as a profession, the most propitious fields of employment for psychologists, and problems connected with teaching of and research in psychology formed the theme of Prof. L. J. Bhatt's address to the Section of Psychology and Educational Sciences. Prof. Bhatt observed that though opportunities for those specializing in psychology at present were limited, the demand for the services of psychologists in many fields is increasing and there would henceforth be a wide range of professional openings for those possessing requisite qualifications.

The Directory of Indian Psychologists compiled last year reveals that a large number of psychologists are engaged in teaching and research. Others are employed in hospitals, in clinics and in vocational guidance bureaus. A few are employed in the Defence Services and in the industry. Still the opportunities for profitable careers for psychologists in different fields are limited.

The most propitious fields for psychologists are school psychology, industrial psychology and counselling psychology.

A considerable amount of reshaping of our educational system at different levels is going on and the help of psychologists is essential to give effect to the proposed reforms. For instance, school psychology will be playing an important role in the selection of suitable candidates for different professional courses.

Only a small number of psychologists is employed in Indian industries. In view of the steps that are being taken for rapid industrialization of the country, the need for personnel trained in industrial psychology

will increase. Psychologists who seek openings in industry should have a knowledge of the practical side of the industry so that they can effectively help in solving its problems. This means a change in the training methods and programmes followed in our universities. Subjects relating to industry such as personnel problems, job analysis, testing techniques, incentives, etc., should be included in the curricula.

Psychologists play an important role in the proper utilization of the man power resources of a country. Counselling service is a rapidly expanding field and the help of psychologists is needed in schools, in industry and Government establishments not only in fitting personnel in places suitable for their talents and aptitudes but also for promoting better relations between personnel.

The courses of study for the teaching of psychology should be carefully formulated as they are to a great extent responsible for fostering the growth of psychology as a profession. Psychology has close affiliations with other branches of knowledge and also with the practical field of human relations. These and the problem of personal limitations of the teacher should be taken into consideration when planning courses of study in psychology.

Research carried out in India in the field of psychology has so far been of a theoretical nature and a matter of individual exploration. More emphasis should be laid on research on applied aspects of the subject if it is to develop as a profession. Also, research should be carried out on a co-operative basis as in other fields and concentrated on problems arising out of local needs. The solutions thus found may ultimately be of national significance.

THE NEED FOR A NEW OUTLOOK IN POWER ENGINEERING PRACTICE

THE impact of the development of atomic energy on engineering sciences and practices, particularly in the field of power engineering, is far-reaching. With the availability of this new source of power, the very basis of power production and utilization practices will undergo a revolutionary change. Addressing the Section of Engineering and Metallurgy, the president, Dr. Birendra Nath Dey, said that with the development of atomic energy, a new age

has dawned which has brought about a phenomenal change in our approach to power engineering problems. Dr. Dey urged the scientists and the engineers to find better and workable methods of harnessing energy from conventional sources and also from unconventional sources such as solar energy, cosmic rays, heat stored in the earth, tides, winds, etc. The role of the power engineer, he observed, is not only to investigate the problem of harnessing energy from unconventional sources but to go on perfecting and improving the methods now in vogue

or find new ways of obtaining larger quantum of mechanical energy from established sources.

Dr. Dey emphasized the need for developing indigenous material and man power resources to find an effective solution for national reconstruction problems. He said that a new approach to the question of training of engineers is necessary and that the existing pattern of engineering education and research should be remodelled to meet the requirements of the new era in power science and engineering.

Forty-third Indian Science Congress, Agra

THE Indian Science Congress Association held its forty-third annual session during 2-8 January 1956 at Agra, under the presidentship of Dr. M. S. Krishnan. The session, which was attended by a record number of over 1,700 delegates, was inaugurated by the Prime Minister, Shri Jawaharlal Nehru. Thirty-seven distinguished scientists from Argentina, Australia, China, France, Germany, Japan, Pakistan, Poland, U.K., U.S.A. and U.S.S.R. participated in the deliberations of the Congress. Five representatives from international agencies like the Unesco, F.A.O. and W.H.O., and representatives from the British Association for the Advancement of Science and the U.S.S.R. Academy of Sciences took part in the meetings.

Over 1,100 papers were submitted to the 13 sections of the Congress. The number presented in each section was: Agricultural Sciences 77; Anthropology and Archaeology 30; Botany 136; Chemistry 344; Engineering and Metallurgy 60; Geology and Geography 88; Mathematics 27; Medical and Veterinary Sciences 86; Physics 84; Physiology 81; Psychology and Educational Sciences 43; Statistics 22; and Zoology and Entomology 100.

Thirty symposia were organized on the following subjects: *Van Mahostava*; *Role of geology and geography in national planning*; *Stain technique*; *Energy metabolism*; *Role of*

psychology in national planning; *Geometry of complex manifold*; *The prospects of manufacturing synthetic liquid fuels in India*; *Livestock improvement in relation to public health*; *Effect of different cropping systems on the structural conditions of soil*; *Metallogenic epochs in India*; *Muscle physiology*; *The Indian approach to psychology*; *Riesz summability and its application*; *Nitrogenous fertilizers — their production and application*; *Relation between social anthropology and sociology in India*; *The problem of rural health in India*; *Extraction of cobalt and its byproducts from cobalt ore of Indian origin*; *National sample survey*; *Modern radiation and particle detectors*; *Distribution of population in India*; *Basic requirements for a study of physical anthropology in India*; *Guidance and counselling*; *Possibilities of development of fine chemicals industry in India*; *Modern trends in plant taxonomy*; *Correlation between the glacial and the pluvial cycles in extra-peninsular and peninsular India*; *Relation of vitamins and trace elements*; *Problems in experimental education with special reference to mathematics*; *River conservancy for flood control*; *Scientists and socialistic pattern of society*; and *Economic statistics*.

Nine joint discussions were held on the following subjects under the auspices of two or more sections: *Linear operators*; *The use of organic insecticides in the control of insect-pests of agricultural crops*; *Statistical methods*

in engineering and metallurgy; Role of adaptation in organic evolution; Geological age determination with the aid of radioactivity; New trends in research; Applied aspect of insect nutrition; Teaching of mathematics in engineering institutions; and Soil survey — its technique and application.

Four special lectures delivered by the scientists from abroad included: *The problem of protein requirements and protein malnutrition* by Dr. W. R. Aykroid (F.A.O.); *Prevention of regression of some types of experimental diabetes by estrogens or corticoids* by Prof. B. A. Honssay (Argentina); *Metamorphic function of several variables; and Celestial mechanics* by Prof. C. L. Siegel (Germany).

The following eight popular lectures were delivered: *First Indian atomic reactor* by Dr. H. J. Bhabha; *Planning in India* by Prof.

P. C. Mahalanobis; *Oil resources of India with special reference to discoveries in Assam* by Mr. P. Evans; *Human skin and its pigments* by Dr. B. Mukerji; *Geology of India* (in Hindi) by Prof. K. N. Kaul; *High energy accelerators* by Prof. B. D. Nag; *Evolution of modern means of communication in the army; and Modern trends in petroleum exploration* by Dr. Alfred Benz (Germany).

A large variety of scientific apparatus and instruments of Indian and foreign make was on show at the Exhibition organized under the auspices of the Indian Science Congress. About 40 firms participated in the exhibition.

The next session of the Indian Science Congress will be held at Calcutta over which Dr. B. C. Roy, Chief Minister of West Bengal, will preside.

Design & Development of a Simple Ionospheric Equipment

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Engineering College, Banaras Hindu University, Banaras

MOST of the ionospheric investigations are now carried out by the group retardation method developed by Breit and Tuve¹⁻³. In this method, a series of radio frequency pulses of short duration are radiated upwards to the ionized layers to be received back on the earth after reflection, and the time taken by the pulses for the to and fro motion between the earth and the ionosphere is measured for the calculation of the height of the ionospheric layers. Besides the height of the ionosphere, there are other properties of the ionosphere which are studied from the nature of the reflected pulses. For such investigations, it is necessary to have a transmitter which generates and radiates pulses of suitable width and proper repetition frequency and a receiver with a cathode-ray oscillograph for the reception and reproduction of the reflected pulses on a calibrated time axis. In the

earlier sounding equipment⁴⁻⁶ the generation of the radio frequency pulses is accomplished in a single oscillator unit by the action of a condenser and grid resistance. Such an equipment, however, suffers from the defect that the pulse recurrence frequency cannot be maintained constant throughout the range of frequency of the equipment. In view of this difficulty many equipment⁷⁻¹⁰ have been designed in which the recurrence frequency can be kept fairly constant.

The present communication describes a compact and simple ionospheric equipment of medium power designed and constructed in this laboratory for ionospheric sounding, with particular reference to investigations on the scattering of radio waves^{11,12}. In this equipment, a d.c. pulse generator is separately built which excites a c.w. oscillator at regular intervals through an electronic switching unit. A receiver, based

on the superheterodyne principle, has been designed and built for reproducing the pulses with a commercial cathode-ray oscillograph.

Ionospheric equipment

The equipment consists of two important units, viz. (1) the transmitter, and (2) the receiver with a recording system.

The transmitting unit consists of three parts: (a) d.c. pulse generator, (b) switching unit, and (c) c.w. oscillator.

D.C. pulse generator — The d.c. pulse generator (Fig. 1) generates triggering pulses at the power line frequency due to simple transients which are developed in the RC network composed of R_4 and C_1 , when a voltage square wave is applied to the network. V_1 is a double diode used

as a half wave rectifier which develops a d.c. voltage across R_2 obtained from 50 cycles a.c. input across R_1 . This voltage is applied to the grid of the square wave generator V_2 , care being taken for the proper polarity such that it always drives the grid of this valve in the negative direction. V_2 is a sharp cut-off pentode operating at zero bias and is rapidly driven to the cut-off point and thus clips the input signal and, as a result, an amplified square wave voltage appears across the plate resistance R_3 . The voltage wave obtained with the present equipment is shown in Fig. 2. This voltage is applied to the RC series network which differentiates the square wave and produces sharp peaky pulses of either polarity across R_4 (Fig. 3). These pulses are applied to the grid of the pentode valve V_3 which

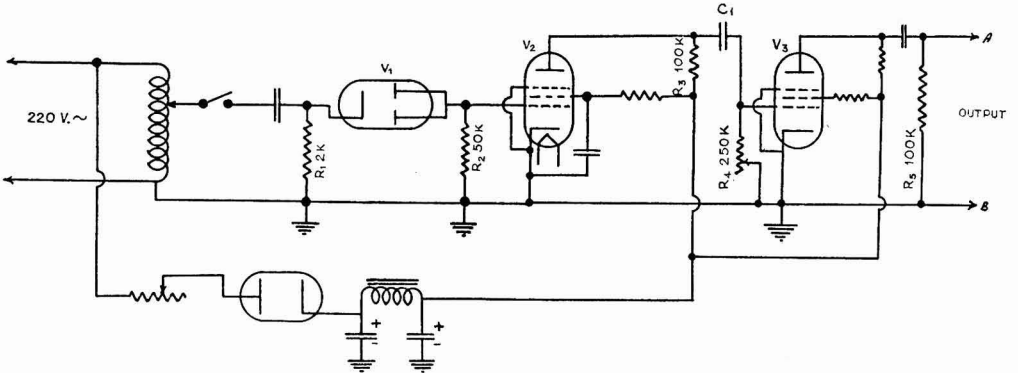


FIG. 1 — CIRCUIT DIAGRAM OF D.C. PULSE GENERATOR

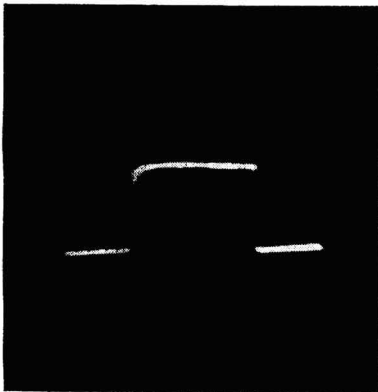


FIG. 2 — SQUARE WAVE

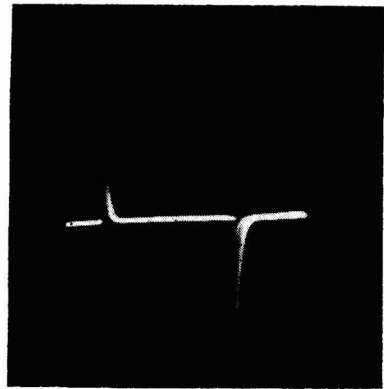


FIG. 3 — DIFFERENTIATED POSITIVE AND NEGATIVE PULSE

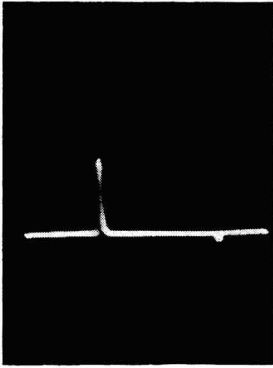


FIG. 4 — POSITIVE PULSE

is biased sufficiently to remove the pulse of negative polarity. Thus an amplified pulse of positive polarity appears at the output of the pulse generator across the resistance R_5 . The output is then applied to the switching unit of the transmitter. The type of d.c. pulse obtained at the output of the pulse generator is shown in Fig. 4. The small negative pulse which is still left is of little importance. The amplitude of the pulse can be altered by varying the input voltage and the pulse width can be adjusted with the help of the resistance R_4 from 80 μ /sec. to 2 millise. The larger pulse width obtained by the above process is shown in Fig. 5.

Switching unit — The switching unit consists of a single hard pentode valve V_4 (enclosed within dotted lines in Fig. 6). The plate of this valve is connected to one end of the filament of the oscillator which is heated by 6.3 V. a.c. supply and the cathode of the pentode valve is connected to the negative end of the power supply (Fig. 6). Normally the pentode is biased to cut-off so that it offers a very high resistance between the filament of the oscillator and the negative end of the power supply and thus keeps the oscillator inoperative. When, however, the positive pulse (Fig. 4) is applied to the grid of the pentode valve V_4 , the tube is made to conduct and the oscillator operates for the duration of the pulse. The small negative pulse (Fig. 4), which is applied in between the two positive pulses, is of little importance as it drives the grid of V_4 slightly more in the negative direction and makes the switching valve remain non-conducting

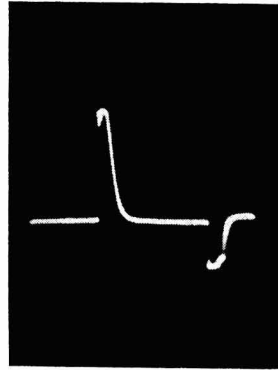


FIG. 5 — PULSES OF INCREASED PULSE WIDTH

during that period. This negative pulse should not be allowed to be too high because the recovery of the switching valve may not be efficient when it is high. Thus, with the operation of the d.c. pulse generator and the switching unit, the transmitter will generate r.f. pulses at the rate of 50/sec.

C.W. oscillator — This is a tuned anode and tuned grid c.w. oscillator with two triodes (Philips T.B. 2.5/300) connected in push-pull arrangement (Fig. 6). The power pack for the high tension supply of the oscillator is also shown in Fig. 6. Provision is made to record the plate and grid currents and the plate voltage by the various meters provided (Fig. 6). By suitable combination of the variable condensers in the anode and grid circuits, the frequency of the oscillator can be varied from 3 to 16 Mc/s. Horizontal dipole aeriels are used which are fed through the anode coil of the oscillator (Fig. 6). The peak power radiated from the transmitter is of the order of 10-25 kW.

Receiving unit — An a.c./d.c. superheterodyne receiver was built with nine valves for receiving the reflected echoes which consisted of two r.f. and three i.f. stages. These were found necessary for the detailed study of the echoes and the scattering of the radio signals with a transmitter of medium power as used in the present equipment. The receiver was used in conjunction with a commercial cathode-ray oscillograph. The special feature of the receiver is the absence of the a.v.c. system and RC coupling in all predetector stages for avoiding the overloading of the receiver due to the strong ground

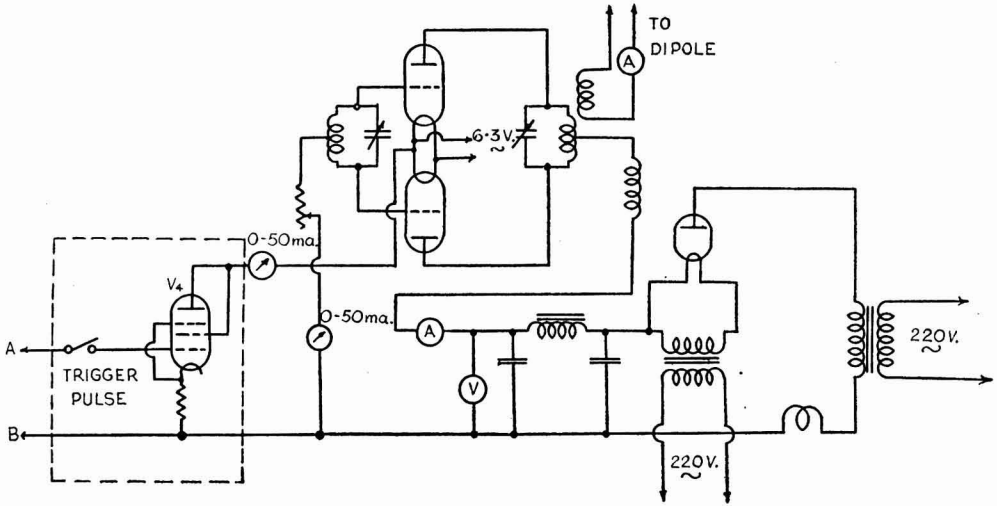


FIG. 6 — CIRCUIT DIAGRAM OF TRANSMITTING UNIT

wave. The bandwidth of the receiver was properly adjusted with the resistances across the primary and secondary coils of the i.f. transformers. The frequency range of the transmitter could be covered in two bands in the receiver from 3 to 9 Mc/s. and 7 to 16 Mc/s. For proper r.f. amplification and signal to noise ratio of the receiver, it was found that at least two r.f. stages were necessary, although the indication of the echoes may be obtained with even one r.f. stage. A general idea about the sensitivity of the receiver will be gathered from the curve in Fig. 7, which shows the relation between the detector current flowing for a small fixed input signal at the aerial for different frequencies. The selectivity curve for the receiver obtained by feeding a small i.f. signal at the first i.f. amplifier is shown in Fig. 8, which represents almost the overall bandwidth of the receiver. The bandwidth has been found to be 18 kc/s. which is in close agreement with its relation with the pulse width as required in such receivers. For instance, for the proper functioning of a pulse receiver the bandwidth should be equal to $2/t$, where t is the pulse width. Substituting the value of t as 100 μ sec., the bandwidth in the present equipment would be of the order of 20 kc/s. The reflected echoes from the ionosphere could be obtained for both the E and F regions of the ionosphere and a typical record of the echoes is

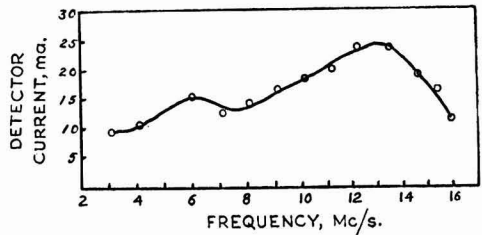


FIG. 7 — SENSITIVITY CURVE OF RECEIVER

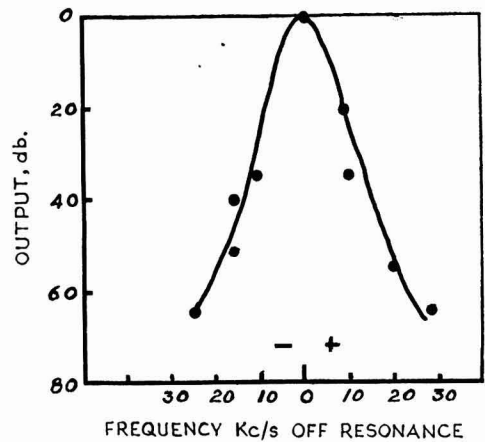


FIG. 8 — SELECTIVITY CURVE OF RECEIVER



FIG. 9 — IONOSPHERIC REFLECTIONS (F_2 REGION) OBTAINED WITH THE EQUIPMENT

shown in Fig. 9. The equipment is manually operated but it can be made automatic with necessary modifications.

