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A — General

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## IN THIS ISSUE

### A: GENERAL

Inventions and their  
protection

Radioactive isotopes for  
study of tropical meteorology  
and oceanography

Bending characteristics of  
antinite

### B: PHYSICAL SCIENCES

Characteristics of transistor  
with special reference to  
temperature

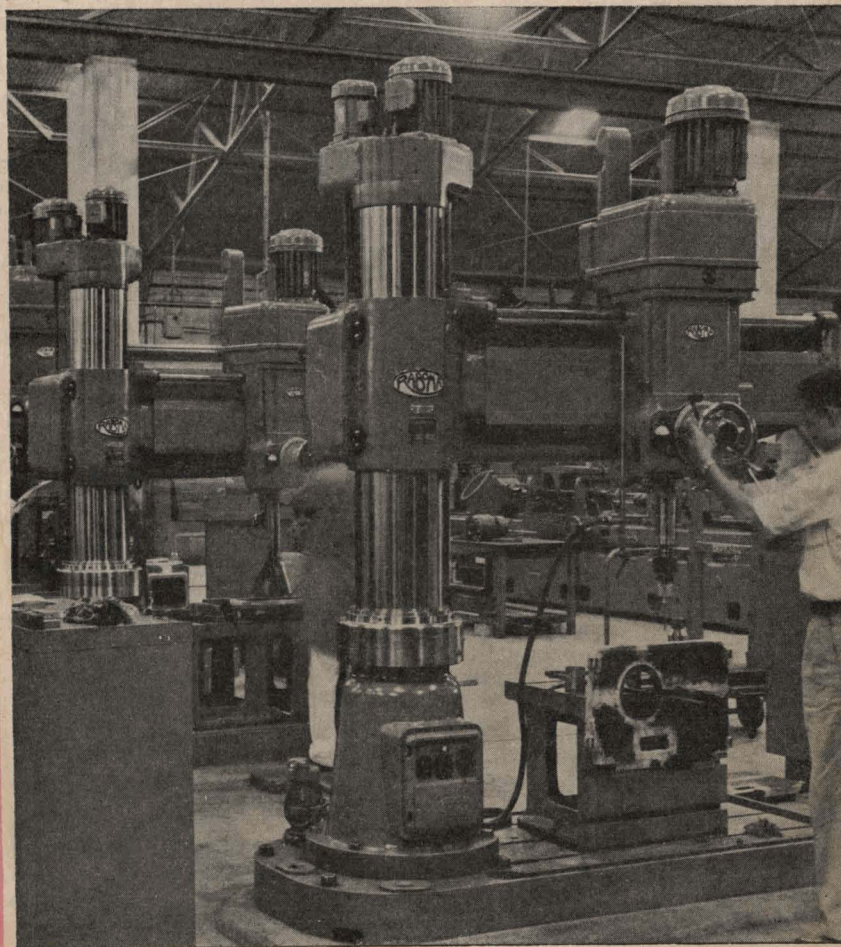
Heavy nickel reductions

Recovery of uranium from  
carbonate leach liquors

### C: BIOLOGICAL SCIENCES

Effect of ultraviolet  
radiation on surface  
charges of bacteria

Fibre-yielding Malvales



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J. sci. industr. Res., Vol. 15A, No. 6, Pp. 257-300

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## COVER PICTURE

The Hindustan Machine Tools Factory, Bangalore, set up at a cost of Rs. 8.37 crores, went into production on 6 October 1955, and is now turning out high speed precision lathes of 8½ in. centre, built entirely from components made in the factory. The picture on the cover shows a battery of radial drilling machines in a section of the factory.

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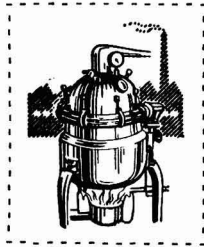
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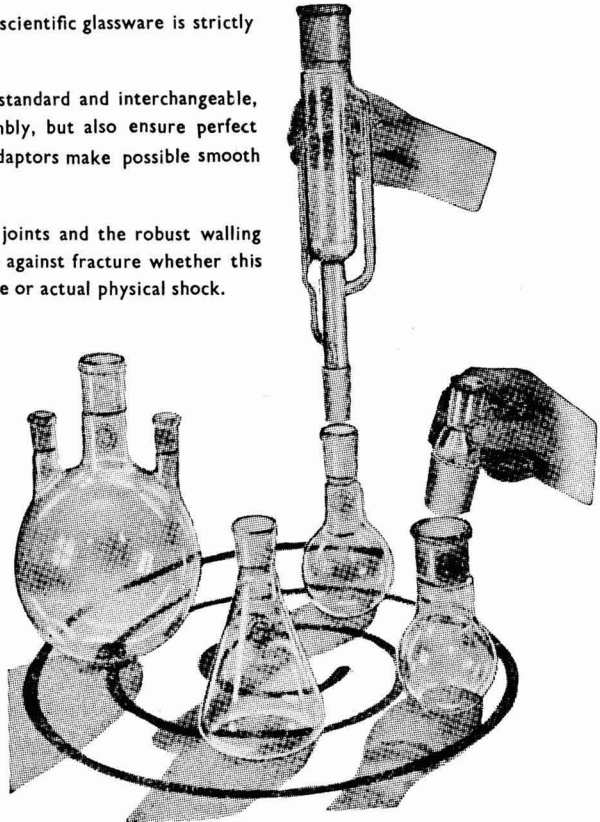
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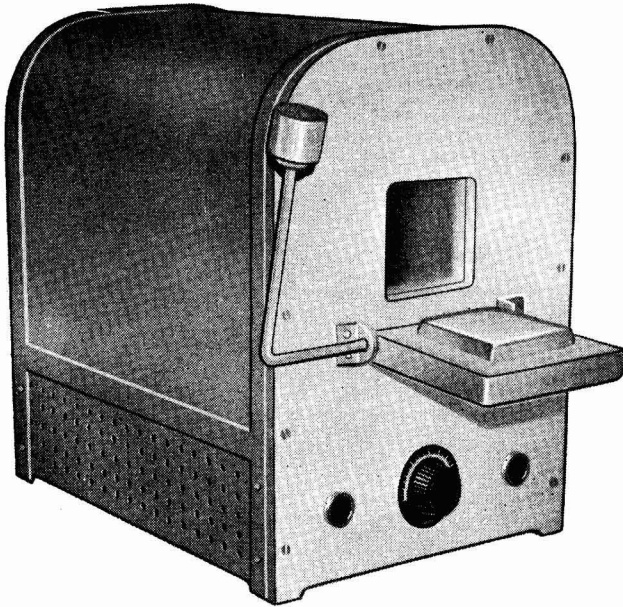
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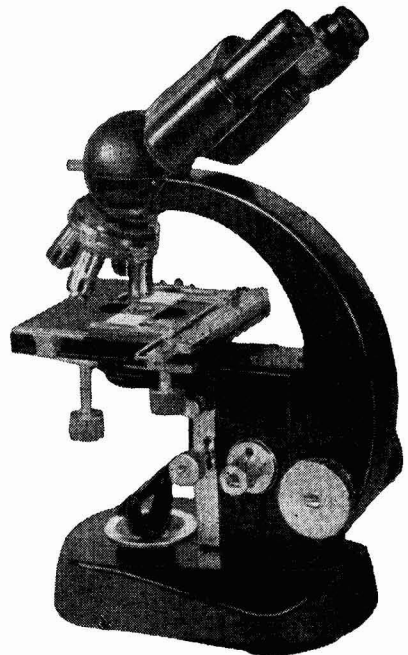
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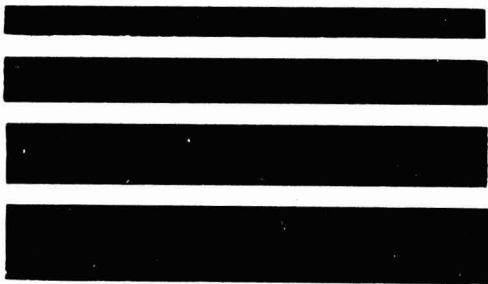
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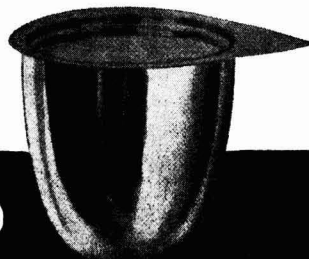
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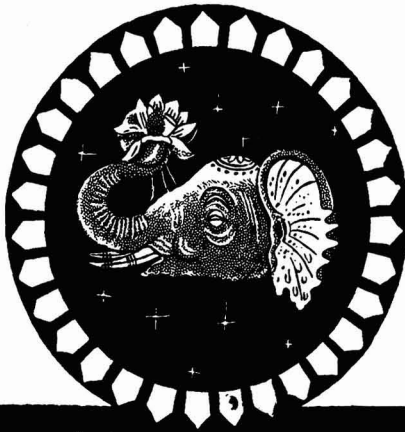
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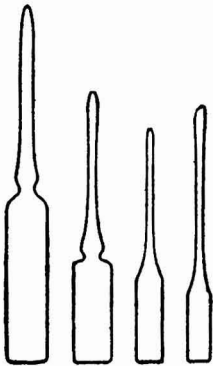