Summary

A simple and compact ionospheric equipment of medium power has been designed and built. The equipment consists of a transmitting and a receiving unit. In the transmitting unit, a separate pulser circuit excites a c.w. push-pull oscillator at regular intervals with a d.c. pulse generator having variable pulse width and a hard valve as an electronic switch. A suitable superheterodyne receiver receives the reflected echoes from the ionized layers with the help of a commercial cathode-ray oscillograph. The equipment is manually operated and can be used with simple horizontal dipole serials for

the reception of the echoes from the ionosphere and the power obtained in the transmitter is sufficient for carrying out observations on the scattering of radio waves.

Acknowledgement

The author is indebted to Dr. S. S. Banerjee for his valuable suggestions during the progress of the work and to Principal M. Sengupta for his interest. His thanks are also due to the Council of Scientific & Industrial Research, Government of India, and the Scientific Research Committee of Uttar Pradesh Government for financial assistance.

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Investigation of Winds in the Ionosphere by Spaced Receiver Method

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IT is well known that the upper regions of the atmosphere are subjected to winds and turbulence of large order of magnitude, the study of which is of considerable geophysical interest. Early measurements on these wind movements were made visually by observing luminous phenomena like meteor trails and noctilucent clouds simultaneously from two widely separated places. These measurements made by Stormer¹, Olivier² and others led to wind velocities ranging between 44 and 90 m./sec. A new meteoric echo method for studying winds in the upper atmosphere, which is based on the measurement of Doppler frequency shift imparted by ionospheric wind to c.w. reflections from meteoric ionization columns, has been recently developed by Manning³ and his collaborators.

Ionospheric winds can be studied by radio methods which involve the comparison of fading records of radio waves reflected from the ionosphere and picked up by two or three receiving centres. Pawsey⁴ has interpreted the time displacements observed in the fading records of two receivers separated by 170 meters as an evidence of the existence of ionospheric winds. Using two receivers separated by 60 km., Mimno⁵ has observed the swift movement of clouds of intense ionization in the E layer with an apparent velocity of 1 km./sec. Munro⁶ has developed an entirely new method of study employing three transmitters placed at the corners of a right-angled triangle of sides 15 and 25 miles and radiating pulses of 100 microseconds width and 50 c./sec. repetition frequency on a radio frequency of 5.8 Mc/sec. The h'-t curves of these signals received at a single station show characteristic perturbations which are attributed to travelling disturbances of hundreds of kilometers lateral extent moving with a horizontal speed of about 100 m./sec. These perturbations of the position of the echoes showed a time

difference of occurrence in the three records which enabled the determination of the velocity and direction of motion of the travelling disturbance. Winds in the F layer have also been observed by Beynon⁷ who reported velocities of the order of 120 m./sec.

Systematic wind measurements in the ionosphere were made by Mitra⁸, using the spaced receiver technique. This method involves the use of three receiving aerials situated at the three corners of a right-angled triangle and a single transmitter radiating pulsing waves of width 200 microseconds in the range of 2 to 6 Mc/sec. The amplitude of the first hop echo from the aerials is depicted on three single beam oscillographs arranged in such a manner that photographic records of the variation of the amplitude versus time can be obtained on 35 mm. film. The magnitude and direction of the winds were then calculated from the time shifts in the three fading records. Krautkrammer⁹ employed a similar method to study these winds using radio waves of frequency 2.6 Mc/sec. Seasonal variation of wind directions has been observed both in the E and F regions by Salzberg and Greenstone¹⁰ who adopted a similar method for wind study with the modification that pen recorders were used for recording fading of the first hop echo from the ionosphere.

The present investigation deals with the study of wind movements in the ionosphere started in this laboratory using the spaced receiver method. Preliminary results¹¹ obtained by us have already been reported. In this paper we give the full details of the equipment used and the results obtained during the last one year.

Experimental details

The experimental set-up, the block diagram of which is shown in Fig. 1, is essentially similar to that adopted by Mitra. It

consists of a push-pull transmitter of conventional design employing two 810 valves. Band switching arrangement was provided to cover a wide frequency range of 2 to 16 Mc/sec. in four bands. Another band switch was provided in the primary of the H.T. transformer to change the supply voltage from 1,000 to 3,500 V. in steps in order to control the power of the transmitter. The pulse transmitter was controlled by a modulator using two 807 valves biased to cut-off and connected in parallel between the filament of the transmitting valve and ground. The transmitter was triggered by pulses of 100 microsecond duration and 50 c./s. repetition frequency fed to the grids of the modulator valves. The pulse generator was a conventional cathode-coupled multivibrator followed by power amplifiers and synchronized to the mains frequency. The power from the transmitter was fed to the two dipole transmitting aerials tuned to 2.4 and 5.9 Mc/sec. through coaxial feeders of 76 ohms impedance. Three dipole receiving aerials, A_1 , A_2 and A_3 , were erected for each of the frequencies 2.4 and 5.9 Mc/sec. such that their centres are situated at the corners of a right-angled triangle and whose sides are parallel to north-south and east-west directions. Aerials A_3 and A_1 were situated along a north-south direction and were spaced 106 m. apart. Similarly A_2 and A_1

were separated by a distance of 106 m. along an east-west direction. The lengths of the receiving and transmitting aerials were adjusted to be parallel to each other for maximum sensitivity. Signals from all the receiving aerials were brought to the recording station at A_1 by using twin flexible flat wire as feeder line and were connected to three receivers through D.P.D.T. switches so as to enable easy interchange of the 2.4 and 5.9 Mc/s. aerials. Two Hallcrafters SX-25 receivers and one U.S. Army type BC-348 communication receiver were employed for the purpose of amplifying the reflected signals from the ionosphere picked up by the receiving aerials. All the three receivers were suitably converted for pulse reception by first increasing the bandwidth of the pass band to 50 kc. and then incorporating a video amplifier stage for the output. The overall gain of each receiver was 150 db. The outputs of the receivers were then connected to the Y plates of a three-beam oscillograph designed for this purpose in order to display the three first hop reflections from the ionosphere received by the three aerials. The use of a triple-beam oscillograph is a special feature of this investigation and has simplified the method of recording simultaneously the fading of radio waves at the three receiving sites without using elaborate mirror arrangements as was done in Mitra's

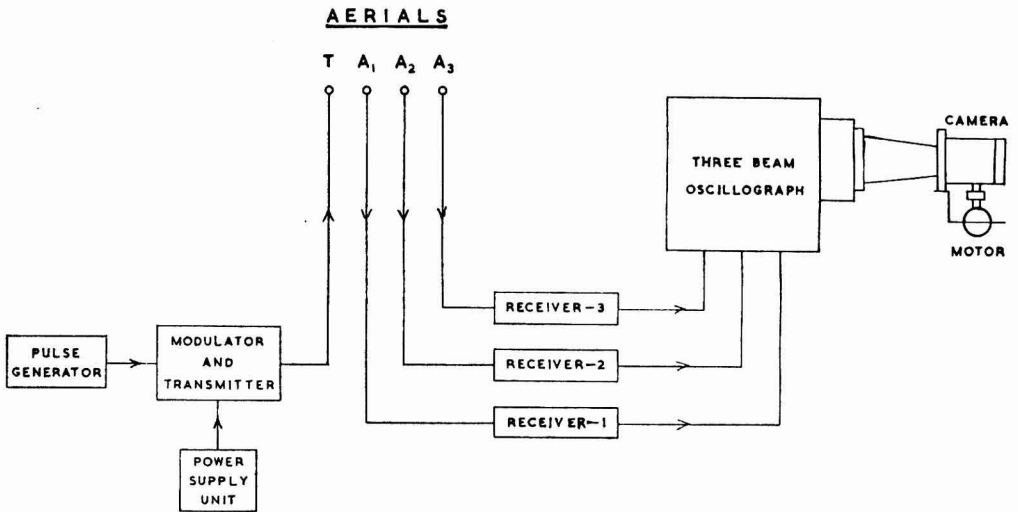


Fig. 1 — SCHEMATIC DIAGRAM OF THE EXPERIMENTAL SET-UP FOR MEASURING WINDS BY THE SPACED RECEIVER METHOD

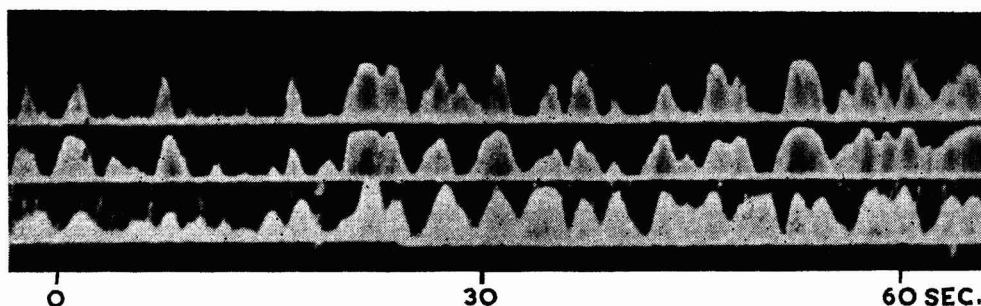


FIG. 2 — TYPICAL FADING RECORD TAKEN ON A TRIPLE-BEAM OSCILLOGRAPH

investigations. The oscillograph employs a 5 in. three-gun cathode-ray tube, type 53 RAP1, with blue phosphor suitably mounted in a chassis. Excepting for the deflection plates, the rest of the electrodes of all the three guns were connected in parallel so that the supply voltages were common for all the three tubes. The time base circuit used in this oscillograph was triggered by the pulse generator to synchronize with the mains frequency and was provided with a fine and coarse control for adjusting the speed. This was followed by an amplifier stage having linearity control and fed to the input of a balanced output stage employing three 807 valves. Controls were provided in the output stage for adjusting the amplitude, anastigmatism, and X shift of the time bases in common for all the three beams. The three pairs of X plates of the cathode-ray tube were connected to variable taps across the plate load resistances of the output stage of the time base in such a manner that independent fine X shift control was possible for two of the beams in order to adjust all the beams to exact coincidence when they overlap. Independent Y shifts provided for each beam were adjusted to set the three beams separated vertically by a distance of 3.5 cm. The three pulses received by the three receiving aerials were displayed on the three beams of the oscillograph. The return trace of the time base was blanked out by applying a negative signal to the grid. Provision was made for displaying the signal on the beam without the time base by using a video amplifier for intensity modulation. A height marker circuit incorporated in the unit provided sharp pulses of a repetition frequency of 3,333 c./sec. which were dis-

played on the normal time base as sharp pips or bright dots on the intensity modulated time base. The interval between the marks corresponds to a distance of traverse of 100 km. by the electromagnetic wave.

A Cossor model 1428 oscillograph camera was fixed over the face of the oscillograph tube and a 1 r.p.m. synchronous motor was coupled to the shaft for driving the film continuously with a speed of 7.8 cm./min. Records of the fading of the first hop echo from the ionosphere were then obtained by covering the face of the oscillograph with a circular diaphragm having vertical slit in the centre which allows only the first hop echo to be photographed by adjusting the time base position. A typical record thus obtained is reproduced in Fig. 2. It will be seen from the record that there are definite time displacements between the maxima in each record which enables the determination of wind velocities and directions.

Method of analysis of the records

Most of the records obtained in this investigation show fading which is in general similar for all the three aerials, but the peaks in each record are slightly displaced indicating a time lag or lead in the fading. This time displacement is interpreted as due to a steady wind in the ionosphere and the velocities and directions of the wind are determined following the usual method adopted by previous investigators. In order to determine the time intervals between identical maxima in the fading pattern of the three stations, the photographic record obtained on the 35 mm. film is examined in a microfilm reader of magnification 9 and the relative displacements in the peaks in each

record are measured in millimeters. If a_x and a_y represent the displacements (in mm.) between the fading curves of A_1 and A_2 and A_1 and A_3 respectively, time shifts t_x and t_y in sec. are given by

$$t_x = \frac{6a_x}{ms} \dots \dots \dots (1)$$

and

$$t_y = \frac{6a_y}{ms} \dots \dots \dots (2)$$

where m is the magnification of the microfilm reader and s the speed of the film in cm./min. Knowing the distances x and y between the aerials A_1 and A_2 and A_1 and A_3 respectively, the apparent component velocities V'_x and V'_y can easily be calculated from the relations

$$V'_x = \frac{x}{t_x} \dots \dots \dots (3)$$

and

$$V'_y = \frac{y}{t_y} \dots \dots \dots (4)$$

The velocity V of the amplitude pattern moving on the ground and its direction are then given by the usual relations

$$\left(\frac{1}{V}\right)^2 = \left(\frac{1}{V'_x}\right)^2 + \left(\frac{1}{V'_y}\right)^2 \dots \dots (5)$$

$$\text{and } \tan \phi = \frac{V'_y}{V'_x} \dots \dots \dots (6)$$

where ϕ is the angle which the wind direction makes with the y direction. The actual wind velocity will then be given by half the value of V as the amplitude pattern on the ground travels past the receiving aerials with twice the actual wind velocity in the ionosphere.

Results and discussion

The results of wind measurements conducted during the year 1954 are presented as polar diagrams in Figs. 3 and 4. The results obtained for the winter and summer months are grouped together and are plotted as separate diagrams in order to study the seasonal variations. The polar diagram in Fig. 2 shows the wind directions and velocities in the E region based on a total number of 75 observations made on a frequency of 2.4 Mc/sec. during daytime between 09.00 and 17.00 hr. I.S.T. It will be easily seen from Fig. 2a that winds in the winter months of January, February, November and December 1954 are predominantly directed towards south-south-west having a mean direction

of 210° east of north. Fig. 2b shows the average wind motion in the summer months of May, June, July and August 1954 to be towards east having an average wind direction of 130° east of north. There is no significant seasonal variation of the wind velocities, most of the values being in the range of 30 to 80 m./sec. for both the seasons. The most probable wind velocities are in the range of 50 to 70 m./sec. The wind velocities determined by us are in good agreement with the values reported by Mitra which are in the range of 20 to 110 m./sec., the most probable value being 50 m./sec. Early observations by Störmer and others on meteoric ionization led to wind velocities in the range of 44 to 83 m./sec. having a mean of 60 m./sec. which is also in good agreement with the data obtained by us. The seasonal variation of the wind directions in the E region was studied by Salzberg and Greenstone. They found a south-westerly direction in the winter and an easterly direction in summer which is in fairly good agreement with our observations. Recent work on wind velocity and directions at E-layer level by Manning and his collaborators by using radio methods of tracking meteoric ionization has yielded values of 35 m./sec. for velocities of E-layer winds which are a little less than the values recorded in this investigation. It may be of interest to note that the average wind velocity at E-layer level observed by most of the investigators is in agreement with the value of 65 m./sec. for 100 km. height worked out by Weekes theoretically on the basis of his theory of atmospheric tidal oscillations.