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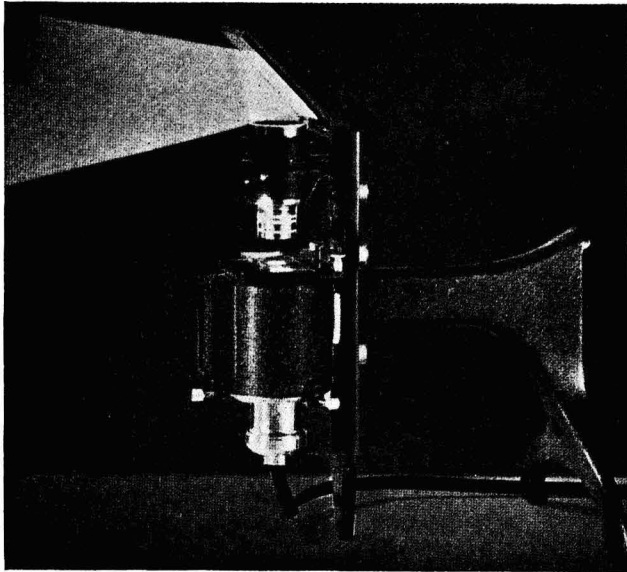
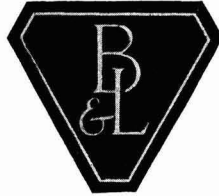
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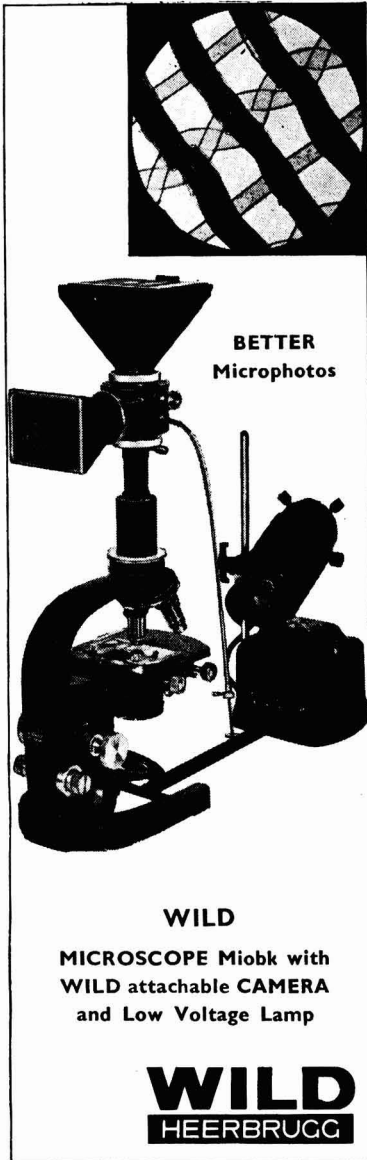
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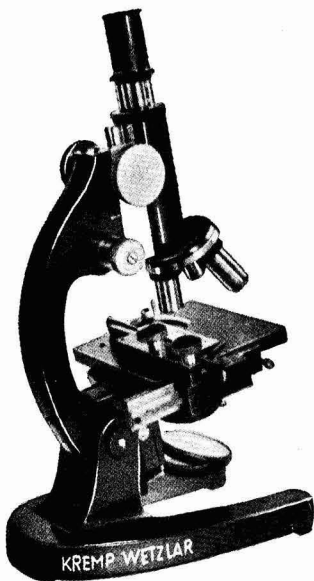
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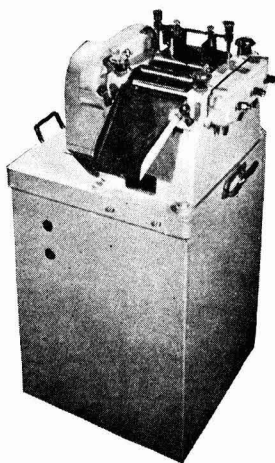
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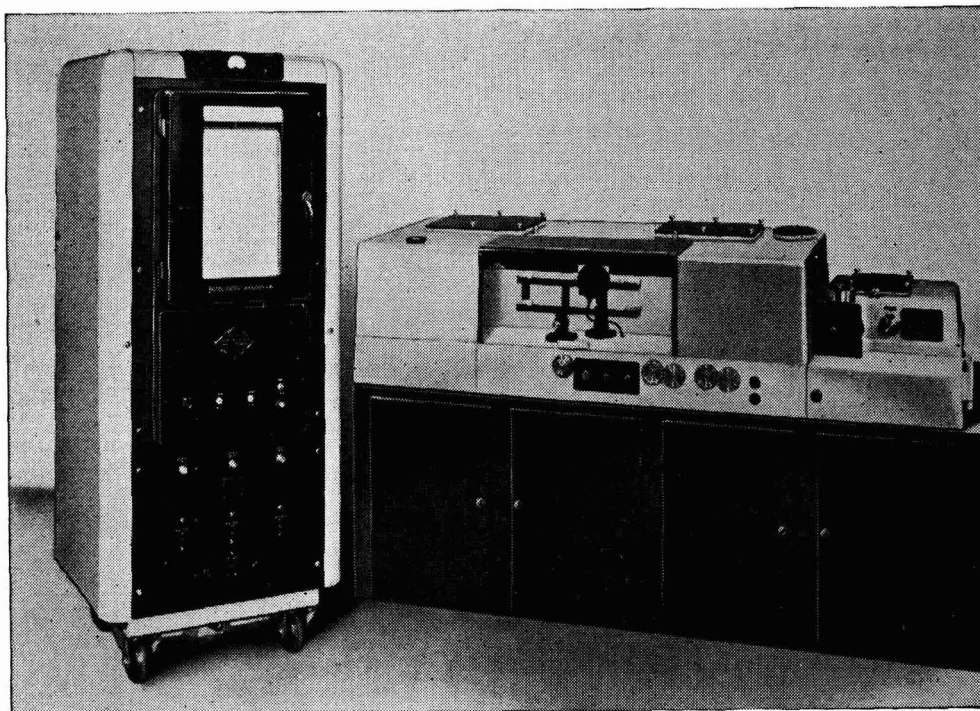
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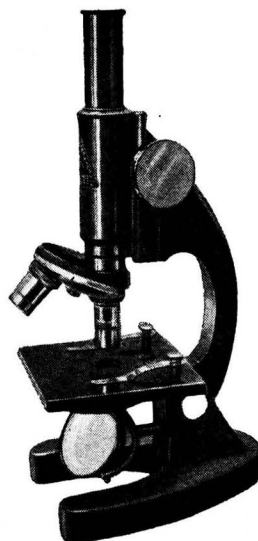
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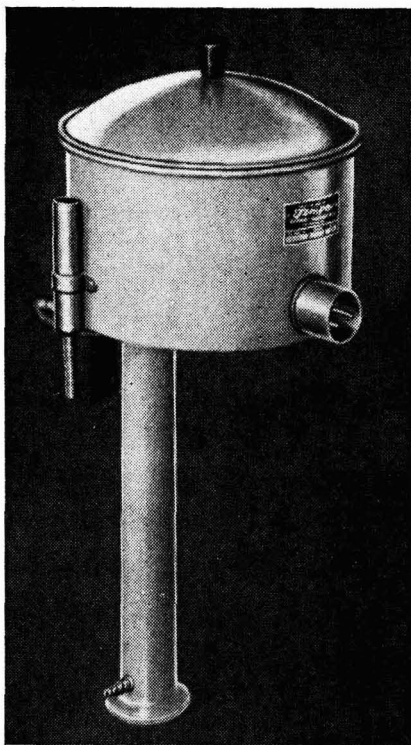
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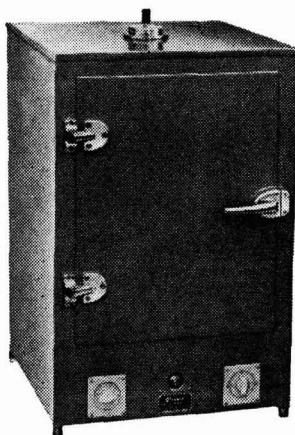
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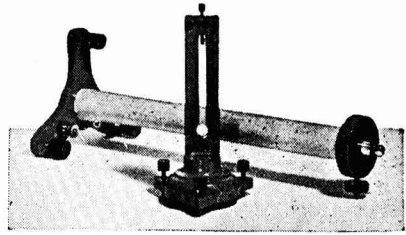
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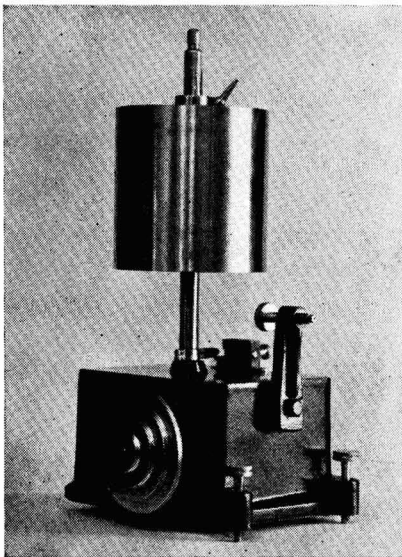


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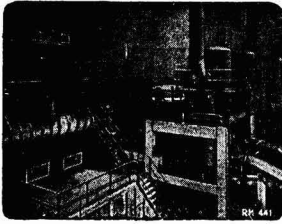
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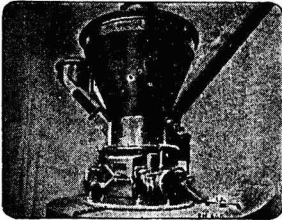
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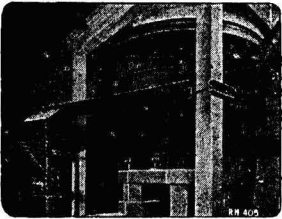
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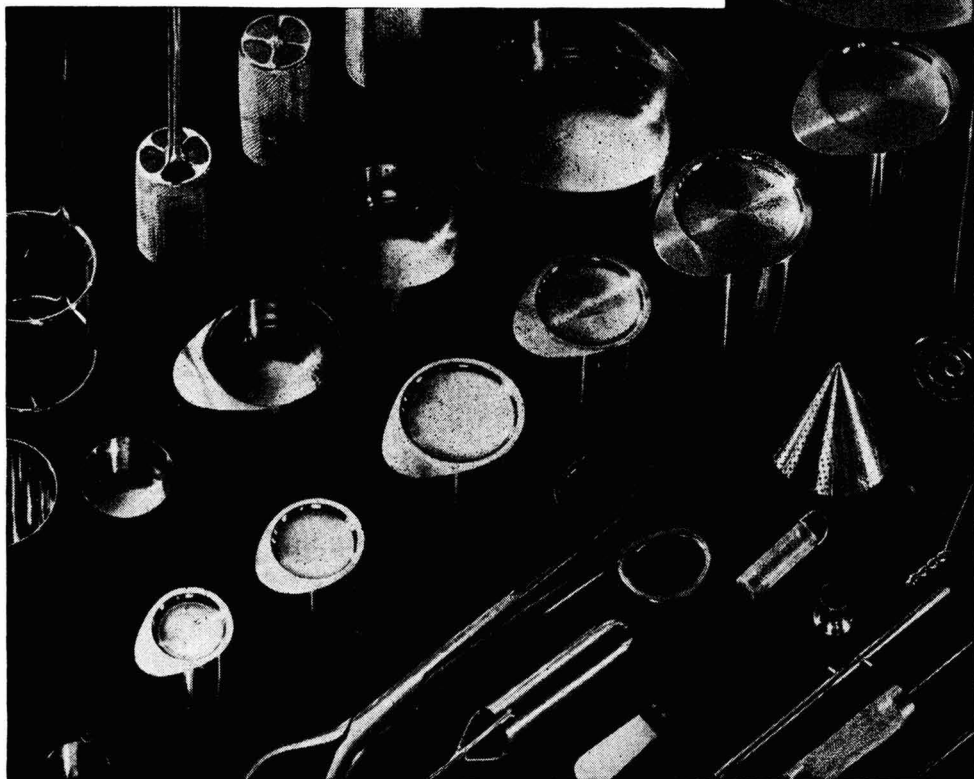
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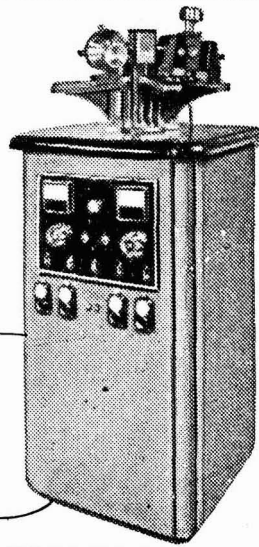
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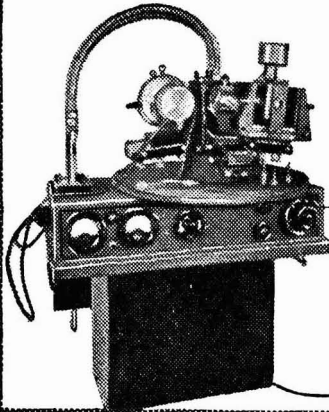
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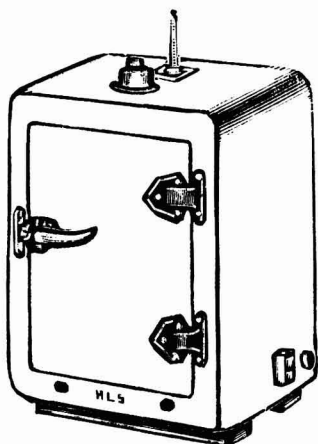
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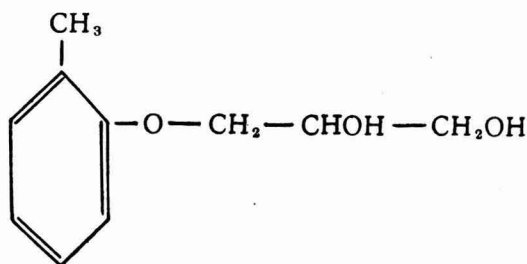
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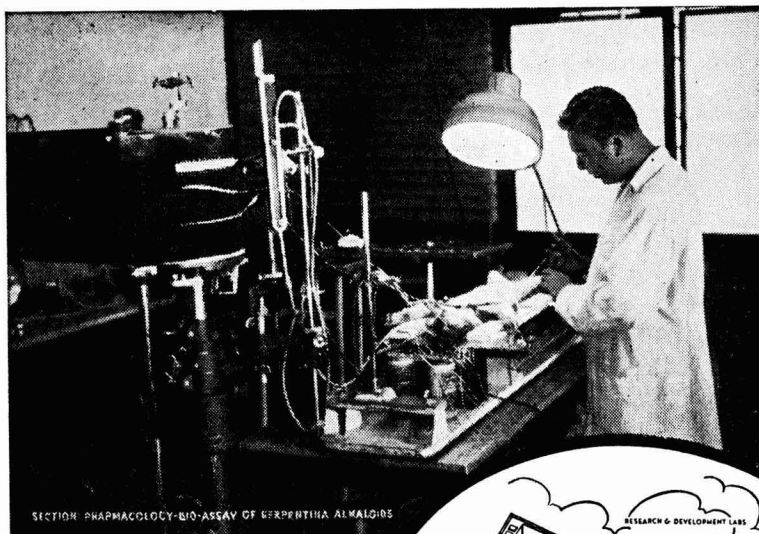
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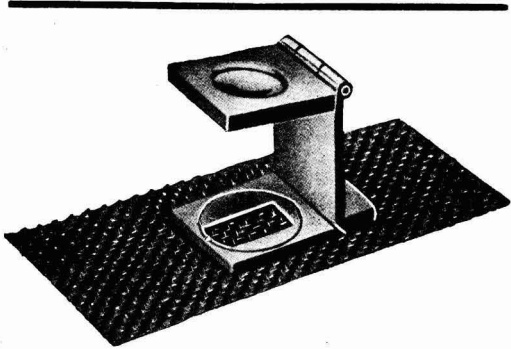
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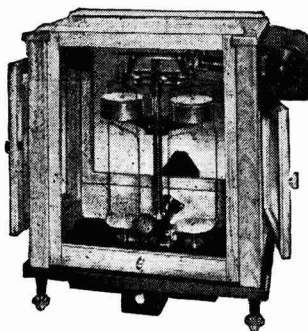
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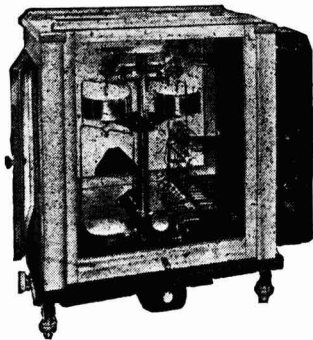