The data presented in the polar diagrams in Fig. 3, a and b, are the wind velocities and directions for the F-2-layer level for the winter and summer seasons respectively obtained from about 92 observations taken during daytime between 09.00 and 17.00 hr. I.S.T. on a frequency of 5.9 Mc/sec. The number of observations in the winter months are few in number compared to those in summer months. There is no significant variation in the average wind velocities between summer and winter seasons. The wind velocities are found to vary between 50 and 100 m./sec. in winter, while for the summer months the points are more scattered and the velocities range from 40 to 130 m./sec. These values for wind velocities are found to be in fairly good agreement

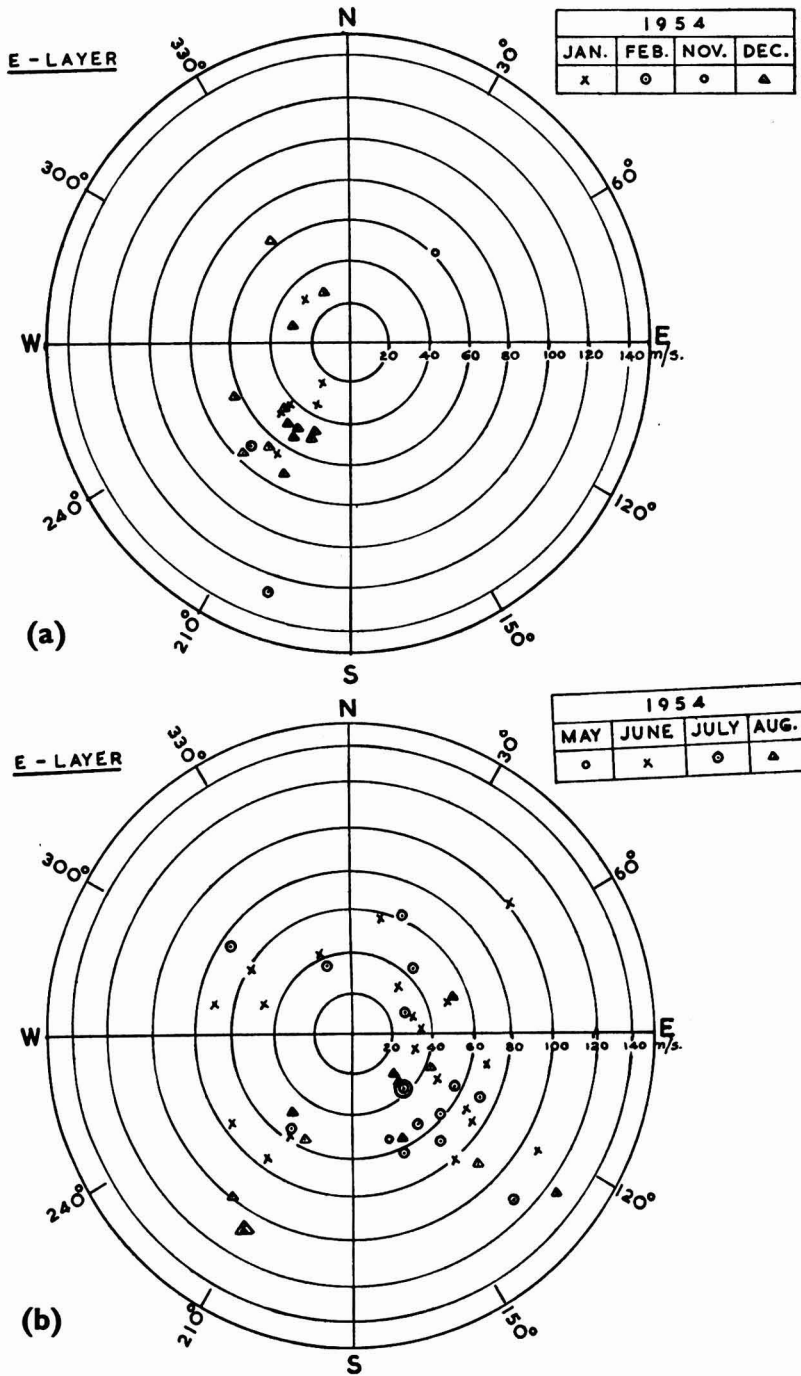


FIG. 3 — POLAR DIAGRAM ILLUSTRATING SEASONAL VARIATION OF WIND MOVEMENTS IN THE E REGION

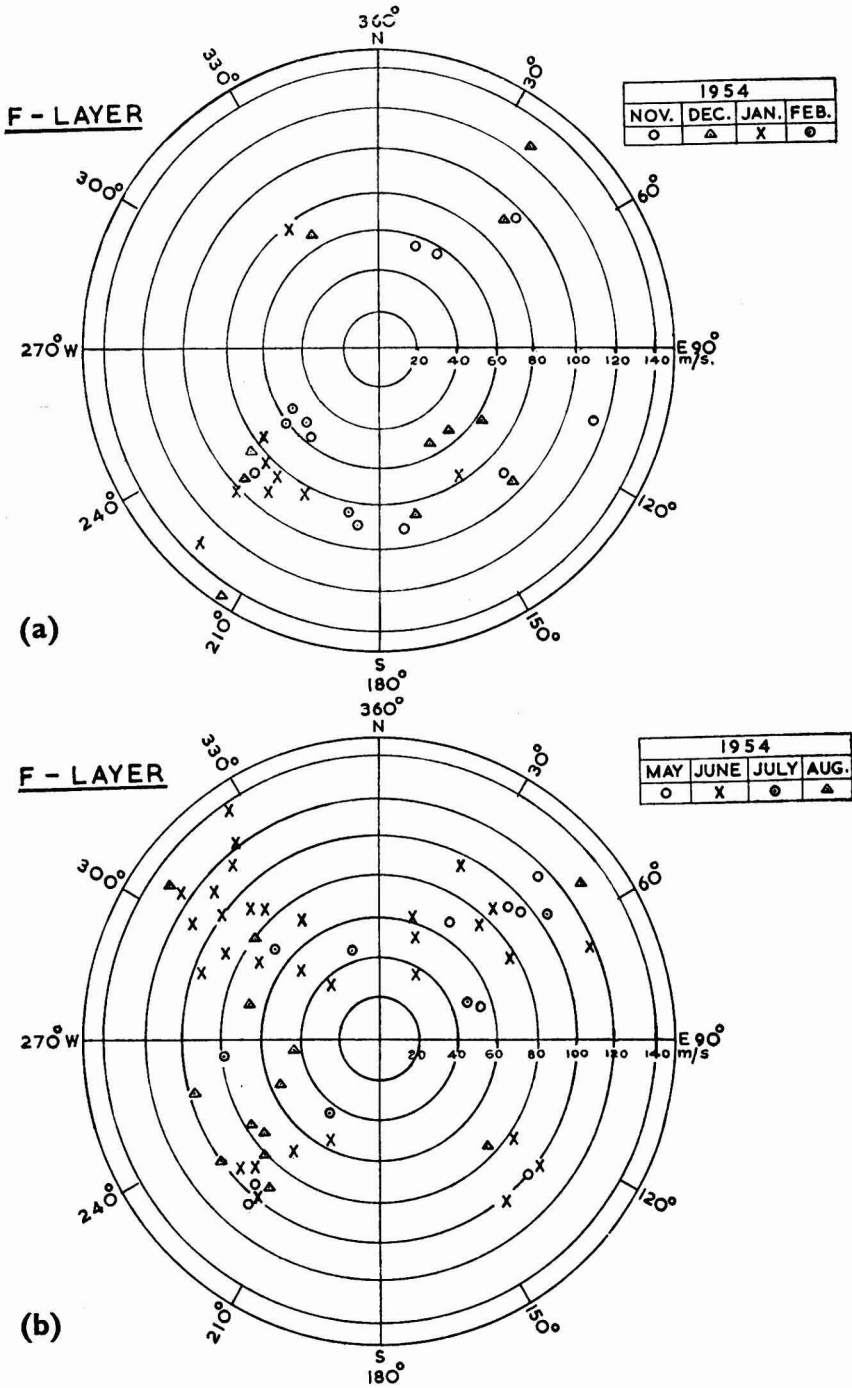


FIG. 4 — POLAR DIAGRAM ILLUSTRATING SEASONAL VARIATION OF WIND MOVEMENTS IN THE F REGION

with the values obtained by Krautkrammer and Munro for the F region. It will be seen from Fig. 3a that the winds in the winter season are predominantly towards south-west direction just like those in E region. These wind directions observed in winter months compare favourably with the wind directions observed by Salzberg and Greenstone during the same months. Millman¹², however, observed an eastward wind direction during the months of December and January. From Fig. 3b it will be evident that during the summer months there is no definite direction of wind movement. Fluctuations in wind directions are quite wide. It will be seen that the wind directions during the month of June are directed mostly towards north-west, while those in the month of August are in the south-west direction. Seasonal variations of travelling disturbances were studied by Price¹³ who observed directions between 0° and 60° east of north during the winter months of April to July and between 90° and 180° east of north in the summer months of October and November. These directions are exactly opposite to the predominant wind directions observed at this place and this may be due to the fact that observations of Price were taken at the University of West Australia in southern hemisphere.

It may be of interest to note that we have adopted a slightly modified procedure for calculating the wind velocities from the measured time displacements in the records. It is usually observed that these time displacements are not constant for the same record taken during a short interval of 2 min. and that sometimes the deviations from the mean value are quite large. Previous investigators who used this method have taken

the average value of these time displacements in calculating the wind movements. In this investigation we have adopted a slightly different procedure by discarding all those observations of time displacements which deviate widely from the median values and considering only such of those time displacements which do not vary very much, the average of these being taken as the most probable value. We found that, by using this method, there is more consistency in the data for wind velocities and directions.

Acknowledgement

Our thanks are due to the Radio Research Board for sponsoring this research scheme and to the Council of Scientific & Industrial Research for financial assistance.

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A Mixed Nitrogen-phosphorus Fertilizer

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THE production and use of cheap fertilizers in large quantities is one of the important problems in the economic development of India. Some effective steps have been taken in respect of nitrogenous fertilizers, but the present production of phosphatic fertilizers falls far short of the requirement. In view of this, the Planning Commission has recommended the immediate production of 200,000 tons of phosphatic fertilizer which, expressed in terms of single superphosphate, is more than double the present production.

The increased production of phosphatic fertilizers is, however, beset with difficulties. For instance, in the matter of supply of the two principal raw materials, viz. rock phosphate and sulphur, the country is almost completely dependent on imports. Though some deposits of phosphatic nodules occur at Tiruchirapalli, they are not of the required quality and it is somewhat difficult to work them. It may be possible to obtain rock phosphate from soft currency areas, but the same is not true of sulphur, which is imported chiefly from the U.S.A.¹

If the Planning Commission's target of 250,000 tons P_2O_5 is to be achieved, it would mean a consumption of 562,000 tons of sulphuric acid, equivalent to 183,000 tons of sulphur based on a ratio of 0.36 ton of acid for every ton of superphosphate. This requirement is large, especially when it is realized that the country's present consumption of sulphur is about 60,000 tons per year. Alternative methods should, therefore, be examined to attain the desired target of phosphatic fertilizers with the minimum use of imported sulphur.

An alternative to sulphuric acid in the acidulation process in the manufacture of fertilizer from phosphate rock would be hydrochloric acid, which can be obtained as a cheap byproduct from the electrolytic caustic-chlorine plants. For every ton of caustic soda produced by the electrolytic process, approximately 3 tons of 30 per cent

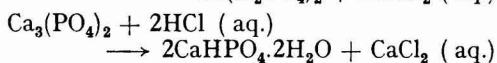
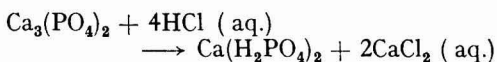
hydrochloric acid can be obtained. India's production of caustic soda in 1953 was about 22,500 tons, which was roughly 60 per cent of the rated capacity and 33 per cent of the country's requirement. The reason for the low output of caustic soda in spite of increasing demand is the difficulty of disposal of chlorine produced. Hence, if the chlorine produced can be utilized in making hydrochloric acid for the manufacture of phosphatic fertilizers, it would serve the three-fold purpose of conservation of sulphur, utilization of surplus chlorine and expansion of the caustic soda industry.

Some attempts at making new phosphatic fertilizers by either replacing sulphuric acid with hydrochloric acid², or by using it in proportions much less than what is consumed in the superphosphate process³ have been reported earlier. The present article describes the process (covered by Indian Patent No. 47439) developed in this laboratory for the manufacture of a mixed nitrogen-phosphorus fertilizer from rock phosphate, hydrochloric acid and ammonium sulphate, the latter being now obtainable directly from gypsum without the use of sulphuric acid.

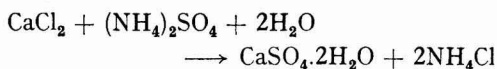
The process

The chemistry of the two-stage process is represented by the following equations:

Stage 1



Stage 2



The product from the first stage is a thick slurry containing water from the hydrochloric acid used. It could not be dried owing to the presence of the hygroscopic cal-

cium chloride. The product from the second stage, however, is free from hygroscopic constituents and is a pale brown, free-flowing powder, which retains its high citrate-solubility (90 per cent) indefinitely during storage. It is principally a mixture of mono and dicalcium phosphates, ammonium chloride and gypsum.

The raw materials used were Kossier rock phosphate ground to -85 mesh B.S.S., commercial hydrochloric acid (27 per cent; w/w) and ammonium sulphate (technical grade). The results of chemical analysis of the rock phosphate are recorded in Table 1.

Requisite amount of commercial hydrochloric acid was placed in a suitable vessel and the powdered rock added slowly in small batches to avoid loss by foaming. Overflowing of the slurry due to frothing was prevented by mechanical stirring. The temperature of the slurry during reaction was about 40°-45°C., which was sufficient for the decomposition of the phosphate rock. The slurry was then mixed with ammonium sul-

phate (which was finely ground to ensure thorough mixing and maximum conversion) and the mixture was left to cure for three weeks. The final product (coarsely ground) was a free-flowing powder, stable to weather changes, and contained nitrogen 7.4 and P₂O₅ 15 per cent.

By using different proportions of hydrochloric acid and its equivalent of ammonium sulphate, the solubilization of phosphate rock increases steadily up to 3 mols of acid per mole of tricalcium phosphate, beyond which solubilization is not commensurate with the amount of acid that has to be added (Table 2). This 3:1 ratio of acid to Ca₃(PO₄)₂ yields a 2:1 mixture of water-soluble and citrate-soluble P₂O₅ in the final product, the analysis of which is given in Table 3.

The curing period of the final mixture, i.e. the time after the addition of ammonium sulphate during which the slurry sets to a dry friable product and gives maximum conversion of rock phosphate to citrate-soluble phosphate, was found to be about three weeks. This was found by analysing the samples of the mixture at weekly intervals.

TABLE 1 — CHEMICAL ANALYSIS OF KOSSIER ROCK PHOSPHATE

[Moisture (drying at 105°C.), 2.02%; all values expressed on dry basis]

CONSTITUENT	%
Ca ₃ (PO ₄) ₂ *	67.30
CaCO ₃	13.73
CaSO ₄	3.62
CaCl ₂	0.70
Fe ₂ O ₃	1.04
Al ₂ O ₃	0.70
SiO ₂	2.35
MgO	0.87
Combined water and organic matter	4.40
CaF ₂	5.29
Total	100.00

*P₂O₅ = 30.8%.

TABLE 3 — CHEMICAL ANALYSIS OF N-P FERTILIZER

CONSTITUENT	%
P ₂ O ₅	15.00
Water-soluble P ₂ O ₅	9.28
Citrate-soluble P ₂ O ₅	4.11
Total 'available' P ₂ O ₅	13.39
Nitrogen (ammoniacal)	7.40
CaO	23.00
SiO ₂	1.20
MgO	0.40
Mixed oxides (Al ₂ O ₃ + Fe ₂ O ₃)	0.80
Sulphate	26.70
Chloride	18.60
Fluoride	1.30

TABLE 2 — TREATMENT OF ROCK PHOSPHATE WITH VARYING PROPORTIONS OF HYDROCHLORIC ACID AND AMMONIUM SULPHATE

(Wt. of phosphate rock used per batch, 100 g.)

BATCH NO.	ACID REQUIRED* mol	HYDROCHLORIC ACID (27% w/w) g.	AMMONIUM SULPHATE g.	WT. OF THE PRODUCT AFTER AIR DRYING g.	ANALYSIS OF PRODUCTS				
					Total N %	Total P ₂ O ₅ %	Water-soluble P ₂ O ₅ † %	Citrate-soluble P ₂ O ₅ † %	Total available P ₂ O ₅ † %
1	4.0	171.0	84.0	220.0	8.1	13.6	84.7	7.2	91.9
2	3.5	156.0	76.0	210.0	7.7	14.3	79.2	10.6	89.8
3	3.0	142.0	70.0	200.0	7.4	15.0	61.9	27.4	89.3
4	2.5	127.0	62.0	190.0	6.9	15.8	62.3	22.1	84.4
5	2.0	112.0	55.0	180.0	6.5	16.6	63.0	18.8	81.8

*In addition to the acid required for CaCO₃, Al₂O₃, Fe₂O₃ and MgO in 100 g. of rock phosphate.

†Fraction of total P₂O₅.

Pot-culture experiments with this fertilizer on a Kharif crop (marwa) and a Rabi crop (wheat) carried out at the Indian Agricultural Research Institute, New Delhi, during 1953-54 showed significant increases in crop yields over 'no manure' and 'superphosphate alone' treatments. The fertilizer was also found to be somewhat better than ammonium sulphate applied at the same level of nitrogen. Its application was also associated with increased utilization of nitrogen and P_2O_5 by the crops.

The fertilizer has been reported by the Indian Agricultural Research Institute to be "slightly inferior to an equivalent mixture of ammonium sulphate and single superphosphate". This drawback will be more than compensated for by the neutral character of the new fertilizer and its low cost of manufacture without the use of sulphuric acid.

Summary

A mixed nitrogen-phosphorus fertilizer has been prepared from phosphate rock

using hydrochloric acid and ammonium sulphate.

The product is a free-flowing powder containing 15 per cent P_2O_5 (90 per cent of which is citrate-soluble) and 7.4 per cent nitrogen as ammonium chloride.

The fertilizer value of the product has been assessed by the Indian Agricultural Research Institute, New Delhi, and it has been found to be superior to ammonium sulphate and 'superphosphate alone' treatments, but is slightly inferior to an equivalent mixture of ammonium sulphate and superphosphate.

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Indian Essential Oils & Aromatic Chemicals—A Symposium

A SYMPOSIUM on Research and Development of Indian Essential Oils and Aromatic Chemicals was held under the joint auspices of the Forest Research Institute and the Council of Scientific & Industrial Research at the Forest Research Institute, Dehra Dun, during 5-9 October 1955. Eighty papers covering the botanical, chemical, technological and other aspects of essential oils were read and discussed. The symposium was inaugurated by the Union Minister for Agriculture, Dr. Punjab Rao S. Deshmukh. Prof. M. S. Thacker, Director, Scientific & Industrial Research, presided over the inaugural meeting.

In his address, Prof. Thacker referred to the programme of work on essential oils under the Second Five-Year Plan. He

revealed that it had been decided to open four centres of research and development at: (i) Forest Research Institute, Dehra Dun; (ii) National Chemical Laboratory, Poona, in collaboration with Poona Agricultural College; (iii) Indian Institute of Science, Bangalore, in collaboration with Forest Research Laboratory; and (iv) Harcourt Butler Technological Institute, Kanpur, in collaboration with National Botanical Gardens, Lucknow.

Shri A. K. Menon, Chairman, Essential Oils Research Committee, referred to the role of the committee in initiating pioneer research work for the development of essential oil industry. Comprehensive surveys on vetiver, jasmine, roses, citrus oils and cultural experiments on the introduction of high

class patchouli plants in India were some of the important achievements to the credit of the committee. Shri Menon made a special mention of the valuable contributions made by the Forest Research Institute for an all-round development of the industry and of the recently completed Essential Oils Processing Laboratory.

A number of papers dealt with the development of lemongrass oil industry in India. About 80 per cent of world's total production of lemongrass oil, worth about one and a half crores of rupees, is exported annually from India. The production is centred in north and central Travancore-Cochin and in South Malabar. The 'Cochin Oil' or 'East Indian Oil' is renowned for its high citral content. Lemongrass oil is produced on a cottage industry basis and although most of the samples conform to the E.O.P. and other standards, deep colour and cloudiness of the oil are two undesirable features which need improvement. Attempts are being made to produce selected varieties of grass with a view to increase the oil yield as well as its citral content.

It has been found that vetiver (khus) can be successfully and profitably cultivated as a rain-fed crop in the west coast of India. The oil obtained resembles that from Java and Bourbon Islands in physico-chemical properties. Khus grows wild in North India but the oil obtained from different North Indian samples is laevorotatory while South Indian and Java oils are dextrorotatory. The present production of vetiver oil in India is hardly sufficient to meet 30 per cent of the requirements of the Indian soap industry and the industry has ample scope for development in India.

A number of Indian essential oils, including lemongrass oil, was found to possess high antibacterial activity. In most cases the antibacterial activity was found to run somewhat closely parallel to the phenol coefficients of these oils except in the case of oil of turpentine. The bactericidal efficiency of lemongrass oil was found to be generally high against gram-negative bacteria but very low against gram-positive organisms. The activity against acid-fast organism was practically nil. The disinfectant preparations from lemongrass oil were found to lose their bactericidal efficiency on long keep-

ing. The addition of certain antioxidants to the pure oil was found to retard the oxidative deterioration of the oil but was ineffective in preventing the loss of germicidal power.

The results of chemical examination of a number of well-known as well as less familiar essential oils were reported. These included: oil of champaca (*Michelia champaca*); oil from *Rosa damascena* and Edward Rose; rhizomes of 'bach' (*Acorus calamus* L.), 'Shiyah zeera' (*Carum bulbocastanum*), *Zataria multiflora*, *Seseli indicum* and *Apium graveolens*. Of a number of indigenous perfume-bearing materials tested [buds, chips, featherings and twigs of cinnamon (*Cinnamomum zeylanicum*), the rhizomes of 'gorabach' (*Acorus calamus*) and 'kapur kachri' (*Hedychium spicatum*), roots of 'jatamansi' (*Nardostachys jatamansi*) and 'kuchu gundubi' (*Homalomena rubescens* Kunth.)] gorabach is found to be rich in oil content. The oil possesses good odiferous characteristics.

Chemical examination of Indian spearmint oil (*M. viridis* L.) has been carried out for the first time. The plant, on steam distillation, yielded 0.23-0.31 per cent of a pale yellow oil which contained α -pinene, phellandrene, dihydrocarvenol and its acetate (all in traces), and 1:8 cineol (31.0-34.6 per cent). Its main constituent (47.6-54.4 per cent) is a new monoterpenic glyoxal ($C_{10}H_{14}O_2$) which has been given the name of 'mint glyoxal'. The structure of this material has been fully elucidated. It is the first specimen of a glyoxal derivative isolated from essential oils. Indian spearmint oil also contains a mono-semicarbazone-forming liquid (8.9 per cent) which is somewhat similar to mint glyoxal and shows strong absorption in the ultraviolet region.

The infra-red spectra of α -santalol, tricycloekasantalic acid, teresantalic acid, tricyclicene and Δ^3 -carene have been studied. These along with mint glyoxal and several of its well-characterized derivatives form a representative group of compounds containing cyclopropane ring. Apart from their absorption in other regions, these compounds indicated strong specific absorption in the 9.8-10.0 μ region, which makes infra-red absorption study in this region a reliable means of detecting the cyclopropane ring.

REVIEWS

RADIO-ISOTOPES IN BIOLOGY AND AGRICULTURE — PRINCIPLES AND PRACTICE by C. L. Comar (McGraw-Hill Book Co. Inc., New York — Toronto — London), 1955. Pp. xiii + 491. Price \$9.00

In recent years, radio-isotopes of many elements have been made available for tracer work in the fields of biology and agriculture with the result that scientific journals today contain innumerable research publications on the use of radio-isotopes. At the recent conference in Geneva on the peaceful uses of atomic energy, over a hundred papers were presented by scientists from different parts of the world, which dealt with the applications of radio-isotopes in biology and agriculture. The volume under review is intended both for the student as well as the research worker and deals with the principles and practice of isotopic-tracer technique in a manner which can be easily understood by the biologist.

The principles of tracer methodology are given in the first chapter, care being taken to exclude detailed considerations of nuclear physics. The principles are, however, well illustrated by examples of tracer technique in such different fields as nutrition, physiology, entomology, soils and fertilizers. The difficulties which are generally encountered in adopting the tracer technique have been presented in the second chapter, while the third chapter deals with practical problems of health physics, definitions of various units and physical constants. In the following two chapters methods which can be adopted for studies on plants and animals have been given in detail. The sixth chapter gives the characteristics of each of the 55 isotopes useful in biology and agriculture together with appropriate references to literature. These will make it possible to decide, for any particular isotope, suitable counting methods, the facilities required and the amounts of radioactive materials necessary for the investigation. Techniques such as autoradiography, paper chromatography, ion exchange and radio-activation analysis, which find application in any investigation with radio-isotopes are described with

a number of examples in the next four chapters.

The availability of a number of C-14 labelled organic substances as also those of radioactive phosphorus and sulphur has made it possible to elucidate many metabolic cycles in animals and plants. The manner in which radio-isotopes have been injected into pigs, cows, dogs, rats and other experimental animals and the ingenious devices developed to collect the various tissues as well as the excreta from these animals have been well described in the book. Similarly a detailed treatment is given of the autoradiographic technique so as to make possible study of cellular functions at the cell level. Various ion-exchange resins suitable for use with radio-isotopes have also been described. Finally, the most interesting of all techniques, the radioactivation analysis, has been dealt with. This consists in placing the sample to be analysed in a flux of bombarding particles, long enough for the production of a measurable amount of a radio-isotope of the element to be determined. Such a measurement should, however, be made after eliminating other radio-contaminants.

The book concludes with a glossary of selected terms in nuclear science, a list of available radio-isotopes and a catalogue of U.S. Atomic Energy Commission Reports which have so far been released for publication.

This volume will perhaps need early revision in view of the forthcoming publication, in sixteen volumes, of the papers which were read and discussed at the recent Geneva conference. Similarly, the tables of commercially available labelled compounds may have to be revised consequent on the decision of several countries to release a larger number of radio-isotopes for use in medical and biological research. However, the intrinsic value of the book should be recognized, for it is one of the few books which describes in a cogent manner the principles and practice of the use of radio-isotopes and illustrates them by examples drawn from different fields of study. The reviewer can confidently recommend this volume to all those

who wish to know the theoretical and experimental details connected with tracer technique in biological and agricultural research.

P. S. SARMA

INTRODUCTION TO PAPER ELECTROPHORESIS AND RELATED METHODS by Michael Lederer (Elsevier Publishing Co., Amsterdam — Houston — London — New York), (*Distributors*: Cleaver-Hume Press Ltd., 31 Wright's Lane, Kensington, London W. 8), 1955. Pp. xii + 206. Price 37s. 6d.

This monograph presents a general up-to-date survey of the developments in the field of paper electrophoresis. Possibilities of application of this technique to many problems in organic, inorganic, biological chemistry as well as in the fields of radio-chemistry and analytical chemistry are indicated. Both the analytical and the preparatory aspects have been discussed. The experimental techniques have been dealt with in sufficient detail so that they can be easily adopted in the laboratory. The principles underlying separations are explained clearly so as to make the reader appreciate how electrophoresis on paper or columns can be applied to improve or speed up existing separation methods, especially when no other method has been successful or where only minute quantities of the materials are available for study and no elaborate analytical equipment is on hand.

The book has maintained the usual perfection and get-up associated with the publishers. An error, occurs on page 12, line 8; the word 'specific' should be replaced by the word 'molecular' or 'equivalent'.

K.S.G.D.

MICROWAVE SPECTROSCOPY by C. H. Townes & A. L. Schawlow (McGraw-Hill Book Co. Inc., New York — Toronto — London), 1955. Pp. xviii + 698. Price \$ 12.50

To the "International Series in Pure and Applied Physics", under whose auspices well-known books like Clarke's *Applied X-Rays*, Richtmyer's *Modern Physics* and Kennard's *Kinetic Theory of Gases* have already been published, a new book on *Microwave Spectroscopy* has been added. The book is a massive one with nearly 500 pages, seven appendices covering another 150 pages and an extensive bibliography. The subject matter, however, is not evenly distributed. The first 300 pages are on more or less pure

spectroscopy discussing topics in molecular and atomic spectra which are too well known to merit so much detailed treatment. If this portion could have been presented in such a manner as to describe only the topics where microwave techniques and applications have been most fruitful, the usefulness of the book would have considerably increased. As it is, the Lamb and Retherford apparatus for measurement of hydrogen fine structure gets five lines. Where the authors discuss the special fields of microwave spectroscopy, such as quadrupole moments, magnetic hyperfine structure, Zeeman and Stark effect in molecular spectra, the treatment is authoritative and fully explanatory.

After the first 300 pages, the subject matter is much to the point. The ammonia spectrum and hindered motions (Chapter XII) are well described; so are the shapes and widths of spectral lines (Chapter XIII). The practical techniques like microwave circuit elements and the design of microwave spectrographs (Chapters XIV-XVII) are adequately dealt with. The last chapter is on the application of microwave spectroscopy for chemical analysis.

The seven appendices are: (1) intensities of hyperfine structure components and energies due to nuclear quadrupole interactions, (2) second-order quadrupole interactions, (3) and (4) coefficients for energy levels, (5) transition strengths for rotational transitions, (6) molecular constants involved in microwave spectra, and (7) magnetic and quadrupole moments.

W. M. VAIDYA

LIGHT CIRCULATIONS AND MEASUREMENTS — AN INTRODUCTION TO THE SYSTEM OF QUANTITIES AND UNITS IN LIGHT TECHNOLOGY AND TO PHOTOMETRY, by H. A. E. Keitz (Philips' Technical Library, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands) [*Distributors in India*: Philips' Electrical Co. (India) Ltd., Calcutta 20], 1955. Pp. xvi + 413. Price Rs. 25

Comparatively few books are available at present on 'light measurement', and in these the subject seems to have been treated with little relation to the way it is handled in a modern illumination laboratory. They usually contain long discussions on antiquated photometers while modern photo-

electric methods of light measurement receive little attention. Similarly concepts like the 'International Candle', which is a basic unit in modern photometry, are not adequately dealt with in these books. Mr. Keitz has to a large extent eliminated these drawbacks in his book.

This book is divided into two parts. The first part deals with the fundamentals of photometry and various methods of lighting computations which the lighting engineer usually deals with. A precise and detailed account of the properties of the optical systems, to the extent that it is necessary for the illumination engineer, is also included. While explaining the photometric system, the author first takes into account white sources only and later develops the theory with reference to sources of different colours. This gives a better understanding of the subject to the beginner.

In the second part are described methods of photometry utilizing the theory developed in the first part. A detailed account of the visual as well as physical photometers, measurement of luminous intensity and flux and allied problems is given. The author, however, does not say anything about the concept of colour temperature and its measurement. Since both the luminous intensity and flux standards are maintained at definite colour temperatures, the omission of colour temperature from the topics treated in the book seems to be a serious omission.

A brief account of C.I.E. and its activities is also included and this should be of interest to the illuminating engineer.

The book, which is essentially a practical manual, will be a useful guide to the student as well as the practising engineer.

K. S. SARMA

**MATHEMATICS FOR ENGINEERS: PART I—
THE DIRECTLY USEFUL TECHNICAL SERIES**
by W. N. Rose (Chapman & Hall Ltd., London), 1955. Pp. xiv+527. Price 21s.
The Directly Useful Technical Series, published by the well-known publishers Messrs Chapman & Hall, seeks a balanced treatment between the direct handling of numerical practical problems which arise in technology and the theoretical treatment without which training would degenerate into the mechanical application of rules. The subjects treated in Part I include algebra, mensuration, graphs and plane trigonometry. The

explanations are clear and there is a sufficient number of worked examples in each section. The exercises are all highly practical problems taken from engineering practice, and are illustrated by drawings, so that one working through the book acquires a large amount of engineering information in various fields besides learning the method of dealing with the mathematical problems which arise therefrom. The highlights of this volume are: the plotting of difficult curve equations (Chapter 9), the determination of laws from observed results (Chapter 10) and the construction of practical charts (alignment charts, nomograms, etc.).

That the book has passed through nine editions from 1918 onwards is sufficient proof of its popularity and usefulness. The reviewer has nothing but praise for this excellent work.

A. NARASINGA RAO

THE QUANTITATIVE ANALYSIS OF DRUGS by D. C. Garratt (Chapman & Hall Ltd., London), 1955. Pp. xv+670. Price 70s.
The author's first book *Drugs & Galenicals: Their Quantitative Analysis* is a familiar volume to everyone who has worked on the standardization of drugs and pharmaceuticals and is a constant companion of many analysts and assayists. With the rapid progress of therapeutics and the introduction of many new drugs, the need for a second edition of the book was increasingly felt. The reviewer himself was one of the many who had requested Dr. Garratt to undertake this work when he met him in 1954. It is, therefore, pleasant and refreshing to see the second edition of the book, though its title has been changed.

This edition has been considerably revised and enlarged though the pruning knife has also been used in several sections. Additional monographs on antibiotics, vitamin A, steroids, sulphonamides and other synthetic drugs recently included in pharmacopoeias have been included. The general monographs comprising the methods for the quantitative determination of compounds, their salts and other preparations cover 523 pages of the text and these have been arranged in alphabetical order. At the end of each monograph references are given. A section on the general application of physical methods of assay such as electrometric titrations, absorption and emission spectro-

graphy, flame photometry and polarography is also included. From a perusal of this section it appears that the author is in favour of adopting physical methods in chemical and pharmaceutical analysis. Other sections deal with the analysis of oils, fats, waxes and essential oils with standard methods and their possible modifications. In the appendices, the author has described the general methods for the determination of water by Karl Fischer technique and other methods, determination of metallic impurities in organic substances, extraction of non-volatile organic compounds from vomits, viscera, tissues, etc., microtests for foreign substances in foods and drugs, titration in non-aqueous solvents, etc. The book is well illustrated with diagrams of the apparatus used in the assays.

As is to be expected, the book deals mostly with those drugs that are included in the *British Pharmacopoeia*, the *British Pharmaceutical Codex* and other official and semi-official publications. A supplementary chapter has been added in which amendments on subject matter and standards of the *British Pharmaceutical Codex*, 1954, have been included.

In this edition, as in the previous one, the use of alternative methods of assay, based on the author's own experience and on the experience derived from other analysts, has been emphasized so that double checks on assays are made by these methods besides those described in official publications. There is no doubt that the second edition of the book will prove as useful as the first one to the analysts and assayists in almost all fields of pharmaceutical practice. This book should also be a useful guide in toxicological analyses.

B. MUKERJI

A LIST OF THE INSECTS OF MYSORE INCLUDING THE MITES — Series Bulletin No. 16 by S. Usman & M. Puttarudraiah (Department of Agriculture, Mysore State), 1955. Pp. viii + 194. Price Rs. 1/9

The State of Mysore has been responsible for many useful publications on Agricultural Entomology and the present book under review is probably the latest addition to such publications. It is systematically arranged and in some cases an annotated list of

insects and mites, mainly of importance to agriculture, recorded to occur in the State of Mysore, is given. In a brief introduction, the authors point out that several hundreds of species of insects, available in the collections of the Division of Entomology of the State, still await identification and are not included in the list. The authors do not claim that their work can be used to decide disputed points of nomenclature of the insects listed by them. This caution is understandable in view of the fact that not only the specific but also the generic names of many insects are and would continue to be subject of disagreement among systematic entomologists.

The authors can hardly claim, as they appear to do on page 2 of their introduction, that they have indicated the distribution of the species listed by them, even in the State of Mysore. All that they have done is to record the names of districts or places in which the insect specimens considered or examined by them were collected. For example, it is difficult to believe that the red ant, *Oecophyla smaragdina*, occurs only in Bangalore (p. 139). On the other hand, many species are said to occur throughout the Mysore State, thereby implying that others not so indicated are confined only to the places mentioned under them. In several cases, the distribution is not given at all.

The definition of Agricultural Entomology, attempted in the preface, is not quite correct. Agricultural Entomology deals with the biology, ecology, etc., of insects of agricultural importance and of their control or economic uses and not with 'biology, habits and economy of insects' of all kinds. Pages 161-64, listing 'Literature cited', contain a list of publications which have not been actually cited in the book but which appear to have been consulted in compiling the list of the insects and mites. The index at the end (pp. 167-94) is helpful.

The criticisms made are not intended to detract from the value of the publication, which is indeed useful, but are only in the nature of suggestions to be considered when a revision of the work or the preparation of other similar publications, as stated, is undertaken.