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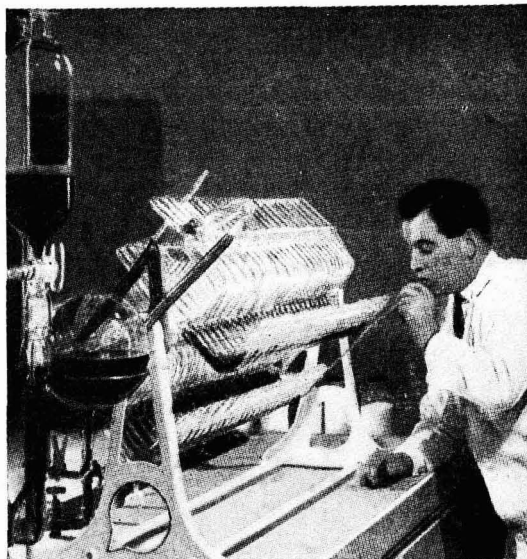
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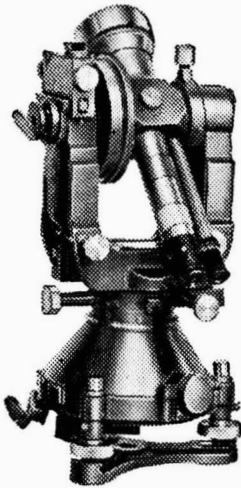
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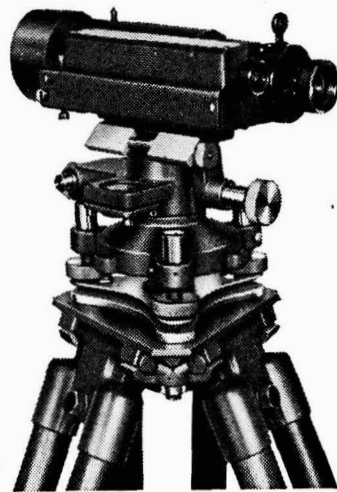
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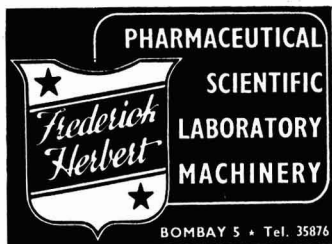
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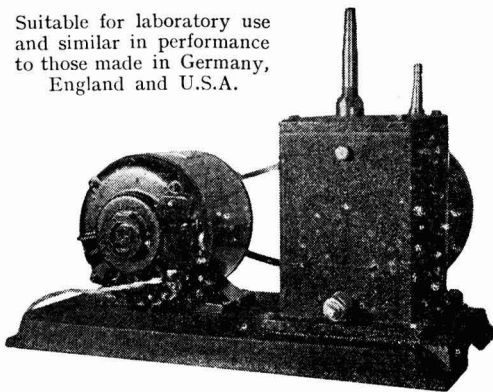
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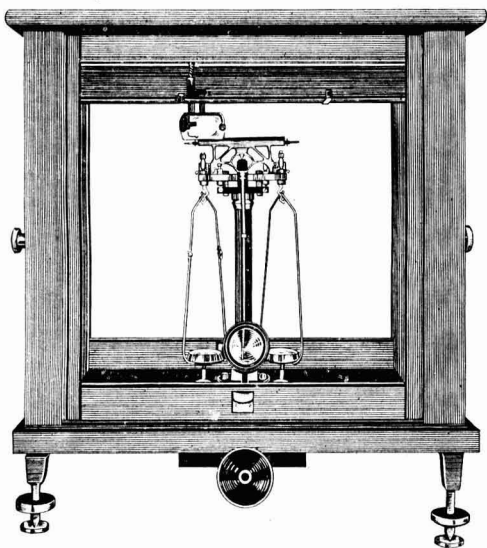
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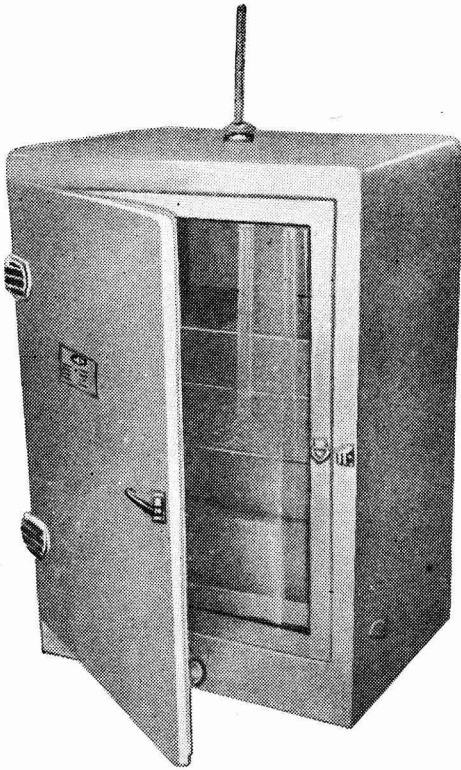
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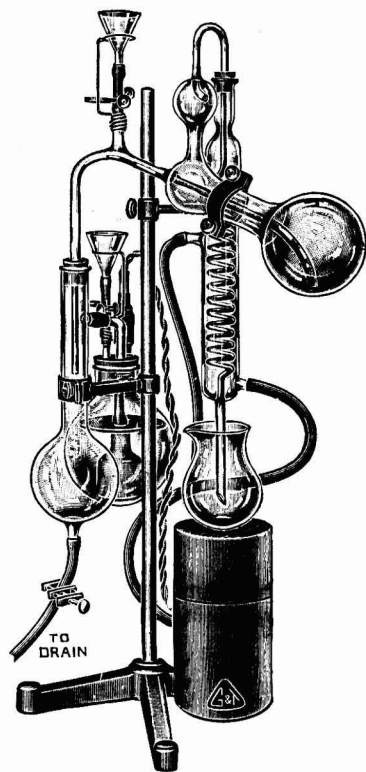
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## Inventions & Their Protection\*

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**M**AN throughout the ages has been on the quest of knowledge. The things that he lives by are everywhere the same. They are the air, the water, and land, the rivers in the valleys, the minerals within the earth and the vegetation covering its surface. It is these that he digs for, processes and contrives. And the success with which a people do so is a measure of their prosperity. At the root of such success lies their knowledge of the laws and forces of nature and of the properties of materials which are within their reach.

### **Practical application of knowledge**

But mere knowledge is not enough; it is the application of knowledge to practical ends that matters for better living. In Europe and North America, the standard of living has changed enormously since 1856 when the Indian Patent Law was first enacted. It has been a period, in those lands, of strenuous endeavour for advancement of science, and the development of tools, machines and processes based on scientific discoveries. Under the guidance of skilled masters, these machines reclaim land, till the soil, sow the seeds and harvest the crops. They transport men and goods on the land, over the sea and through the air. They carry messages to distant lands almost in no time. Spectacular progress has been made in the improvement of the fertility of the soil, quality of crops and livestock. New processes have been discovered for transforming raw materials, the minerals within the earth and vegetation on its surface into finished products of almost infinite variety, which men have need of or wish to possess. Above all, mechanical power has been placed at the

disposal of man which has increased his efficiency hundreds of times; and measures for control and cure of diseases have increased his expectations of life.