K. B. LAL

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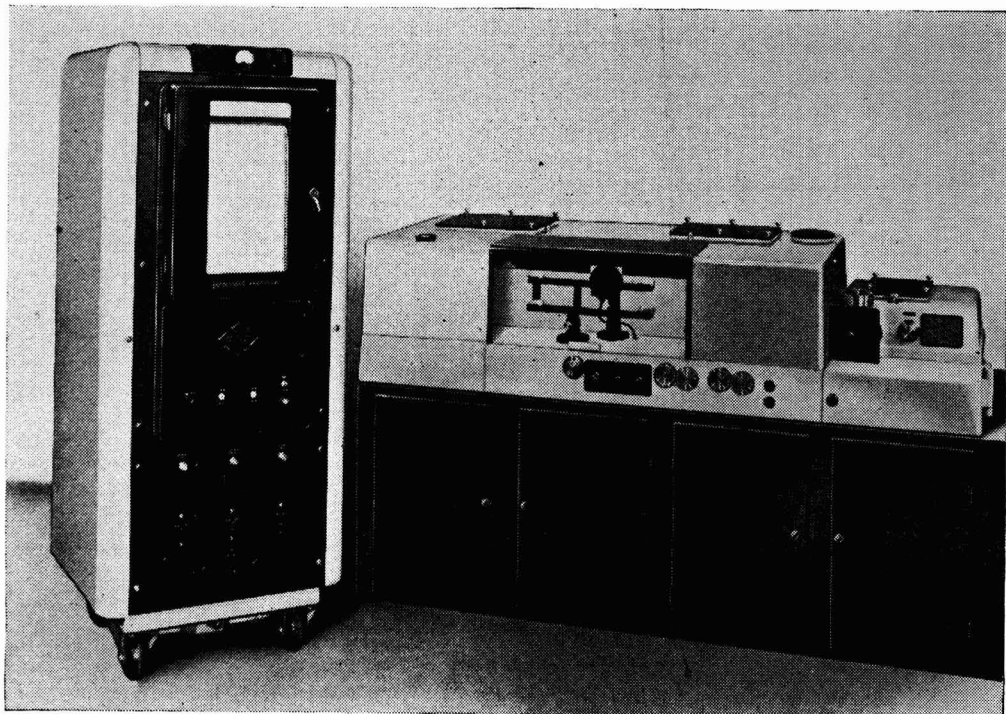
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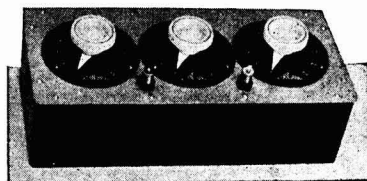
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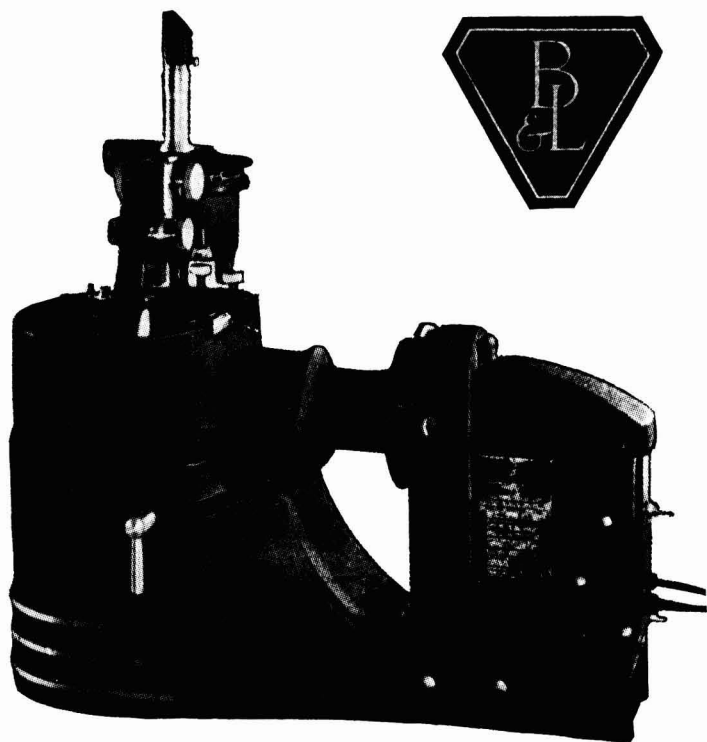


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NOTES & NEWS

Negative proton

THE UNIVERSITY OF CALIFORNIA and the U.S. Atomic Energy Commission have jointly announced the detection of the negative proton, or 'anti-proton'. Protons which had been accelerated to an energy of 6,200 MeV in the bevatron—the proton synchrotron of the University of California Radiation Laboratory at Berkeley—were allowed to collide with a copper target. Negatively charged particles coming out in a forward direction from this collision were selected and separated by a focusing and analysing magnet system to provide a beam of negative particles of known momentum. These particles were then distinguished both by measurement of their time of flight from the target and by means of a device measuring the velocity of each particle passing through by the angle of its Cerenkov radiation. In this way the presence of negative particles with protonic mass (within about 10 per cent) and distinct from the known K-particles and hyperons was established.

The creation of anti-particles had been predicted by theoretical physicists. It was postulated that anti-neutron and the negative proton could be created together with a neutron or a proton when sufficient energy was available to form the rest mass of the nucleon-antinucleon pair in accord with the Einstein relationship between rest mass and energy. The discovery of the anti-proton has thus removed a major uncertainty in theories of the structure of the basic nuclear particles.

The anti-proton is stable in vacuum, but in contact with a proton both particles immediately decay into mesons and disappear. It seems probable that this annihilation process would generally lead to two or three fast Π -mesons, although there are also other possibilities. It has not been established experimentally yet which is the annihilation process of importance [*Nature*, **176** (1955), 860].

Odour classification

AN INGENUOUS METHOD HAS BEEN developed for a more objective comparison of different odours. Adsorption of odorous molecules on a surface-active layer has been made the basis of this method as this is presumed to be the first thing that happens in the sequence of events that enables us to register smell. The capacity of five different adsorbent materials chosen—activated charcoal, silica gel, activated alumina, activated fullers' earth and vegetable fat—for adsorbing a particular odour was measured by blowing air containing the odorous substance through a glass column loosely packed with the adsorbent. The air speed was gradually increased, until the smell could just be detected by the observer's nose at the open end of the column. The avidity of adsorption is expressed as the 'critical time of contact' of the odorized air with the adsorbent, derived from the air speed and the volume of the adsorbent in the column. Odours that are very rapidly adsorbed can only be blown through at high air speeds, whereas those that are poorly adsorbed can be detected at a very low air speed. The critical times of contact are then converted to a simple logarithmic scale, so that 0 represents very fast and 9 very slow adsorption. A number consisting of five digits, one for each adsorbent, gives the characteristic adsorption pattern for any one particular odour.

From the adsorption patterns of a number of odorants it was found that each odour had a characteristic number pattern, similar smells having nearly similar number patterns. For example, two esters with a fruity smell, allyl caproate and ethyl acetate, had the numbers 21537 and 21449. Musk, both natural and synthetic, was not effectively adsorbed by any of the adsorbents and that perhaps explains its long-range transmitting character. Two compounds having strong odour of violets, α -ionone (a ketone with a ring structure) and methyl octine carboxylate (a straight chain

ester)—were found to have adsorption numbers 11227 and 21326 respectively. The numbers also show that both odours are very rapidly taken up by four out of five of the adsorbents, and this suggests an explanation for the fleeting nature of the perfume of violets.

One other striking feature of the adsorption patterns was a general difference between the most pleasant and the most unpleasant smells. It was observed that a pleasant smell was characterized by a fairly uniform adsorption on different adsorbents, while non-uniform pattern of adsorption was characteristic of unpleasant odour. Thus smells of faeces and carbon disulphide are characterized by the numbers 00999 and 46999. It seems that more or less uniform activation of the receptors in the nose is perceived as a pleasant smell, while intense activation of only a proportion of the receptors produces the sensation of an unpleasant smell [*Discovery*, **16** (1955), 404].

Physics in agriculture

PHYSICS IS EXPECTED TO PLAY AN increasingly important role in the field of agriculture. Some of the promising but largely overlooked possibilities for advancing agricultural science through applications of physics are enumerated below.

The evolution of tillage implements has been mainly by trial and error. By logical application of the principles of dynamics, entirely new and superior designs of ploughshares, discs and teeth could be evolved. If the tool could be given a suitable electric charge it might repel the electrically charged soil particles and serve as a sort of electrical lubrication to reduce friction and thereby the effort required to move the tool through the soil.

Certain types of radiations including ultrasonics, radio frequencies and ultra-short electromagnetic waves stimulate the germination of seed, break the dormancy of 'hard' seed, and even induce the development of stronger and higher yielding plants. The embryo in a seed carries an electric potential and it has been found that the strength of this potential bears a direct relation to the vigour of the plant produced by the seed. The feasibility of using this principle in

selecting seed with greatest growth possibilities could be investigated. The seeds of different plants respond differently to static electrical fields, which offers a new possibility in making separations of seed mixtures that are not separable by screening or other standard methods of seed cleaning.

Uptake of nutrients by plant roots involves electrochemical forces, fundamental study of which might lead to more rational and efficient principles in crop fertilization. It has been suggested that the uptake of nutrients by roots could be increased by treatment with ionized air.

By giving plants short bursts of light during the middle of the night it has been found possible to induce blossoming during a season of day length in which the plants will not normally blossom, and even to change the sex of some plants. If brief night illumination can be carried out economically on commercial plants, it should be possible to hasten the maturity of crops or even enable crops to grow to maturity in parts of the world where the length of the day or of growing season does not now permit their cultivation.

Physics has useful applications for the processing of farm products also. High frequency currents have been employed for hastening the aging of wines, fermenting tobacco and tea, and for improving the quality and bread-baking properties of flour. Ultrasonics have been used for extracting fats and vitamins from animal tissues and for obtaining vaccines.

Radiations of various kinds can be used for sterilizing foods, seeds, livestock housing and water supplies. Radioactive wastes from atomic energy installations could be put to agricultural uses; one already announced is the use of atomic radiation to prevent the sprouting of stored potatoes. Still another application of physics to agriculture is in the development of instruments for controlling the quality of farm products [*Chemurg. Dig.*, **14** (1955), 20].

A new yttrium mineral

DOVERITE, A NEW YTTRIUM MINERAL, has been discovered in Dover, N.J. It is yttrium fluorocarbonate and occurs in aggregates mixed with xenotime, haematite and quartz. The marked similarity of the X-ray diffraction powder patterns of doverite and synchi-

site ($\text{CeFCO}_3 \cdot \text{CaCO}_3$) indicates that the minerals are in the same crystal system and have the same crystal structure.

Doverite is brownish red and constitutes the bulk of the aggregates which have a non-metallic lustre and a brownish streak, are brittle and break with an uneven to subconchoidal fracture. Their hardness is 6.5, and specific gravity 3.89 [*Science*, **122** (1955), 31].

Palustric acid

PALUSTRIC ACID, A NEW RESIN ACID OF THE ABETIC ACID TYPE, has been isolated from pine gum. It represents 10 per cent of the acidic portion of slash and long leaf gum and 16-19 per cent of the acids in gum rosin.

On chromatographing rosin and oleoresin, five peaks were obtained which did not correspond to the peaks of previously isolated rosin acids. Palustric acid was obtained by repeated recrystallization from the third eluant with methanol. It has been identified as an intermediate in the heat and acid isomerization of L-pimaric acid to L-abietic acid. It does not react with maleic anhydride at room temperature, but at elevated temperatures it forms an addition product identical with the product obtained by the reaction of L-pimaric acid and maleic anhydride [*Chem. Engng. News*, **33** (1955), 3908].

Arlidin

ARLIDIN—PHENYL-L-BUTYL NOR-SUPRIFEN—is a new drug found useful as a vasodilator in the treatment of arteriosclerosis. It is claimed to be superior to other vasodilative agents because it increases blood flow to the heart and the rate of blood vessel dilation. The drug increases flow of blood to the muscles rather than to the skin, thus ensuring more blood supply to the affected areas.

Arlidin is the result of a search for new vasodilative agents conducted by German researchers F. Kulz and M. Schneider. Initial clinical investigations of about 50 epinephrine-ephedrine derivatives showed phenyl *sec*-butyl norsuprifene to have the most promising properties. By condensing suprifene with ephedrine and reducing the intermediate ketone formed, the secondary alcohol Arlidin is obtained.

Satisfactory therapeutic response was observed in the treatment of patients with peripheral vascular disease. Favourable results were also obtained when Arlidin was used to treat circulatory disturbances, such as arteriosclerosis, Raynaud's disease, diabetic vascular disease, diabetic gangrene and frostbite [*Chem. Engng. News*, **33** (1955), 2896].

New arthritis drugs

THE FOLLOWING METHODS OF SYNTHESIS OF prednisone (Meticorten) and prednisolone (Meticortelone), two new cortical hormones for rheumatoid arthritis therapy, have been reported by the Schering Corp., U.S.A.

The starting materials for the synthesis are either dihydrocortisone acetate or alldihydrocortisone acetate. These are brominated with bromine in acetic acid forming a mixture of dibromides. After dehydrobromination by collidine, the mixture is separated by chromatography. Prednisone (Δ^1 dehydrocortisone acetate) is then formed by saponification. If desired, prednisone may be converted into prednisolone. It is treated with semicarbazide and then reduced with potassium borohydride. Further treatment with nitrous acid gives prednisolone in 5 per cent yield.

Since the yield was low in the chemical method, biological synthesis was tried with the micro-organism *Corynebacterium simplex*. An alcoholic solution of cortisone is added to *C. simplex* grown in a nutrient medium of 0.1-1.0 per cent Difco yeast extract. After about 24 hr. culture, the resulting broth is extracted with chloroform and the final products—a diol and prednisone—crystallized from acetone. Yields are c. 70 per cent. Prednisone could be converted into prednisolone by semicarbazide treatment or alternately it could be prepared directly from hydrocortisone by *C. simplex* [*Chem. Engng. News*, **33** (1955), 3670].

Carbon black-filled silicone rubber

SILICONE RUBBER IS BEING CURED successfully for the first time using carbon black fillers instead of the conventional silica-type fillers. A new type of gum stock, Linde W-96 Silicone, developed by the Linde Air Products Company, is

used in the manufacture of carbon black-filled rubber. The carbon black-filled silicone rubber is a new product and is claimed to have advantages over conventional silicone rubber in certain applications. Thus a conductive silicone rubber is now available which can be used at temperatures above and below the limits for organic rubbers. A material of this type will be useful in such applications as aeroplane de-icers, where the properties of an organic or silicone rubber alone have not been able to meet the requirements [*Chem. Age*, **73** (1955), 576].

Nutritive value of heated vegetable oils

THE NUTRITIVE VALUE OF SOME OF common edible oils — groundnut, sesame and coconut — after heating has been investigated. The oils, heated in an open iron pan at 270°C. for 8 hr., were incorporated into synthetic diets at a 15 per cent fat level and fed to albino rats. A control group was fed with diet containing unheated oils. It has been found that in all cases the heated oil adversely affected the gain in weight. There were no significant changes in the weights of stomach, kidney and spleen of the two groups of animals. However, the liver weights of the rats fed with heated oil were significantly higher than those of controls. The fat content of the livers of the heated-oil group was nearly twice that of the control groups. Further, the livers were badly damaged and congested and were not of the normal colour [*Nature*, **176** (1955), 513].

Yeast food from seaweed

EXTRACTS FROM SEaweEDS AS well as carbon-rich compounds isolated from them have been used as media or as media supplements for the cultivation of 46 strains of yeast. It has been observed that several yeasts from widely varying genera are able to grow in aqueous extracts of seaweeds, certain yeasts being able to produce crops of an order approaching those obtained when they were grown in the nutrient-rich M.Y.G.P. (malt, yeast, glucose and peptone) medium under similar conditions.

Extracts of *Laminaria cloustoni* (frond) were found to afford the most suitable media for the

growth of *Candida krusei*, *Candida solani*, *Nadsonia fulvescens*, *Pichia membranaefaciens* and *Oospora lactis*. Aeration of the cultures tended to increase the yield. No appreciable increase in the yield was obtained when the yeasts were grown in media prepared from acid hydrolysed seaweed.

Hydrolysis of seaweed polysaccharide fractions by various enzyme systems (*Aspergillus oryzae*, yeast 'zymin', malt enzymes and *Myrothacium verrucaria*) has shown that of these, only malt extract and the filtrate of *M. verrucaria* culture medium hydrolysed laminarin to glucose. Relatively high concentrations of the enzymes are, however, needed for effecting hydrolysis. Such treated seaweed preparations are excellent media for yeast growth and fermentation [*J. Sci. Food Agric.*, **6** (1955), 611, 618].

Improved optical cement

AN OPTICAL CEMENT SUITABLE for the exacting requirements of modern instruments should possess the following properties: (1) Substantially colourless and neutral in light absorption; (2) clear and non-scattering; (3) refractive index between 1.51 and 1.58, preferably within the limits of 1.52 to 1.54; (4) chemically neutral to glass; (5) good adhesion to glass, with sufficient flexibility and mechanical properties such that adhesion and clarity are unaffected by indefinite storage at any temperature between -60°F. and +160°F.; (6) capable of polymerizing (if necessary) with minimum amount of shrinkage; (7) sufficiently stable to ship and store; (8) good ageing characteristics, including resistance to moderate amounts of ultraviolet light; (9) fungistatic, preferably fungicidal; (10) non-toxic; (11) permit separation of optical elements when necessary with low breakage hazard; (12) have no effect on optical properties of component elements, e.g. straining or surface distortion; and (13) sufficiently fluid at 250°F. to permit cementing.

At present there is no known cement which fulfils all these requirements. Canada balsam, which has been used for many years and is still employed for numerous applications, does not withstand extreme temperature variations. The Naval Research Laboratory, Washington, have

developed an improved optical cement based on cellulose caprate.

Cellulose caprate meets all but three of the above-mentioned requirements: it has a refractive index 1.4734 which is too low; the material is not fluid enough to permit cementing at 250°F.; and it is not fungistatic. Investigations carried out to develop an ideal modification of cellulose caprate by (1) further esterification of the free hydroxyl in the cellulose caprate polymer with functional groups of high refractivity; (2) introduction of functional groups of high refractivity; and (3) hydrolysis and re-esterification of cellulose caprate to obtain the desired number and kind of groups failed to give the desired product.

A thermoplastic mixture containing one part secondary to three to four parts primary plasticizer and 20 parts cellulose caprate was developed which meets with most of the requirements. The primary plasticizer found most suitable was Dow Resin 276-V2, a polymerized product derived from α -methyl styrene. The secondary plasticizer selected was Santiciser 1-H, N-cyclo-hexyl paratoluene-sulphonamide. The formulation results in a cement that is sparkingly clear.

The plasticized cellulose caprate has a refractive index of 1.473 to 1.493 which is still low. The fungicidal property is enhanced, but not sufficiently. It can be cemented at temperatures below 250°F. but has no cold flow at 160°F. The cement meets all other requirements, as does cellulose caprate; in addition, it is lighter coloured and has fewer foreign particles. It imparts less strain to the cemented elements during cooling and setting [*Chem. Age*, **73** (1955), 473].