It has been estimated that roughly 87·7 per cent of the present total annual income in the U.S.A. from farms, forests, mines, transportation, manufactures and commerce is due to invention, discovery and technology as distinct from the unaided efforts of man.

### **Importance of research**

Although the 'practical men' and the 'curious amateurs' continue to make their contributions to the technical progress of industries, the importance of their work, compared with that done by trained scientists and engineers co-operating in organized laboratories, has, for the last fifty years, been steadily diminishing. In these laboratories trained chemists, physicists, metallurgists, engineers, mathematicians and biologists have been continually pushing outward the frontiers of science. Industrialists in India should realize, as has been done by their counterparts in the U.S.A., that many of their problems which defy rule-of-thumb methods would yield to the application of science. Today the research laboratory is widely recognized as an indispensable part of the country's industrial equipment. From it comes the knowledge that leads not only to improved methods and materials but also to entirely new processes and products and occasionally to new industries. That is why apart from the public expenditure of more than Rs. 1,000 crores on research, American industry employs over 70,000 research workers in over 2,200 laboratories at an estimated annual cost of Rs. 250 crores.

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\*Inaugural address by Dr. J. C. Ghosh delivered at the Symposium on 'Role of Inventions in India and Their Protection', Indian Patent Centenary Celebrations, Calcutta, 5 March 1956.

### Conditions in India

Industrial research and inventions resulting therefrom constitute a major national resource, which should, therefore, be fostered with great zeal. Unlike the United States of America where scientific research in relation to industries is mainly concentrated in the various industrial concerns themselves, very few industries in India, excepting probably half a dozen, have got any research laboratories worth the name. Rapid industrial expansion in India is possible in the present state of world trade only if the industries are modernized. It is, therefore, essential that there should be an efficient organization for scientific research on which industry could draw to help it in its efforts to modernize. The National Laboratories that have been established by the Government during the First Five-Year Plan period are meant to fill this lacuna.

I welcome in this connection the publication of a new journal — *Research & Industry* — by the Council of Scientific & Industrial Research. This is “a venture with a purpose. It carries information on discoveries and inventions emerging from the work of scientists in the laboratories and institutes. It seeks to enlist the co-operation of industry in utilizing the results of research. It also invites problems of immediate or long-range interest from industry for investigation. *Research & Industry* would welcome enquiries in the fulfilment of its mission to forge an enduring link between science and industry.”

### Provision in the Second Five-Year Plan

Though researches on pure science should be the normal function of university laboratories, long-range problems of applied science may well receive their attention, specially during this period of transition in India. Encouragement of research in the universities through liberal provisions by the University Grants Commission and by the Council of Scientific & Industrial Research and similar bodies is one of the important features of the Second Five-Year Plan.

India is on the threshold of rapid and large-scale industrialization. The Second Five-Year Plan is primarily intended to gear our economy to this goal. In the public sector, a provision of about Rs. 710 crores has been made for industrial and mineral development in the plan of Rs. 4,800 crores. In addition, Rs. 200 crores are allotted for the

development of village and small-scale industries. Out of the total investment of Rs. 2,300 crores in the private sector, that on industrial development programmes in the organized sector is expected to be of the order of Rs. 620 crores over the Second Five-Year Plan period. The development of industry is closely related to the availability of power and a provision of Rs. 440 crores has been made in the plan for developing the power resources in the country.

### Patent system as a stimulant

For sustained industrial progress in future, it is essential to set up conditions which would stimulate inventions and facilitate their adoption in practice. It has been suggested that the patent system serves this purpose. It rewards the inventor by recognizing his right to have an opportunity to benefit himself from his invention and confers on him the right to prevent the unauthorized use of his invention normally for a period of 16 years. The patent system tries to stimulate invention in the following ways:

(1) by appealing to the profit motives of the inventor;

(2) by making the inventor disclose faithfully his new invention to the Patent Office so that there is available, for public use, the product of invention, and the invention itself can be used by the public after the expiry of the patent; and

(3) by attracting capital for investment in the development of new inventions, as unpatented inventions would fail to attract the attention of industrialists, and also by protecting enterprises based on new inventions from the risk of competition during the period of development.

The industrial progress in U.S.A. is closely associated with the extensive use made by the American industrialists of the patent system. The patent system has been a part of the American incentive system and has been a great factor in creating many great industries in that country. In the words of Abraham Lincoln, “the patent system added the fuel of interest to the fire of genius”.

### Patent Law in India

The Patent Law was enacted in India in 1856 and its working for nearly a century has been recently assessed by the Patent Enquiry Committee (1948-50). The first thing that strikes one is that more than 90 per cent of

the patents granted in India are held by the foreigners. In all advanced countries, the percentage of patents granted to foreigners is comparatively small; for example 13·2 per cent in the U.S.A., 24 per cent in Japan, 25·8 per cent in Germany, 29·9 per cent in France and 51·7 per cent in Great Britain. As regards even the 10 per cent of the patents which are granted to the Indian nationals, the Patent Enquiry Committee reports that "the Indian inventors have been confining their attention to cottage and small-scale industries and that among the major industries in India there is none which has attracted appreciable attention of Indian inventors". Among the other conclusions arrived at by the Patent Enquiry Committee, the following are of special significance:

"(a) There is at present no means of ascertaining the extent to which patents granted in India have been, or are being, worked in this country;

"(b) the Indian Patent System has failed to achieve its main purpose, namely, to stimulate invention among Indians and to encourage the development and adoption of new inventions for industrial purposes in the country so as to secure the benefits thereof to the largest section of the public;

"(c) the Indian Patent System has been misused, and in some cases abused to the detriment of Indian interests, particularly for blocking free use of industrial processes for the growth and development of industries in the country;

"(d) foreign concerns owning patent rights in India impose unreasonable terms for authorizing the use of their patents; and

"(e) such foreign concerns, particularly those which have secured patent rights in industries concerned with food and medicine, do not at all undertake the manufacture of their products in India. They merely use the monopoly rights to guarantee to themselves a market in this country free from competition; and in this way they keep up prices artificially at a very high level."

It is, therefore, necessary to amend the Patent Law so that the abuses referred to above can be prevented.

#### **Suggested amendments**

The following are some of the amendments which might be considered:

(1) There should be a clear provision in the Indian Patent Act on the lines of the provi-

sion laid down in Section 27 of the British Act, whereby "the patents for new inventions are granted not only to encourage inventions, but to secure that new inventions shall, so far as possible, be worked on a commercial scale in the United Kingdom without undue delay".

(2) As in the British Act, it should be specifically laid down that in the case of chemical products and substances intended for use as food, no one shall be allowed to hold a monopoly right. Any applicant whatsoever should be able to obtain a licence to manufacture them by applying to the Controller of Patents and paying suitable royalty to be fixed by the latter.

(3) One of the drawbacks of the present Patent Law results from the defective provision of the Sections 22 and 23 of the Indian Patent Act. Though, after amendment of the Act by our Parliament in April 1950, on the lines suggested by the Patent Enquiry Committee, the amended sections constituted an improvement in many respects, they are still capable of being misused by interested parties.

To be of real value to the country, these two sections should be clear cut and free from ambiguity and provisions should be made for (a) granting licences at any time after the date of the patent and not three years after the sealing of the patent, (b) not denying the grant of licence on any ground to any one who asks for it for the purpose of manufacturing in the country, (c) providing that the appeal against the decision of the Controller of Patents should be to a Special Tribunal and not to the High Court, and (d) fixing the maximum value of the royalty to be granted by the Controller of Patents to five per cent of the sale price of the product in any case.

I am also personally of the opinion that in India, the manufacture of medicines and other articles which are considered by Parliament as essential for the life of the community should not be restricted by patent rights (in Belgium, where free enterprise is given full play, manufacture of medicine is not subjected to any patent rights). In the co-operative commonwealth which we wish to establish in India, work for common good is more important than work for personal benefit. Patent laws of the country should reflect this philosophy of social life which we have accepted as our goal.