Cashewnut shell resins

THE RAW LIQUID ISOLATED FROM the cashewnut shell consists mainly of anacardic acid (2-carboxy 3-pentadecadienyl phenol), together with a minor quantity of cardol, which is primarily metapentadecadienyl resorcinol. The heat applied during the extraction process causes substantial decarboxylation of the anacardic acid as well as some polymerization. Further treatment of the cashewnut shell liquid by a normal distillation process yields cardanol. The non-distillable fraction is an unsaturated

polymer which contains cardol. Each of these products may be subjected to a variety of treatments such as polymerization, condensation with aldehydes, etherification and hydrogenation, to yield a wide range of materials with different combinations of desirable properties.

Polymers of CNSL (treated cashewnut shell liquid) can be suitably activated so that reaction with aldehydes such as para-formaldehyde will take place in the cold. The hardening rate can be accelerated, if desired, by the application of gentle heat. Resins of this type are the basis of acid and alkali-resisting cements, which find many applications in chemical and other industries where corrosion problems are present. Thus they are used for the cementing floors, lining of steel pickling tanks and for the impregnation of various grades of carbon used in the fabrication of heat exchangers which are thus rendered impervious to acid and alkaline liquors.

Cashew polymers are compatible with a wide range of resins and drying oils used in surface coatings where acid and oil resistant characteristics are required, and where colour is a secondary consideration. Coatings of good solvent resistance are prepared by combining a cashew polymer with a formaldehyde donor such as etherified urea-formaldehyde resin. Coatings of this composition are extensively used for bottle cap liners and also for refrigerator enamel type finishes.

A relation reaction which is independent of atmospheric oxidation is associated with another type of CNSL polymer, which is employed in the formulation of insulating varnishes which are required to dry in thicknesses and under conditions which preclude the possibility of oxidation. Polymers of this type are usually employed with other resins or resins and the properties of the resulting gel can thus be modified in many ways. The production of solventless insulating varnishes based on cashew resins and polymers has also been investigated.

Fast-curing CNSL-modified phenol formaldehyde resins are incorporated into synthetic rubbers, such as nitrile rubbers, to reinforce tensile strength, modulus, hardness and abrasion resistance. By curing and vulcaniz-

ing simultaneously these resins form an intrinsic part of the binder system and increase the resistance of the product to ageing, chemical attack, and the action of solvents and oil.

Another important use for cashew resins is in the production of 'cold-punching' laminated boards. Modification of the phenolic or cresylic resin by co-condensing with a CNSL derivative makes it possible to reduce the brittleness of the board without using a plasticizer which cannot be chemically linked with the resin.

The higher cashew polymers are used as intermediates in the preparation of fully thermo-hardened resins which, when ground fine, find applications as friction-modifying materials in the manufacture of brake linings and clutch facings.

Cardanol may be employed as a plasticizer for a wide range of materials, notably phenol formaldehyde resins. The ethers of CNSL have been used as plasticizers for rubber where low temperature conditions are liable to be encountered as in aeroplanes. The linoleum industry employs CNSL polymers as binder resins [*Chem. Age*, **73** (1955), 425].

Continuous refining of soapstock

SOAPSTOCK FROM VEGETABLE OIL refining usually presents either a disposal problem for the refiner or a processing problem for the user. The nature of the impurities in vegetable oil foots renders them resistant to treatment by acids as in normal acidulation. It has been found that, if the soapstock is first treated with strong caustic, the resultant product is partially soluble in 5-10 per cent aqueous caustic solution. At this concentration a soap phase of 40-55 per cent total fatty acid (TFA) could be separated centrifugally, and the majority of the impurities or their degraded products discharged with the lye stream. It was found, however, that batch acidulation of the purified soap was not always readily accomplished and experiments were conducted to develop a continuous method of purification of the soap.

A full-scale continuous plant incorporating three stages is in operation at the oil refinery at Opelousas, La., U.S.A. A metered quantity of soapstock is mixed

with a measured amount of 50 per cent caustic and hot water and agitated in a mixer. The temperature is kept at 200°-210°F. to maintain a high soap TFA. The hot mix passes downward through a hold-up tank and is separated into soap and pitch water in the first stage centrifuge. The soap, usually at 35-50 per cent TFA, is diluted in the covers of the centrifuge with hot water and drops into an open tank where it is grained by 20 per cent brine. Temperature is maintained at 170°-85°F. at this stage since lower temperatures produced foamy emulsions instead of clean grains. The feed is then diverted to the second stage centrifuge, where soap and pitch water are again separated.

The purified soap at 50-62 per cent TFA is diluted with hot water in the covers of the second stage centrifuge and drops directly into an agitated open tank fitted with steam coils. After heating to about 180°F. and blending with 2-5 per cent solution of a dispersing agent, the mix is pumped to the acidulation tower. The 66°Bé sulphuric acid is diluted to about half strength and pumped to the tower. The overflow from the tower is fed directly to the third stage centrifuge, where it is separated into Brown acids and spent mineral acid. The latter partially neutralizes the first stage pitch water in a skim tank before discharge to sewer.

The variables of the acidulation stage have the most significant effect on the final product. The optimum conditions were a temperature of 175°-95°F., 4 per cent sulphuric acid and a hold-up time of 10-15 min. A clean, brown, fast-breaking fatty acid phase with acid value of *c.* 188, unsaponifiables about 3 per cent and an oxidized acids content of 3-5 per cent is obtained under these conditions [*J. Amer. Oil Chem. Soc.*, **32** (1955), 517].

Ammonium sulphate from coke oven gases

THE EVAPORATIVE PROCESS FOR ammonium sulphate production and ammonia recovery developed by Simon-Carves Ltd., Cheadle Heath, Stockport, England, has several advantages over conventional semi-direct system or the older direct and indirect processes. In this process, the ammonia recovery stage is entirely separate

from the ammonium sulphate production stage, so that the latter can be carried out as and when convenient. The system, further, allows the conditions of sulphate manufacture to be closely controlled, so that crystals of the desired size and shape are consistently produced.

The evaporative sulphate plant consists of an absorber, a vacuum evaporator, a cone separator, a centrifuge and a salt dryer, and facilities for salt handling and storage.

Ammonia is recovered from the condenser liquor in the normal way by a still, which delivers its vapours to the gas stream before it enters the absorber. The absorber is a simple bubble hood tower with slotted sides. The vessel is made of Monel metal and is slightly smaller than a semi-direct saturator of equivalent capacity. Dilute sulphuric acid is pumped to the top tray of the absorber and flows countercurrent to the gas stream, the circulation rate and the amount of fresh acid added being so adjusted that the bleed-off consists of a concentrated solution of sulphate of ammonia just below saturation point. This solution is stored and is pumped to the evaporator as required.

The evaporator is of the normal callandria type operating under reduced pressure, the vacuum being maintained by a jet condenser [*Chem. Tr. J.*, **137** (1955), 684].

Utilization of chlorine

SOME WELL-ESTABLISHED AS WELL as some new uses of chlorine in the treatment of industrial water have been reviewed in a recent issue of *Chemistry & Industry* [No. 45 (1955), 1432].

Water supply for industry—Chlorine is finding increasing use as a modifying or activating agent for silica before the latter is used as a coagulant aid in water clarification. Chlorine, which is normally used for the disinfection of water supply, may first be used for silica activation, enabling the advantages of activated silica treatment to be obtained at considerably lesser cost.

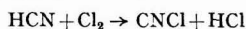
Apart from its use as an aid to flocculation processes, chlorine can also be used for the direct bleaching of colour present in water. When the colour is of organic origin 40 to 80 per cent

reduction in colouration has been achieved by chlorination. Colour removal by chlorination is often particularly sensitive to pH value. Generally high pH favours optimum removal, but sometimes small changes of pH value around neutrality have been found to have profound effect on the final result.

Process water treatment—Chlorine is extensively used in the treatment of the cooling water passing through the condensers of steam turbines, in order to prevent fouling of the tubes by the slime film. A relatively high dose of chlorine is administered for short periods at predetermined intervals to the cooling water just as it enters the condensers. The intermittent high concentration is found to be far more efficient in preventing slime formation and far cheaper in terms of chlorine consumption than a continuous low concentration. The intermittent chlorination process is applicable to all water coolers where efficiency of heat transfer is a matter of economic importance and where micro-organisms are present in the cooling water.

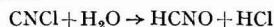
Chlorine is used to advantage as a medium for the reduction of the bacterial flora of meat, fish, vegetables and fruit during processing and canning. Chlorine is also used in the treatment of wheat washing water for the reduction of organisms of *B. mesentericus* group in the final flour and as a means of improving the keeping quality of bran. Chlorine dioxide, prepared *in situ* by the reaction of chlorite and chlorine, is an effective agent in destroying a variety of objectionable organic odours such as those produced in fat splitting and rendering. A dilute air/chlorine dioxide mixture is used for treating bakers' flour in order to improve its baking qualities and to whiten it.

Treatment of trade effluents—Among the common constituents of trade effluents cyanides are by far the most significant of those which are toxic to fish. The alkaline chlorination process is at present the only one by means of which cyanide concentrations may be substantially reduced on a commercial scale at a reasonable cost. The basic reaction is



which proceeds rapidly to stoichiometric completion at pH values

above 11.0. The hydrolysis reaction



proceeds concurrently and is also complete in a few minutes.

The removal of phenols from effluents is another field in which chlorination has been used successfully. The method is, however, not suitable for the removal of phenols present in coke-oven plant effluents which contain high concentration of ammonia. Chlorine dioxide can also be used instead of chlorine for the destruction of phenols.

There are several applications of chlorine in the treatment or pretreatment of textile wastes. It is often used to bleach dyes and to control septicity, as a direct aid to coagulation or as an indirect aid by the preparation of activated silica. Limited use is made of chlorine in the treatment of wastes from food-processing factories, dairies and sugar refineries. However, in these it is almost exclusively used as an aid or as a supplement to chemical coagulation and sedimentation in the same way as in the textile industries.

Manufacture of hydrogen

THE MAIN RAW MATERIALS FOR the production of the hydrogen gas (apart from electrolytic hydrogen) are coke, natural gas and oil. There are a number of processes available for the production of hydrogen, but excepting the electrolytic process, which produces practically pure hydrogen direct, most of the other processes start by making a mixture of essentially carbon monoxide and hydrogen. This mixture is subsequently treated for the production of hydrogen.

There are two main processes available for the purification of carbon monoxide-hydrogen mixture, viz. the steam-iron and the water-gas catalytic processes. The first is a cyclic process in which a bed of iron ore is first reduced at 850°-950°C. to a lower oxide of iron or to iron itself by a reducing gas (usually a mixture of carbon monoxide and hydrogen), following which superheated steam is passed through the ore bed, re-oxidizing the ore and producing hydrogen. The purity of hydrogen produced is independent of the reducing gas used, although variations in the purge efficiency

between the phases of the cycle will affect the purity.

In the water gas catalytic process, CO-H₂ mixture together with steam is passed over a catalyst, usually an iron oxide/chromium oxide mixture, at temperatures ranging between 360° and 550°C. The reaction is exothermic and the rate of reaction increases with rise in temperature, but low temperatures favour low carbon monoxide content with a minimum of steam consumption. If the gas contains much carbon monoxide, two stages are used: in the first the temperature is allowed to rise to 500°C., and then the gases are cooled and the second proceeds at 400°C. Maximum conversion of carbon monoxide to dioxide is attained by limiting the monoxide conversion, removing the dioxide and repeating the process. Carbon monoxide in small concentrations is removed from the gas by washing with copper liquor or it may be catalytically converted to methane. As the process is a direct one, the purity of the hydrogen produced is dependent on that of the raw gas treated; while carbon monoxide can be removed to very low limits, any methane, argon or nitrogen will pass through untouched.

Carbon dioxide and hydrogen sulphide, if present in moderate amounts, are removed by caustic soda solutions but larger concentrations are removed by water under a pressure of 10-50 atm.; small amounts of monoxide and dioxide in the final product are removed by copper liquor. Monoethanolamine solutions also serve to remove the dioxide but the cost of steam for regenerating the solution is heavy if large amounts of the gas are present.

Hydrogen mixed with carbon monoxide is produced when methane with 90-100 per cent excess steam is passed over a nickel catalyst heated to 800°-1,000° in alloy-steel tubes in a furnace. With suitable modifications other gaseous and liquid hydrocarbons can be used. Processes have also been developed in which hydrocarbon gases are cracked *in situ* in a refractory lined chamber by partial combustion with oxygen. The reaction can be carried on under pressure without using any catalyst, or using a catalyst which enables the reaction to be carried out at a lower temperature.

Not one process is universally the most economic and the choice must depend on the scale of operation, the purity and pressure of hydrogen required and availability of raw materials. Electrolytic hydrogen (from dilute NaOH or KOH solutions) is most suitable for small plants requiring high purity hydrogen [*Chem. Tr. J.*, **137** (1955), 1225].

Hard anodizing of aluminium

NEW PROCESSES DEVELOPED FOR hard anodizing of aluminium, providing an oxide coating of from 0.001 to 0.005 in. (usual processes produce a coating of 0.0001-0.0008 in.), have increased the application of aluminium alloys in machinery and in highly corrosive atmospheres. A further use of these processes is to build up over-machined or worn parts that are too expensive to be scrapped or replaced.

The major difference between normal anodizing processes and the hard-coating processes is that the latter are performed at a higher current density and lower temperatures in a strongly agitated bath. These processes increase the wear resistance of the metal beyond the point of ordinary anodic coatings and equal to or better than even cyanide coatings on steel. One limitation of the hard coatings is their tendency to lower the fatigue strength of the coated metal.

A more recent process developed by the Sanford Process Co. Inc., Los Angeles, utilizes a cold acid electrolyte and progressively increasing voltage. Bath temperatures range from 0° to 15°F., considerably lower than in other processes. Voltages range from 15 to as high as 150 d.c. Current density is 12-15 amp./sq. ft. A 6-mil coating can be obtained by the Sanford process in 55 min. Rockwell hardness ranges from C 50 to C 58 on this coating, with a Mohs scratch hardness of c. 8.

In another process developed by the Dowty Equipment Ltd. of England, the current density is maintained within a 10 per cent range and varies from 2.5 to 10 amp./sq. cm. With normal alloys, an anodic coating of 0.002 in. is obtained in 1 hr. The maximum thickness of coating that can be obtained economically by this process is c. 0.0035 in. [*Aluminium News*, (October 1955), 7].

India's first ammonium chloride plant

THE 25-TONS-A-DAY AMMONIUM chloride plant of the Fertilizers & Chemicals (Travancore) Ltd., Alwaye, formally inaugurated in June last year, is the first of its kind in India. The plant was designed and supplied by Messrs Krebs & Co., Zürich, Switzerland, and is equipped with the most modern machinery, incorporating the latest developments in the field.

Ammonium chloride is produced by the direct neutralization of synthetic ammonia with hydrochloric acid in saturators. The saturators are operated under vacuum and the heat of reaction is utilized for evaporation causing the crystals to separate out.

A unique process has been developed and adopted in the F.A.C.T. plant by which locally available firewood is utilized for the production of ammonia. Wood, cut to required lengths, is charged to the producers by means of conveyers. The producer plant has six generators which are the largest of their kind in the world. The producer gas containing about 40 per cent reducing gases (carbon monoxide and hydrogen) is cleaned of tar by electrostatic precipitators and stored in gas holders. About 250 tons of firewood are required for the production of 12 to 14 million cu. ft. of producer gas for maintaining the plant at full production.

Ammonium chloride is an important constituent in the manufacture of dry cells, accounting for a consumption of 1,500 tons a year in this country. It is also used as a cleaning agent and as a flux in the galvanizing of steel sheets and structures. It is also used as a fertilizer supplying 26 per cent nitrogen. The total estimated Indian demand of c. 4,000 tons, which was so far met from imports, can easily be met from this new plant which has a rated annual capacity of double this quantity.

Documentation of molecular spectroscopic data

THE PUBLICATION OF A NEW SYSTEM of documenting infra-red Raman spectra (DMS) has been announced jointly by Butterworths Scientific Publications, London, and Verlag Chemie, Weinheim/Bergstrasse, Germany.

The system consists of a set of cards punched with a double row of holes on all four edges. By leaving some perforations uncut and cutting others into slots according to the code devised, the cards can be sorted manually by the use of a steel needle. If sorted negatively, the selected cards drop from the pack. The spacing between the perforations on the edges of the cards conforms to other international sizes, so that the cards can be sorted by any of the usual sorting machines. There are two identical editions in English and German.

The following advantages have been claimed for the new system (DMS): It combines a survey of current literature with an expanding collection of selected spectra of purified substances of interest in many fields of chemistry, and is suitable for the smaller laboratory possessing no sorting machine. It also offers a complete classification of organic substances which enables all organic and inorganic compounds to be included, and incorporates a large amount of data on single cards.

The DMS Service will be started this year with an initial batch of about 500 cards. It is expected that 2,000 cards will be issued annually — 20 per cent of which will be literature cards and 80 per cent spectra cards [*Chem. Age*, 73 (1955), 791].

Commonwealth Oceanographic Conference

THE PROCEEDINGS OF THE COMMONWEALTH OCEANOGRAPHIC CONFERENCE held during 18-22 October 1954 at the National Institute of Oceanography, Wormley, Surrey, have been recently published (Cambridge University Press, Cambridge, 1955; 7s.).

The conference considered the application of oceanographic research to defence, coastal engineering, shipping, meteorology and fisheries in the commonwealth countries. Many examples of the practical value of this research were discussed by the conference.

A better understanding of waves is necessary to make reasonably accurate predictions for exposed anchorages, harbour approaches and beaches; it would also save millions of pounds spent in dredging and shaping channels and protecting coastlines. More knowledge is required about beach currents

which cause erosion and silting. Oceanographic research can make important contributions to the detailed understanding of ship behaviour in a seaway to prevent excessive movements and straining. Meteorologists used information about the circulation of water and heat in the oceans to assist them in forecasting. Fishery scientists need to understand and predict oceanic water movements which are a guide to the most profitable areas and depths for fishing operations.

The conference agreed that a co-operative scheme to be organized by the National Institute of Oceanography, whereby equipment and facilities could be shared, would be of considerable value. It was agreed that Commonwealth countries, excluding Canada, would explore the value of the cruise to the Indian and southern oceans in 1958-59. The ship will undertake work in consultation and in association with different Commonwealth countries, which would bear a portion of the cost.

International Union of Pure & Applied Chemistry: Analytical Section

THE ANALYTICAL SECTION OF THE International Union of Pure & Applied Chemistry (I.U.P.A.C.) was very active during the year 1954-55. Two of its Commissions reported to the I.U.P.A.C. on pending publications. The Commission on Analytical Reactions under Prof. Jan Gillis (Belgium) reported about the publication of the monograph on Colorimetry of Inorganic Compounds prepared by Prof. Clement Duval (France).

The Commission on Equilibrium Data under Prof. L. G. Sillen (Sweden), has collected a large amount of published equilibrium data. Prof. J. Bjerrum (Denmark) has prepared a complete set of tables of stability constants of inorganic complexes and chelate compounds, covering literature up to 1953. After making the data complete up to the end of 1955 tables will be published in 1956 by the Chemical Society, London, under the sponsorship of the I.U.P.A.C. This Commission is also engaged in making a critical compilation, with representative diagrams, of the solubility of hydroxides, hydrous oxides, slightly soluble sulphates, metal sulphides and silver halides.

The Commission on Electrochemical Data under Dr. Roger G. Bates (Washington) has been compiling selected electrochemical data of analytical importance, specifically of oxidation-reduction potentials at various ionic strengths in several electrolytes. Data for 52 of the elements are complete and work on the remainder are being taken up. A systematic collection of selected values of polarographic properties is being made. A standard data form has been adopted for the uniform presentation of data (half-wave potential, diffusion current), experimental conditions (solvent, pH, maximum suppressor, type of micro-electrode), reference and explanatory remarks. A critical evaluation has been completed of the accuracy and limitations of the several methods by which dissociation constants have been obtained. Since the solvent medium plays a fundamental part in acid-base dissociation, the constants are being arranged according to solvent. Some 80 original articles have been reviewed and constants for 50 compounds have been collected.

The Commission on Optical Data under Prof. G. Duyckaerts (Belgium) is engaged in the preparation of a critical compilation of numerical data on absorption spectra and extinction coefficients of complexes used in inorganic analytical chemistry. The Commission will also assist in the co-ordination of information on molecular spectroscopy (infrared) of analytical interest.

The Commission on Terminology and Expression of Analytical Results, under Prof. Robert J. Forbes (Netherlands), has brought to completion a draft on Format of an Analytical Method. The Commission is co-operating with ISO/TC 47 in this project to develop a uniform recommendation on the writing of commercial test methods for national and international use. Similar co-operation is being maintained with ISO/TC 12 on the subject of uniform symbols and units.

The Commission on Microchemical Techniques, under Prof. Michael K. Zacherl (Austria), has completed a survey of microchemical techniques in some 25 different countries to ascertain profitable subjects for standardization. Work is being started on the preparation of international standards of microchemical appa-

ratus and listing of preferred notations (units) of measurement with special reference to micro techniques.

Technical assistance under Colombo Plan

THE SERVICES OF 392 EXPERTS were made available and training facilities for 2,676 students from South and South-east Asian countries were provided under the Colombo Plan during the year ending June 1955. Australia provided training facilities for 916 persons, Canada 311, Ceylon 11, India 340, Japan 11, New Zealand 226, Pakistan 8 and United Kingdom 853. Australia made available the services of 115 experts, Canada 59, India 14, Japan 3, New Zealand 44 and the United Kingdom 157.

The cost of equipment supplied or offered is approximately £ 1,500,000 which includes equipment for training purposes (£ 927,000) and research laboratory equipment (£ 344,000).

The expenditure under the technical co-operation scheme was approximately £ 3½ million, plus firm forward commitments of another £ 2 million, making a total of approximately £ 5½ million. Expenditure and commitments combined at the end of 1951 and 1952 and up to 30 June 1954, were £ 400,000, £ 1,300,000 and £ 4,000,000 respectively.

Apart from the assistance given to the countries of the South and South-east Asia under the Colombo Plan, the services of 2,373 experts were made available and 1,458 fellowships for training were awarded by the United Nations and its allied agencies during the period July 1950 to June 1955. Experts were provided by U.N.T.A.A. (500), I.L.O. (228), F.A.O. (665), Unesco (249), I.C.A.O (120) and W.H.O. (611). The U.N.T.A.A. awarded 523 fellowships, I.L.O. 262, F.A.O. 145, Unesco 221, I.C.A.O. 41 and W.H.O. 266 (P.I.B.).

Low-cost laboratories

UNESCO HAS RECENTLY ISSUED A set of 156 drawings to enable schools to build laboratories for teaching science at a low cost. The drawings cover equipment needed in primary and secondary science teaching and also in the training of science teachers. By using the Unesco plans, a laboratory can be built at a low cost

with the help of local craftsmen (Unesco).

British industries aid science education

LEADING BRITISH INDUSTRIAL companies have combined to form a new trust fund called the Industrial Fund for the Advancement of Scientific Education in Schools. Announcing the Fund, the companies state that they view "with growing disquiet the shortage of scientists, mathematicians and technologists", and have accordingly taken this step to assist the teaching of pure and applied science and mathematics in secondary schools. The assistance will be solely in the form of capital grants towards the building, expansion, modernization and equipment of science buildings [*Chem. Tr. J.*, **137** (1955), 1227].

Introduction of metric system

AT THE SECOND MEETING OF THE Standing Metric Committee held recently under the chairmanship of Shri Nityanand Kanungo, Minister for Industries, decisions were taken for a gradual change-over to the metric system of weights and measures by Government Departments.

On the recommendation of its technical subcommittee the Standing Committee decided that milestones and furlongstones should be marked in metric units as early as possible. As an interim measure, it was suggested, a furlong could be taken as two hectometres (200 metres) and every fifth stone marked to show a kilometre. The error in measuring the distance can be corrected at a convenient point. The Committee also decided that the existing balances and other measuring devices, particularly on the Railways and in the Postal Department, should be recalibrated in metric units.

The Committee also decided that the manufacture of standard weights and measures, based on the metric system, for distribution to the public should be planned in advance in consultation with State Governments. The National Physical Laboratory, New Delhi, will be the agency for the preparation and periodical verification of secondary standards. Working standards will continue to be prepared by the Mint. Work on the metre-bar will begin at the National Physical Laboratory

within two years from now, while work on the kilogram can start earlier. It was also considered that India should join the International Bureau of Weights and Measures, which is the source for obtaining the prototypes of metre and the kilogram. The question of conversion of drawings, maps, specifications, etc., was discussed and it was decided that the Departments concerned should proceed with the task. The Indian Standards Institution will furnish the necessary conversion tables. The Committee decided that existing maps should be converted without any change in the scale.

The Defence Ministry's plan, which is spread over 15 years, divided into three stages of 5 years each, has been tentatively accepted for all the three services. The Railway plan is similarly divided into three periods of 5 years each (P.I.B.).

ISI Certification Marks

THE INDIAN STANDARDS INSTITUTION has granted five licences for use of its Certification Marks to the Indian Cable Co. Ltd., Calcutta. The Standard Marks will be applied to (i) Hard-drawn Stranded Aluminium and Steel-covered Aluminium Conductors (IS: 398-1953); (ii) Cotton-covered High-conductivity Annealed Round Copper Wire (IS: 450-1953); (iii) Hard-drawn Copper Solid and Stranded Circular Conductors (IS: 282-1951); (iv) Bare Annealed High-conductivity Copper Wire (IS: 396-1953); and (v) Rubber-insulated Cables and Flexible Cords (IS: 434-1953) manufactured by the firm.

Bose Institute

THE 38TH ANNIVERSARY MEETING of the foundation of the Bose Institute was celebrated on 30 Nov. 1955, when (late) Dr. Sunder Lal Hora, Director, Zoological Survey of India, delivered the Seventeenth Acharya Jagadish Chandra Memorial Lecture entitled "Conflict versus Co-operation as Factors in Evolution". The lecture expounded the biological principles of evolution as put forward by J. C. Bose that "far more potent than competition is mutual aid and co-operation in the scheme of life".

Dr. D. M. Bose, Director, in his report pointed out that the hundredth birth anniversary of Sir J. C. Bose, the founder of the

Institute, will fall in 1958 and he expressed the hope that the centenary will be celebrated in a befitting manner.

Announcements

■ *A Symposium on Chrome Tanning Industry and Tanning Processes* will be held on the third week of March 1956 in Calcutta under the auspices of the Leather Technologists' Association (India). The object of holding the symposium is to foster exchange of ideas and thoughts between the leather technologists, tanners, research workers and people of the leather trade from all over India.

■ *Rauwolfia for research* — Messrs Rajaranga & Co. Ltd., 5 Thambu Chetty Street, Madras 1, have 900 lb. of *R. serpentina* roots of west coast origin and 400 lb. of the same of Nepalese origin for gratuitous distribution to research organizations and recognized hospitals for investigational purposes. Samples will be forwarded on request on f.o.r. Madras basis.

■ *Award of Doctorate Degrees* — The following persons have been recently awarded the Doctorate degree in Science by the University of Poona:

K. S. Khasgiwale (*Potentiometric studies of metal amines, double salts and metallic soaps*); S. V. Phansalkar (*Studies on protein metabolism with special reference to utilization of animal and vegetable proteins by human subjects*); (Miss) M. N. Deshpande (*Electrolytic reduction of aqueous alkali and alkaline earth nitrates*).

INSTRUMENTS AND APPLIANCES

APPARATUS FOR CONDUCTIVITY WATER

A simple apparatus for the preparation of conductivity water in the laboratory by the use of ion-exchange resins has been designed. A monitor conductivity cell is built into the apparatus to check the quality of the water and the glassware is treated with silicone to prevent leaching by the conductivity water. The apparatus uses 750 g. of mixed resin (Amberlite resins IR 120 and IRA 400 mixed in the ratio of 1:2) and produces more than 7,000 litres of deionized water of specific conductivity $0.07-0.15 \times 10^{-6}$ reciprocal ohms (at 25°C.) in a single

operational cycle when charged with once-distilled water from a normal commercial still. The deionized water may be produced at a rate of 1 litre/min. when the resins are freshly regenerated.

The exhausted mixture of resin beads is suspended in ethyl alcohol in a glass jar and chloroform added to the suspension until the anion-exchange beads float. The beads may be separated, washed with alcohol and then with water, before each resin is regenerated separately [*Chem. Ind.*, No. 30 (1955), 944].

SPILL-PROOF BATTERY CELL

A new cell that operates efficiently without electrolyte spillage at the greatly reduced atmospheric pressures encountered in stratospheric flight has been evolved by Chloride Batteries Ltd., Manchester. Of special light-weight design (9½ oz. dry and 13½ oz. primed), the cells are primed with electrolyte shortly before use. A lead peroxide/zinc couple is used, the former constituting the positive and the latter the negative electrode. The electrolyte is sulphuric acid (sp. gr. 1.270 at 60°F.) to which are added other chemicals and compounds to assist rapid activation and the delivery of a constant potential output during discharge.

The basic construction of the cell element is similar to that of the normal lead acid battery. The element is assembled in a moulded high-impact polystyrene container to which is cemented a lid of the same material. The terminal pillars pass through holes in the lid and are sealed to it by rubber washers held by synthetic resin. A screw plug in the lid is provided for priming, while an integrally moulded vent hole and shielding skirt enable gases generated during discharge to escape. A splash guard above the element prevents spillage or a large-scale movement of electrolyte swamping the ventilating system [*Chem. Tr. J.*, 73 (1955), 845].

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Progress Reports

SCIENTIFIC & INDUSTRIAL RESEARCH IN AUSTRALIA

THE SEVENTH ANNUAL REPORT OF THE COMMONWEALTH Scientific & Industrial Research Organization for the year ending 30 June 1955 records two significant developments towards the solution of the problem of making available abundant supplies of water which is perhaps the greatest natural limiting factor in the Australian environment. These relate to artificial seeding of clouds by which rainfall may be increased over a relatively wide area and the use of cetyl alcohol to retard evaporation of water from dams and other open storage systems. These developments have reached a stage of large-scale practical tests.

The Section of Meteorological Physics has now been designated a Division with Dr. C. H. B. Priestly as the Chief of the Division.

The Carnegie Corporation of New York has made a gift of £ 250,000 to the Organization towards the cost of building a giant radio telescope. The Commonwealth Government has offered to meet half the cost of the proposed radio telescope.

During the year negotiations were effected for a number of sponsored research projects to be undertaken on a co-operative basis with industry and other establishments. These projects include: Investigation by the Division of Building Research on defects in the decoration of fibrous plaster; study by the Division of Industrial Chemistry of the extraction of uranium from unfiltered ore pulps; a project in the Animal Genetics Section on the breeding of mice sensitive and insensitive to oestrogens given subcutaneously; a cloud seeding programme by the Division of Radiophysics undertaken on behalf of the Snowy Mountains Hydro-electric Authority; a research project on tinplate for canning purposes being undertaken by the Division of Food Preservation and Transport for the Commonwealth Can Makers' Association; a project on brown coal in the Mineragraphic Section sponsored by the State Electricity Commission of Victoria; a study of marine fouling in the Division of Fisheries sponsored by the Department of the Navy; a project on farm mechanization sponsored by the Australian Dairy Produce Board and the Rural Credit Development Fund of the Commonwealth Bank of Australia; an investigation on cheese making in the Dairy Research Section sponsored by the Australian Dairy Produce Board.

The following is an account of the more important research investigations carried out in the seventeen Divisions of the Organization.

Soils—Studies on the availability of micro-nutrient metals to plants have shown the suitability of disodium calcium versenate as an extractant of divalent manganese in soils. Evidence has also been obtained of the existence of organic complexes of the first transition series in many organic soils.

A study of the ethylene diaminetetra-acetate titration for calcium and calcium plus magnesium disclosed that the accuracy generally obtainable

by all observers in the titration of calcium plus magnesium was highly satisfactory using Erichrom Black T as the indicator. The titration could be carried out satisfactorily in either aqueous or ammonium chloride extracts of soils.

Phthalein purple (phthalein-complexone) has been found to be a sensitive indicator for alkaline earth and magnesium ions.

The ethylene diaminetetra-acetate method has also been found satisfactory for the determination of small amounts of sulphates in soils, provided a small but sufficient excess of barium chloride is used to ensure complete precipitation.

A method for measuring water content of soil without resort to sampling has been developed. If a source of fast neutrons is placed down a hole the degree to which they are slowed down and scattered by hydrogen atoms in the soil will give a measure of the water content. The necessary apparatus for measuring water content on this basis has been built. The results obtained are highly reproducible and the method shows much promise. It is not accurate at shallow depths of a few inches because of the escape of fast neutrons but its accuracy at greater depths is satisfactory. A theoretical basis for calibrating the apparatus (water content in relation to counts) has been developed. This should help the calibration of new instruments.

A study of the phosphates occurring in soils has resulted in the discovery of a new phosphatic mineral. Chemically the mineral differs from other known aluminium phosphates, wavellite, sterrettite, etc., in being highly hydrated (39 per cent water), and is decomposed at a relatively low temperature, 120°C. Crystallographic study has shown it to be a distinct mineral species.

Plants—Work has been completed on a large-scale vegetation map of Australia.

An interesting interpretation of floral morphology in wheat (*Triticum aestivum*), not in accord with the generally accepted view but supported by palaeobotanical evidence, has been obtained. It has been concluded that the wheat flower is morphologically a short branch system. Upon the main axis of the system the palea, the lodicules, and the carpel are borne as appendages which are homologous with leaves. The ovule or megasporangium is terminal on the main axis while the stamens represent the lateral branches of the system. The carpel arises on the main axis, encloses its apex, and so encloses the terminal ovule; the ovule is not borne on the carpel.

A mutant has been obtained from the flowering plant *Arabidopsis thaliana* which is incapable of synthesizing thiamin. This is the first case of a nutritional mutant to be found in flowering plants.

Animal Health and Nutrition—The nature of radiation-induced gene mutations is being investigated. A study of the mechanism of the competitive suppression of the wild-type back-mutants by the large number of non-growing mutants frequently present has revealed that the non-growing mutant

cells remove sugar from the medium at such a rate that an insufficient amount is left for the back-mutant cells to grow to macroscopic colony size. Suppression can be overcome by increasing the sugar content of the medium.

It has been confirmed, using sheep red cells as a complex antigen, that the response in body to a complex antigen has a lower heritability than a simple one.

Food Chemistry — Work on the preservation of micro-organisms by drying from the frozen state has shown that the mortality during storage is markedly dependent on the water activity during storage and on the nature of the fluid in which the organism was suspended prior to drying. The death rate during storage was increased by certain sugars including glucose and reduced by certain amino acids. These results lead to the hypothesis that death in the dry state is due to the destruction of amino acid side chain of cellular protein and similar molecules by reaction with various carbonyl compounds occurring naturally in the cells.

Chemical studies on limonin, the bitter principle of oranges, have revealed the presence in it of a saturated naphthalene nucleus to which are attached two stable lactone rings and three cyclic ether or acetal groups.

The use of hydrogenated coconut oil as a vehicle and edible antioxidant was found to stabilize considerably the synthetic vitamin A added to milk powder. After 6 months storage at 40°C., more than 90 per cent of the vitamin was unaffected.

Physico-chemical studies on the mechanism of drying of grapes in a special apparatus designed to provide controlled conditions of temperature, humidity and air-flow rate show that the complete drying of grapes occurs in three distinct stages for each of which there is a linear relationship between time and the logarithm of their water content. The first discontinuity occurs at roughly 30 per cent loss in weight, corresponding to the stage where the overall elastic contraction of the skin ceases and the skin wrinkling begins. The second discontinuity occurs at the stage where moisture content of the grapes is about 23 per cent. Experiments on peeled grapes indicated that the water movements within the grapes during drying are fast, relative to the transfer through the skin.

Fuel — A pot furnace to stimulate combustion processes in over-feed fuel bed has been designed and its operating techniques established. A pilot scale slot oven for the investigation of carbonizing conditions and of coal blending for the production of foundry coke was completed.

A mercury penetration porosimeter with working pressure up to 40,000 lb./sq. in., the highest pressure achieved in a similar apparatus, has been constructed.

Industrial Chemistry — Methods for the extraction of various metals from ores received considerable attention during the year. The current efficiency of deposition of copper from calcines obtained by roasting chalcopyrite concentrates was found to depend closely on the iron content of the electrolyte and on the variables influencing diffusion.

A flotation process capable of giving higher yields than the conventional gravity methods has been evolved for the extraction of tin. Sodium hexadecyl sulphate is used as the collector and sodium silicofluoride as the depressant for gangue minerals

during the rougher flotation stage. As more of collector is added during successive flotations, the cassiterite becomes progressively coarser and in each separate concentrate the tin is coarser than the gangue minerals. By sizing, concentrates of the desired grade can be obtained.