# Centenary of the Indian Patent System

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R. B. PAI

**T**HE Centenary of the Indian Patent System was recently celebrated by holding a Patent Exhibition and a Symposium at Calcutta under the auspices of a Centenary Celebrations Committee set up by the Government. The exhibition attracted many interesting exhibits from Indian inventors and gave a measure of the popularity of the Patent System not only among 'small' or 'individual' inventors, working of their own, but also among organized research workers engaged in systematic research in modern well-equipped laboratories. The crowds which flocked to the exhibition even on the last day of its extended period also gave evidence of popular interest in inventions and patents.

The inaugural address by Shri T. T. Krishnamachari, Minister for Commerce and Industry, as well as the address by Dr. J. C. Ghosh, Member, Planning Commission, who presided over the opening session of the symposium, focussed attention on some of the important issues which the Patent System has to face in the present day. The Minister paid a tribute to the Patent System for the help rendered by it to industrial progress and the protection and encouragement afforded by it to inventors. In view of the importance of new inventions to modern economy, the protection of inventions was, in his opinion, a national duty. He emphasized that it was in the public interest that Patent Law should provide the maximum protection to the inventor without giving him an opportunity to abuse his proprietary rights. In his opinion, although the Patent System was not widely known and recognized, the fact that it had existed and served the country for a whole century was a matter to feel happy about.

Dr. Ghosh too referred to the great part which a proper Patent System can play and mentioned that in certain countries, notably in the U.S.A., patents had been a great factor in creating many new and great industries: in the famous words of Abraham Lincoln, "the patent system added the fuel of interest to the fire of genius".

The symposium, which lasted for two days, provided an opportunity for examining some of the problems affecting the fundamentals of the system and its future outlook in this country. In the lively discussions which took place, the usual differences of opinion on patent matters made their appearance. Academic differences about the ethics and utility of patents have always existed side by side with the solid practical achievements of the system.

The difficulty of evaluating the Patent System in the abstract has become quite apparent. Yet comprehensive factual studies dealing with the problems of the Patent System have been practically non-existent. While, on the one hand, frequent efforts are made to discredit the system, and even to abolish it, the votaries of the system, on the other hand, make an equally vehement but non-critical assertion in its favour. No wonder that such divergent views were evident at the symposium and added a good deal to its interest.

On the analogy between discovery and invention, some were of the view that just as a scientist who makes a purely scientific discovery is not permitted to monopolize the discovery, the inventor too should not be permitted to have any exclusive rights in the invention which he creates. On the other hand, it was argued that patents were akin to copyright and just as copyright safeguards the rights of authors of literary and artistic works, patents protect the legitimate rights of the inventor. Some suggested that there should be a provision in the law for due rewards for purely scientific discoveries also, and not merely for inventions, which are essentially based on the discovery of new principles.

A middle view would suggest that the way in which discoveries or inventions can or should be rewarded is governed largely by practical considerations. While patents have, by and large, been found to be a suitable way of rewarding inventions, it may neither be feasible nor desirable to extend the scope of patents to discoveries which do

not result in inventions. At the same time it must be admitted that the mere fact that an invention has been made should not give the inventor an absolute right to an unrestricted monopoly. In brief, as the Minister pointed out, "social objectives should be kept in view and the system should not be allowed to grow into an octopus". It is a challenge to our law-makers to provide a Patent System which will not permit itself to be used to perpetuate anti-social monopolies, but would nevertheless act as a powerful incentive to invention.

The discussions at the symposium have greatly helped to emphasize the basic considerations which should be taken into account in formulating a National Patent Policy.

It is generally recognized that Patent Laws of under-developed countries must contain provisions adapted to meet the special needs of such countries. In particular, the role of patents in the context of modern organized research by large corporations with vast financial resources requires close study. The organized research worker is paid to do his job, which presumes the use of his inventive faculties as part of his normal duties. The patents which are taken out for such inventions are usually the property of the large corporations who employ the inventor, rather than of the inventor himself, for whose benefit the Patent System has so far been primarily supposed to exist.

Large patent holdings by foreign corporations raise peculiar problems from the point of view of the rapid industrialization of the country. There is much truth in the allegation that patents have hitherto served as an umbrella for foreign inventions. Moreover, ethical and public health considerations also arise in connection with exclusive rights in the field of medical and food inventions.

The Hon'ble Minister gave an assurance that liberal use will be made of Sec. 23 CC of the Patents Act prescribing compulsory licences in the field of patents for food and medicines. At the same time he stressed India's respect for international understandings and stated that India would not like to depart very much from international conventions in matters relating to inventions, patents and such other property. Although India is not yet a member of the International Convention for the Protection of Industrial

Property, the need for India to join the Convention has been repeatedly stressed.

Mr. E. D. O. Bernier drew attention to certain conflicting legislation and to resulting uncertainty about the Controller's power and duty to grant compulsory licences in the case of abuse or misuse of patents and also the patentee's right to grant voluntary licences. He drew particular reference to the Industries (Development and Regulation) Act of 1951 and the Foreign Exchange Regulation Act of 1947. This aspect of the question requires consideration and, if necessary, further legislative action to remove practical hindrances, if any, to the Controller's powers to grant compulsory licences.

The strong feeling in certain quarters that the Indian Patent System has failed to achieve its main purpose makes it urgent that a body of experts should carefully go into the question. It would be unfortunate if the system is condemned before a thorough factual study has been made as to the extent to which patents are being abused or exploited to earn heavy royalties at the expense of progress or are abetting artificial monopolies of a harmful nature.

#### **Future of the Patent System**

The symposia and meetings held during the celebrations have shown that considerable thought is necessary to fit the Patent System in the new pattern of society rapidly evolving in India and in keeping with the new trends in the country. Particularly important are the constructive suggestions which have been made towards building up a comprehensive machinery for ensuring the full use of patents in the best interests of the country and to make the Patent System broad-based, so that the incentive provided by it may have real meaning to every worker in the farm and factory who has an inventive bent of mind.

It has been pointed out that with the emphasis on planned economic development of the country, it becomes necessary for the State to take more effective steps than have hitherto been done to build up the Indian Patent System with a view to encourage inventiveness for the common public good.

There is force in the suggestion that the very content of the patent incentive should be re-examined. The essence of a patent at present is a 16-year exclusive privilege,

hedged in by complex restrictions and conditions which in many cases reduce the incentive value of the patent almost to a nullity. The nature of the patent incentive should be reconsidered in the context of the immediate needs of the country. In a socialistic state the grant of a patent should signify much more than a paper monopoly of doubtful value. The grant should carry with it an assurance that the State is behind the inventor and will give proper thought and consideration to the utilization of the invention in the best interests of the country and that the inventor will derive an equitable benefit for his contribution to new knowledge commensurate with the value of the invention to the public. It has been pointed out that the planned development of the Patent System has two aspects: firstly, the system must be more fully utilized by inventors and manufacturers, and secondly, the Patent Law and its administration must be improved as far as possible.

Patents should be grouped and examined in the light of the broad objectives of the national plan and a comprehensive scheme for the development of nationally useful patents should be drawn up. Such a scheme should provide for active participation by all public authorities in the task of encouraging inventiveness and special emphasis should be laid on working patents by Indian inventors.

In order to work such a scheme in practice the first essential step appears to be to expedite the bringing out of an up-to-date compilation of Classified Abridgements of Patent Specifications. This classified information would bring within the realm of practicability the selection and development of patents on a planned basis. A concrete suggestion has been made that steps should be taken to ensure that the printing and publication of Classified Abridgements of Patent Specifications is brought up to date by the end of 1960.

The Government's announcement of its intention to institute a scheme of National Awards for Inventions is also likely to give a fillip to inventive and patenting activity. The conferring of annual distinctions on persons who build up new industries on the basis of patented inventions has also been suggested.