In a continuous process for extracting uranium directly from an ore, the ore pulp containing as much as 35 per cent solids is passed through a bed of ion-exchange resins by jigging. The ion-exchange bed, behaving like a fluid in non-turbulent flow, gives high extraction efficiencies. When the resin particles have fully extracted the uranium they become heavier and sink to the bottom to be continuously removed.

The presence of quinone and hydroquinone structures has been established in the simplest types of chars prepared from ash-free carbohydrates which accounts for the major features of activated carbon and carbon black. While the hydroquinone character of a char prepared at 400°C. is responsible for its ability to absorb alkali, its reducing properties and its ability to fog a photographic plate, the quinonoid structure of a char prepared at 800°C. accounts for the formation of peroxygen complexes, its ability to catalyse the ionization of oxygen, and its oxidizing properties and reactivity with rubber.

Physics — A number of improved apparatus was fabricated including (1) a new steam-point apparatus giving temperatures reproducible to 0.0002°C.; (2) a cell for the realization of triple point of water producing a temperature which is stable and reproducible to 0.0001°C.; (3) a manometer for more accurate control and measurement of pressure for determining the boiling points of water and sulphur; (4) a new antimony freezing point cell for transfer from the resistance thermometry to the thermocouple pyrometry range of scale; and (5) a nomograph for use in optical pyrometry which relates black body temperatures to apparent brightness temperature.

Electrotechnology — Two methods of detecting corona discharge giving increased sensitivity have been evolved. In one, the high-frequency component of current in the discharge is observed by radio receiver methods refined for the purpose. In the other method, corona is detected in three terminal air capacitors by observing the d.c. component in the discharge which appears simultaneously with the onset of corona and deterioration in power factor.

An outstanding development has been the construction of a transformer with secondary voltage ratios equal to the ratio of the number of turns to a precision of 1 part in 10⁶. This has been achieved by using a toroidal core and shielding the primary winding with a succession of copper and 'Permalloy' shields until a region of zero magnetic field is obtained in which the secondary windings can be located.

A new technique has been developed for winding a decade transformer with ten coils such that each coil occupies an equivalent position with respect to the core. The errors in a voltage divider constructed on this principle were less than 5 parts in 10⁶. This divider was incorporated in a decade capacitance box to provide the equivalent of a finely subdivided, high quality, air dielectric capacitor.

INDIAN PATENTS

[A few of the Patent Applications notified as accepted in the Gazette of India, Part III, Section 2, for December 1955, are listed below.]

Chemicals, plastics, rubber, paints and allied products

52029. New dyestuffs: *Treating a chloromethyl or bromomethyl derivative of a tetra-azaporphin by methods known to be capable of replacing the chlorine or bromine atoms* — I.C.I. LTD.
52952. Improvements relating to polystyrene plastic materials: *Polystyrene containing unvulcanized natural and synthetic rubber and an alkyl benzene having alkyl group of at least 9 carbon atoms* — MONSANTO CHEMICALS LTD.
53887. Improvements in fatty products: *Preparing the emulsion by adding oil to an aqueous phase at elevated temperature with stirring the emulsion having dissolved therein a water-soluble emulsifying agent which is sufficiently hydrophilic and lipophilic* — UNILEVER LTD.
53888. Improvements in emulsions: *By adding oil to an aqueous phase at an elevated temperature with stirring the emulsion having dissolved therein water-soluble emulsifying agent containing an anionic or non-ionic capillary active substance of the general formula RXY* — UNILEVER LTD.
54101. Production of alkylated or arylated anthraquinhydrones and anthraquinols and hydrogen peroxide: *Wherein metallic palladium catalyst is prepared by adsorption of aqueous solution of palladium salt on carrier and its reduction* — LAPORTE CHEMICALS LTD.
51370. Improvements relating to the production of polyethylene: *Polyethylene having a molecular weight of 18,000-46,000 is obtained by exposing ethylene to the action of γ -rays* — MONSANTO CHEMICALS LTD.
51974. Process for converting optically active aminodiols into racemic aminodiols: *The active compound is converted into N-acyl derivative, oxidized to remove at least one asymmetric carbon atom forming the corresponding propiophenone which is converted into optically inactive compound containing the original chain* — FARMACEUTICI ITALIA S.A.
52033. Process for the production of heterocyclic monothiocarbonic acid esters: *By reacting haloformic acid ester with a heterocyclic mercaptan or a salt thereof* — J. R. GEIGY A.G.
51811. Manufacture of new pyridazine carboxylic acid esters: *1, 4-Dihydro-4-oxo-1-R pyridazine-3-carboxylic acid, in which R represents an unsaturated heterocyclic monocyclic residue, or derivative thereof is reacted with an alkanol, a functional derivative thereof or with a diazoalkane* — CIBA LTD.
52050. Process of preparing diazoamino compounds: *Adding an excess of caustic alkali to a solution of diazoamino compounds prepared in alkaline medium and effecting separation by further adding salt and raising the temperature* — FARBENFABRIKEN BAYER AKTIENGESELLSCHAFT
51448. Process for the synthesis of steroids: *By introducing a substituent α -oxygenated propyl group in position 2 of dodecahydronaphenethrene-4 β -ol-1-one, introducing in position-1, a radical capable of being condensed to form a 6-ring, cyclizing, splitting between carbon atom 16 and 17 and then cyclizing* — REICHSTEIN
- 52127 and 52128. Manufacture of new esters: *Alkylaminobenzoic acids containing 4-7 carbon atoms in the alkyl group are reacted with polyglycols. HO-(CH₂-CH₂-O)_n-R', R' being a hydrogen atom or a lower alkyl residue and n standing for a number from 8 to 12.*
Butylaminobenzoic acid is reacted with non-ethylene glycol monomethyl ether — CIBA LTD.
53217. Production of phosphorus-containing polymers by polyesterification: *Polyesterification is effected upon one or more of the phosphorus compounds stated in the specification* — ALBRIGHT & WILSON LTD.
53425. New dyestuff compositions of the tetra-azaporphin series: *Comprising at least two tetra-azaporphin compounds one of which contains an acid or acid halide radical* — I.C.I. LTD.
53567. Electrolysis of fused salt, particularly alumina: *Providing a cell gap formed by two opposed, parallel plane, oblique faces presented each by one of two stationary carbon electrodes, and a collecting chamber below the gap* — MONTECATINI SOCIETA GENERALE PER L'INDUSTRIA MINERARIA E CHIMICA, & ING. G. DE VARDA
53717. Ozone-resistant rubber compositions and adhesives and bonded composite structures and materials made therefrom: *Comprising a polyhydric phenolaldehyde resol and polymer resulting from conjugated diene hydrocarbons vinyl aromatic monomer and vinyl pyridine monomer* — GOODYEAR TYRE & RUBBER CO.
54044. Phenolic resin compositions containing a metal chelate: *Comprising phenolic resin and metal chelate* — N.V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ

Chemical processes, engineering and equipment

51257. A process for the clarification of cane juice in the manufacture of white sugar: *By adding to the juice a clay consisting of (a) bentonite activated with sodium carbonate and/or (b) 'multani mitty'* — MAVI, SINGH, DUBEY & DARUVALLA
51357. Improved method of producing trichloromethylpara - acetylaminobenzene - thiolsulphonate: *Treating alkaline metal salt of para-acetylaminosulphonic acid with perchloromethylmercaptan* — N.V. PHILIPS' GLOELAMPENFABRIEKEN
53642. Improvements in suction apparatus: *Comprises a suction box and a housing box in which*

INDIAN PATENTS

the suction box is mounted — BOWATERS DEVELOPMENT & RESEARCH LTD.

52487. New polymeric materials, fibres treated with these materials, and a process for carrying out such treatment: *Reaction product of tetrakis or tris-hydroxymethyl phosphonium chloride and nitrogen containing polyfunctional compound capable of reacting with formaldehyde* — THE BRADFORD DYERS' ASSOCIATION LTD. & ALBRIGHT & WILSON LTD.

53390. An improved method for the production of manganese sulphate from manganese ores and its application for the regeneration of the spent electrolytic manganese sulphate bath: *Digesting manganese ore with dilute sulphuric acid and iron* — COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

53967. Process for the manufacture of carbon disulphide: *Passing preheated hydrocarbons and heated sulphur vapour into contact with a catalyst at elevated temperature and pressure interrupting the flow of reactants at intervals for the generation of catalyst* — FOOD MACHINERY & CHEMICAL CORPORATION

Physics, general

51892. Improvements in electric capacitors: *Thin layers of metal constitute the electrodes and the dielectric between them is a thermoplastic material* — THE GENERAL ELECTRIC CO. LTD.

52055. Thermostatic arrangement for automatic adjustment of output and temperature in solar boilers: *Thermostatic arrangement is provided in a casing having an axial rod guided by an oily liquid* — CAILLOL

53766. Improvements in or relating to transistors: *At least emitter being made of an alloy having one or more of the metals bismuth, indium, lead, thallium and/or tin and also germanium, if necessary, and furthermore not more than 25 per cent of one or more of the elements having atomic number of less than 48 and having S²P configuration of the outer electrons, viz. gallium, aluminium and boron* — N.V. PHILIPS' GLOEILAMPENFABRIEKEN

Drugs and pharmaceuticals

51866. Manufacture of a new hydroquinone compound and pharmaceutical preparations thereof: *Reacting paraquinone with ethyleneimine* — CIBA LTD.

53100 and 55220. Process for the manufacture of penicillin salts of $\omega\omega'$ -dibenzylamino ethers: *Reacting $C_6H_5CH_2NH(CH_2)_nO-(CH_2)_nNHCH_2C_6H_5$ with penicillin or salt of penicillin, where n is 2-5.*

Reacting $NH_2(CH_2)_nO-(CH_2)_nNH_2$ with benzaldehyde, reducing reaction product with H_2 , where n is 2-5 — ALLEN & HANBURYS LTD.

53384. Anaesthetic compositions: *Comprising a solution of 2-(β -naphthoxy)-ethanol, and one or more barbituric acid derivatives, in polyalkylene-glycol* — I.C.I. LTD.

54774. Selective herbicidal compositions: *One or more of ω (2-methyl-4-chlorophenoxy) butyric and caproic acids, their salts, esters, amides and nitriles with inert diluent* — NATIONAL RESEARCH DEVELOPMENT CORPORATION

54855. Production of flavinadenine dinucleotide (FAD): *Cultivating vitamin-B₂ producing fun-*

gus in nutrient medium, separating mycelium from culture medium and extracting FAD from mycelium — TAKEDA PHARMACEUTICAL INDUSTRIES LTD.

53108. Stable antibiotic salts: *By suspending in a solvent a compound which liberates a bivalent tetracycline group antibiotic ion and a compound of metal calcium and magnesium at a pH 8-10* — AMERICAN CYANAMID CO.

Metals and metal products

51355. Method and apparatus for continuously processing strip: *Comprises means for centring the strip prior to its entry into processing equipment and plurality of rolls for supporting said strip, each of said rolls having cylindrical strip supporting surface of less width than the width of the strip* — UNITED STATES STEEL CORPORATION

54367. Desulphurization of cast iron: *Cast iron is deoxidized with a deoxidizing agent other than calcium carbide prior to completion of the injection of calcium carbide into the molten cast iron* — UNION CARBIDE & CARBON CORPORATION

54533. Method of plating aluminium and its alloys: *Before electro-deposition and after anodic film deposition, a modifying step is carried out by subjecting the article to the action of an aqueous solution of sodium hydroxide and sodium silicate* — MACLEAN & CLELAND

52981. Process for preparing an acid-soluble manganese product from manganese-bearing materials: *Heating to obtain fused mass which is rapidly chilled* — ELECTRIC FURNACE PRODUCTS CO. LTD.

53401. Chromium plating of aluminium: *Cooling the bath to prevent temperature from exceeding 65°F., the bath consisting essentially of chromic acid and the sulphate radical* — MACLEAN

54247. Electro-deposition of indium: *The bath has indium, a controlling agent and a neutralizing agent* — VANDERVELL PRODUCTS LTD.

54778. Process and apparatus for preheating air for cupola and like furnaces for metallurgical use: *Heat for preheating air taken from a zone above melting zone disposed above combustion zone of the furnace, preferably immediately above the melting zone* — CHAKRABARTY & DASS

54130. Melting of high melting point metals or alloys: *Comprising one or more cooled arc melting crucibles superimposed above a cooled arc melting crucible of larger cross-section adjustable base used for both crucibles means for supplying raw material, inert gas and means for evacuating the furnace and adjustable electrode for upper crucible* — I.C.I. LTD.

54229. Electroplating of tin: *The electroplating bath contains divalent tin, a controlling agent and a neutralizing agent* — VANDERVELL PRODUCTS LTD.

54231. Electroplating of lead-tin alloys: *Electroplating bath consists of a divalent tin, a controlling agent and a neutralizing agent* — VANDERVELL PRODUCTS LTD.

Glass and ceramics

54303. Glare screens: *Including a thermoplastic material having coloured area of gradually decreasing hue from the edge of the sheet towards its middle and a sheet of glass which absorbs at least*

34 per cent of ultraviolet light passing through it — LIBBEY-OWENS-FORD GLASS CO.

55049. Method and apparatus for bending glass sheets or plates: *Comprising a plurality hingedly connected sections with shaping surface, on them sheet locating and supporting means movable from a position above the mould to a position below the mould and means connecting the sheet locating and supporting means with mould supporting means* — LIBBEY-OWENS-FORD GLASS CO.

54275 and 54276. Method and apparatus for bending glass sheets: *Consists in supporting a glass sheet on a mould, passing it through high temperature region that includes a source of radiant heat, shading an area of sheet from radiant heat and varying the shaded area.*

Bending mould with glass sheet supported on it is passed through a heating chamber and directing beams of radiant heat downwardly on the surface of the glass as it passes through — LIBBEY-OWENS-FORD GLASS CO.

Leather and leather products

53781. Improved leather treatment: *Treating leather with an aqueous emulsion of a polysiloxane composition and a curing agent* — GENERAL ELECTRIC CO.

54385. Process of tanning, and tanning compositions: *Treating the skin in an aqueous acid solution, containing suspended therein a pulverized double silicate of zirconium and an alkali metal* — ROHM & HAAS CO.

Building materials and methods

52517. Improvements in or relating to reinforcement for reinforced structures: *Stress carrying members of reinforcement formed with bond improving formations such as indentations having a transverse character* — BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD.

53954. Method of jointing roofs and framework consisting of light-weight concrete slabs: *Wherein the adjacent light-weight concrete slabs are interconnected by a number of sheet metal parts* — INTERNATIONELLA SIFOREX AKTIEBOLAGET

51989. Twin-slab cavity-wall building blocks and methods and apparatus for making them: *Positioning one end of at least one tie element in moulding space of slab moulding pallet; filling mouldable material, inverting pallet after initial setting of material and registering over second pallet to dispose other end of tie element in its*

moulding space and filling latter with mouldable material — BISHOP

54441. Improvements in or relating to scaffolding: *Ledger support bracket member providing sealing recess with upwardly open side into which angle section ledger member is passed by downward movement transverse to its length and clamped therein between a clamping member and inner face of upright* — DAVID ROBERTS & CO. (ENGINEERS) LTD.

53534. Improvements relating to scaffolding and like structures suitable for the construction of stands, barriers and the like: *At least four elongated side by side connecting members collectively engage complementary extremities of the aligned tubes* — QUADRAC LTD.

51669. Improvements in roofing felt: *One side of the roofing felt in sheet form is marked with fixing marks for correct laying while the other side is marked with fixing marks for correct cutting and laying* — THE RUBEROID CO. LTD.

53388. Apparatus for spraying mortar, cementitious material and the like: *Slurry is in an open container and means are provided to blow compressed air thereon* — INTONACATRICE TIGRE S.R. 1

Miscellaneous

54349. Manufacture of separators for electrical storage batteries: *Method of making characterized by disintegrating a paper pulp, admixing with aqueous solution of resin, adding potash alum and sulphuric acid, concentrating the treated pulp, shaping in a mould and heat treating* — OLDHAM & SON LTD.

53337. Manufacture of electrodes and their use in the melting of high melting point metals or alloys: *Feeding the raw material in sponge, pellet or like form to the melting chamber of an arc melting furnace at a higher rate consistent with complete melting* — I.C.I. LTD.

53395. Refractory magnesia clinkers: *Clinker contains lime, silica and alumina in given percentage* — THE BRITISH PERICLASE CO. LTD.

54321. Bitumen adhesion assistants: *Being aqueous solutions of tetralkyl ammonium halides having a straight chain containing at least 8 carbon atoms and a cycloaliphatic alcohol or ketone* — I.C.I. LTD.

55316. Extracting caffeine from tea wastes: *Boiling tea waste with water, adding oxide of alkaline earth metal to said extract, filtering off the precipitates obtained and concentrating the filtrate* — DAS GUPTA & SEN

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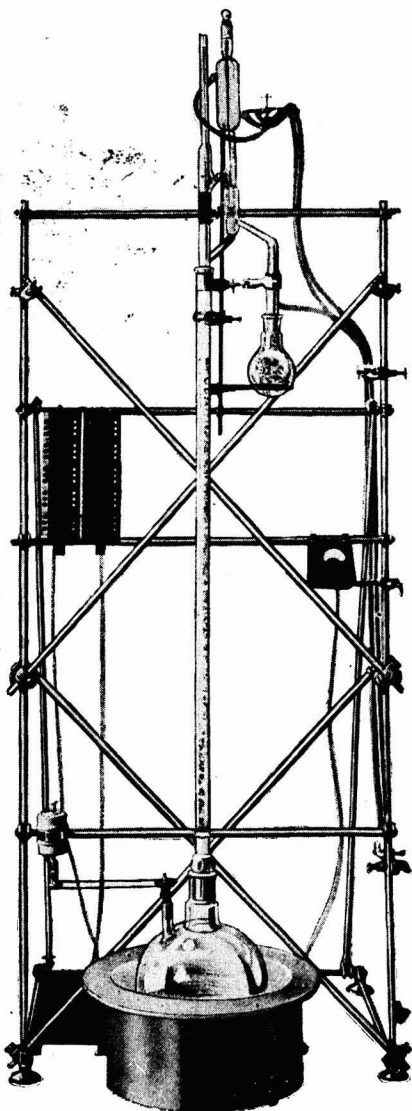
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