Another interesting suggestion calls for a radical change in the interpretation of the present law which holds that the fact that a person owns a patent does not give him a positive right to work the patent. For instance, if there are prior patents by others in the same field, there may be risk of his infringing such prior patents. The suggestion is that a patent should confer on the patentee a positive right to work the patent without any risk of infringing prior patents. The suggested reform, it is claimed, would give added stimulus to the inventor to take out 'improvement' patents, which he will be entitled to work without paying tribute to an earlier or 'master' patent. It is also claimed that such a measure would encourage manufacturers to adopt new and improved processes without waiting for licences from earlier patentees. The suggestion appears to have a good deal of practical merit and should satisfy those who want to ensure that 'master' patents do not block future improvements by refusing licences to work the latter. Perhaps the same result can be more equitably attained by subjecting 'master' patents to compulsory licences in the same way as certain other categories of patents.

With increasing public interest in inventions and patents, it can be hoped that the Patent System will play a more significant role in the nation's life in the years to come than it has done in the past. More interest in patent matters can no doubt be created among scientists and technologists by giving greater publicity to the advantages which can be derived by patenting inventions.

The centenary has stimulated public interest in patent matters. It has for the first time brought about an intimate mutual contact between inventors, scientists, industrialists and patent experts. This by itself is no mean achievement and is bound to have far-reaching effects. One good result had been the general recognition of a need to organize such symposia more frequently to go thoroughly into vital issues of national importance connected with the Patent System. It is hoped that definite steps will be taken to constitute a national forum for discussing and solving India's patent problems.

# Symposium on Antibiotics

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A SYMPOSIUM on 'Antibiotics: their production, utilization and mode of action' was held at the premises of the Hindustan Antibiotics Ltd., Pimpri, during 27-30 March under the joint auspices of the Biochemical Research Committee and the Pharmaceutical and Drugs Research Committee of the Council of Scientific & Industrial Research. The proceedings were inaugurated by Shri K. C. Reddy, Union Minister for Production, under the chairmanship of Dr. Jivraj N. Mehta, Finance Minister, Bombay State. The technical sessions on the 28th and 29th were presided over by Maj.-Gen. S. S. Sokhey and by Dr. V. Subrahmanyam respectively. Out of a total of 63 papers contributed for the symposium only 30 could be read and discussed. Some 19 papers of which the authors were present at the meeting could not be taken up for discussion for lack of time.

The papers were taken up for presentation and discussion under defined heads. In the field of production and technology, 16 papers related to screening of soils and plants for new antibiotics. Most of the work, however, related to preliminary observations. A detailed report on the tuberculostatic properties of oxysporin isolated from a *Fusarium* sp. revealed that its pharmacological reactions would preclude its use in practice. Of interest was the work from the Pimpri group of workers on a powerful antifungal substance produced in submerged cultures by a *Streptomyces* and antagonistic to both filamentous and non-filamentous types of fungi but not to bacteria. The substance was apparently different from helixin and filippin. A notable improvement in the method for the selection of high-yielding *Penicillium* mutants has been effected at Pimpri. Using the test organisms *Xanthomonas malvacearum* and *X. alsycarpi-vaginalis*, which show a sensitivity to penicillin at 1,000 units and above, most of the low-yielding strains are eliminated in petri dishes before taking them to the shake flask stage.

Although most of the 16 contributions on production methods related to penicillin technology, there was a wide coverage of

problems, which included cultural and nutritional factors influencing foam control, pellet formation and other physical properties of the fermentation broth and crystallization and recrystallization procedures. There were encouraging reports that considerable economy was possible through replacement of several of the imported raw materials needed in penicillin manufacture. Thus, 2 per cent sucrose can be used in place of 4 per cent glucose in seed vessels. Peanut oil is used as anti-foam instead of lard oil and corn oil. Partial substitution of lactose with sucrose is possible even on plant scale. Use of peanut meal replacing about three-fourths of the corn steep liquor has been adopted. It is even possible, in the experience of workers at the Standard Pharmaceutical Works Ltd., Calcutta, pioneers in the field of penicillin production on a small scale, to substitute corn steep liquor completely with a combination of mustard and sesame cakes.

Among the papers dealing with the by-products of antibiotics production, one dealing with the mycelium of *Penicillium chrysogenum* evoked some interest. The full-grown mycelium at the end of the fermentation period has about 44 per cent proteins on dry basis and should merit some attention in regard to possible utilization for a variety of requirements.

There were interesting reports concerning possible biosynthetic pathways for penicillin and citrinin. A number of contributions dealt with experimental results concerning the mechanism of action of antibiotics such as penicillin, tetracyclines, citrinin and morellin. It was reported from the Bombay University laboratories that there existed a relationship between the tetracycline antibiotics on the one hand and the vitamins folic acid and B<sub>12</sub> on the other with respect to nucleotide metabolism in micro-organisms. It was also shown that induced resistance to citrinin may result in important changes in amino acid composition of bacterial cells which could result from differences in the extent of uptake of amino acids by respiring cells. There were also differences in nucleotide composition besides alterations in cell permeability properties. There was

considerable discussion on an interesting contribution from the Central Food Technological Research Institute, Mysore, which pointed to modifications in intestinal microflora arising out of the ingestion orally of asafoetida extracts in adult rats.

Papers on the clinical applications of antibiotics were fewer than was expected; extensive efforts at getting the medical profession contribute to this aspect of the subject elicited only partial response. Nevertheless, keen interest centred round the 6-7 papers read. These were largely in the nature of personal experiences with different antibiotics in the treatment of various infectious diseases and the discussion underlined the need for caution in diagnosis and for research in respect of dosage and duration of treatment.

A group of 5 papers was confined to studies on the use of antibiotics in plant and animal nutrition. The effects of antibiotics were considered from the points of view of availability to the host animal of folic acid, vitamin B<sub>12</sub> and vitamin A and of the utilization of dietary amino acids. From the Madras University Biochemistry Laboratory it was reported that the tetracycline antibiotics may inhibit ascorbic acid synthesis in sprouting legumes and that in this manner they could influence plant respiratory functions.

A feature of the symposium was the two well-attended popular lectures on 'The

antibiotic era' and on 'Antibiotics in the treatment of diseases common in India' by Dr. K. Ganapathi and Dr. K. Sanjivi respectively.

The success of the symposium was in no small measure due to the choice of its venue since, as Gen. Sokhey said, the Pimpri factory was an example of international collaboration and was besides the only one of its kind where the visitor could imbibe all the details of its working that he would care to know. It was gratifying to hear from the Union Minister Shri Reddy that in a period of two years we will be having a streptomycin plant working alongside the present penicillin plant.

The general interest evinced in the symposium made many workers express the hope that such meetings will be an annual feature. In fact, it was announced that an internationally sponsored symposium on the same subject was likely to come off in the near future. Opportunity was also taken of the occasion to pass a unanimous resolution upholding the present and needed methods of animal experimentation against which there have recently been expressed some opinions in certain quarters.

The organizers of the symposium are bringing out shortly a special publication containing the papers presented together with the discussions that took place.



# International Society of Sugarcane Technologists, New Delhi

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**T**HE International Society of Sugarcane Technologists held its ninth Congress in New Delhi during January 1956. The Congress was attended by over 250 delegates from 24 countries. Before assembling at New Delhi, the delegates visited various sugarcane breeding stations, research institutions and sugar factories in the country. The Congress was inaugurated by Shri Ajit Prasad Jain, Union Minister for Food and Agriculture, on 25 January 1956.

Shri D. R. Narang, President, Indian Sugar Technologists' Association and General Chairman of the Congress, in his presidential address referred to the progress of sugar industry, with particular reference to developments in India. He stressed the need for modernizing the Indian sugar industry and for finding ways and means of reducing the cost of plant and machinery.

The technical papers presented to the Congress were discussed under 11 sections grouped under (1) Sugar manufacture, (2) Sugar engineering, and (3) Sugarcane agriculture. In addition, there were symposia on selected topics.

## **Sugar manufacture**

The papers relating to sugar manufacture were discussed at three sessions over which Dr. H. W. Kerr (Australia), Dr. K. S. G. Doss (India) and Mr. S. N. Gundu Rao (India) presided. The session on analytical methods was presided over by Mr. J. D. Clayton and that on byproducts by Mr. J. M. Saha. Dr. Douwes Dekker (South Africa) presided over the symposium on cane juice clarification.

Different aspects of sugar manufacture were discussed in 25 papers, of which 9 dealt with juice clarification. Other topics discussed were cation-exchange resins from sucrose, refining qualities of chars, design performance of a new filter for raw sugar, heat transfer in juice heaters, evaporator cleaning and corrosion, determination of cane quality, resistance heating of masscutes, triple feed system of refining sugar,

cane diffusion, cane quality, and melasse-genesis.

In the new sulphur-carbonation process for juice clarification, described in one of the papers, a portion of the calcium carbonate in the carbonation process is replaced by calcium sulphate, thereby improving the filtering rate; this is ascribed to changes in the crystal form of precipitates.

Studies on the application of ion-exchange process to cane juice clarification have shown that juices which are amenable to treatment by carbonation, sulphitation or the Saha-Jain process can be effectively clarified by the use of ion-exchange resins.

A special type of colloidal sodium bentonite is employed in Argentina for the clarification of sulphited juices after liming. Improved sedimentation rates, removal of organic colloid non-sugars, decrease in the viscosity of molasses obtained, and increase in sugar yield are some of the advantages claimed for the clarifying agent.

Two papers dealt with the clarification of cane juice by electrolysis at  $pH$  5.2-7.2 using iron cathodes. The ferrous ions generated during the electrolysis coagulate the negatively charged colloidal particles and form salts with acidic constituents in the juice. A modification of the process consists in heating raw juice quickly to 70°-80°C. and neutralizing with lime ( $pH$  6.8) before electrolysis.

A method described for determining the quality of individual consignments of sugarcane consists in disintegrating and subsampling 100-150 lb. of cane, extracting the sub-sample in a high speed extractor, and testing the extract for sucrose and reducing sugars by the Luff-School method. This method gives reproducible results.

Versene (sodium salt of ethylene diamine-tetracetic acid) extensively employed for the removal of scales formed in evaporators is a costly chemical. A simple method for recovering Versene from spent solutions obtained after cleaning evaporators consists in raising the  $pH$  of the solution to 3

with sulphuric acid when the calcium salt of Versene is decomposed to form calcium sulphate and Versene. The precipitated calcium sulphate is removed by settling and the supernatant treated with caustic soda and re-used for the removal of evaporator scales.

The factors affecting heat transfer in juice heaters were discussed. Firstly, heat transfer through the juice film increases with the increase in juice viscosity and, secondly, an increase in juice viscosity apparently reduces the rate of scale deposition. This may be due to the time factor in the chemical reactions occurring, or to the establishment of an appropriate carrying velocity for the precipitated matter or to a combination of both.

The problem of heat transfer in cooled massecuites was discussed in one of the papers, with particular reference to heating methods which do not depend on heat transfer. Of the three possible methods available, viz. dielectric heating, induction heating and resistance heating, the last method appears to be more promising under factory conditions.

The decomposition of invert sugar in alkaline media and its effect on cane sugar manufacture, with special reference to carbonation process, were discussed in a paper. Normally about 20 per cent of invert sugar in the juice gets decomposed when the juice is heated with lime. The decomposition is influenced by the quantity of lime used and is rapid at 50°C. Lactic acid and sugar humic acid formation increases with temperature; colour formation is high above 50°C., and over-saturated carbonation juices, in particular, are highly coloured.

The design and performance of a new test filter, which could form the basis of a simple and accurate filtrability test for raw sugars, were described. The filter can be used with advantage for research purposes, as it can be worked with small quantities of sugar; the filter cake can be analysed for obtaining an idea of the impurities which impede filtration. The filter is of simple design, portable and independent of services, such as steam, compressed air and electricity. Large-scale trials have indicated that the filter test is of value in picking sugars which are likely to filter badly in the carbonation process.

*Byproducts* — In his presidential address to this section J. M. Saha (India) summarized

the work so far done in India on the utilization of the byproducts of the sugar industry. Large-scale trials have been carried out for the production of newsprint using 70 per cent bagasse and 30 per cent wood pulp, and good quality newsprint has been produced which runs well on printing machines. This, he pointed out, would be the best method of utilizing bagasse. Investigations have also been carried out on the utilization of bagasse for furfural, activated carbon, insulation and paper boards, wrapping paper, plasticizers, and lignin.

Considerable work has also been done on the utilization of molasses. Apart from its use in the production of alcohol, its use as a manure has been investigated. Attempts have been made to produce solid molasses for use in composting. Cattle feed, food yeast, edible syrup, sugars, potash salts, acetic acid, glycerine, levulinic acid, lactic acid, acetic acid, acetone and active carbons are among the products obtained from molasses. Investigations have also been carried out on the use of molasses as a road surfacing material, as a stabilized mud plaster, as a solubilizing agent for phosphorus in bone and rock phosphate, and for the production of combustible gas.

The problem of utilizing press-mud has also received attention. Only two factories in India treat the press mud for the recovery of wax, and the factor that is coming in the way of wax recovery in all factories is that the quality of the product is poor and further processing is necessary in order to market it. Other uses suggested for press mud are preparation of manure, mineral wool, sulphur dyes, active carbon, distemper, filter aids, metal polish, board chalk, etc.

The growth-promoting factors in waste molasses are lost during clarification, but the loss can be made up by the addition of yeast autolysate to clarified molasses. By the ammoniation of molasses, a product containing about 6-7 per cent of fixed nitrogen, with possibilities for use as cattle feed, has been produced. Some animals fed on ammoniated molasses were affected by intense hysteria, which has been overcome by removing the heterocyclic compounds of small molecular weight present in the product by extraction with a solvent or by acidifying the product with phosphoric acid, acetic acid or lactic acid.

*Analytical methods* — Of the eight papers presented, three dealt with methods for

assessing the boiler house efficiency. The computation of efficiency, in numerical terms, is often confusing and complicated, especially in view of the difficulty of defining the terms 'exhausted molasses' and 'recoverable sugar'. A new concept based on pol analysis and apparent purities has been suggested for judging the technical performance of cane sugar mills. The other two papers dealt with recent advances in boiling house efficiency formulae and indicators. The difficulties in assessing the quality factor of sugar were ascribed partly to ignoring the influence of quantity factor and non-sugar composition. Arguments were presented for preferring Gundu Rao's formula to Neel-Deerr formula and an international comparison figure, which takes into account the effect of non-sugar composition on the purities of final molasses, was discussed.

The extension of the potentiometric method for the estimation of chlorides to cane juices formed the subject of a paper. The method is rapid and does not involve preliminary treatment of juice for the removal of colouring matter.

The pol-ratio method for evaluating cane quality possesses many advantages over other methods. It is free from empirical factors, gives information on the fibre content of cane, and is independent of factors due to factory operation. Samples can be stored in a frozen state for analysis.

The use of a high speed disintegrator for determining the pol per cent bagasse in cane juice gives more accurate results than the normal hot digestion method. The extraction is carried out at temperatures slightly higher than the room temperature.

A paper on the analytical procedure for assessing mill tandem performance discussed the basic principles of the procedure. Evidence was presented for the presence of fibro-vascular and hygroscopic water in cane fibre. It was shown that these two factors are responsible for the low sugar concentration in the last expressed juice from dry crushing. Hygroscopic water, together with fibro-vascular water content of cane fibre, partly explain the necessity of using an empirical factor while calculating pol in cane from pol of the first expressed juice.

*Symposium on clarification* — Eleven papers were presented. The introductory paper by Dr. Honig, presented by Dr.

Douwes Dekker, discussed the problems encountered in the effective clarification of cane juice. Some of the problems requiring further investigation are: Chemistry of reactions involved in the liming process, settling characteristics of precipitates, change in pH of juices subjected to settling and fundamental studies on juice clarity.

The chemical reactions involved in the settling of limed cane juices and the effect of clarification on sucrose, reducing sugars and soluble non-sugars were discussed in two papers. A graphical method, based on pH and temperature of juice, for determining sucrose losses by inversion was described. The method is more accurate than the direct determination. The factors responsible for acidity in cane juices and measures for minimizing acid formation formed the subject of another paper. The transformation of  $\text{CaHPO}_4$  into  $\text{Ca}_3(\text{PO}_4)_2$  was considered to be an important factor in acid formation, particularly in juices limed low. Excessive liming also contributes to the acidity of juice, as it results in the formation of organic acids. Proper control of pH, control of lime addition and continuous removal of non-sugars are the remedial measures suggested for minimizing acid formation.

Polyelectrolytes offer promise as clarifying agents for juices of poor settling qualities. Two anionic types, Lystron X-886 and Separan 2610 (calcium salts of an acrylic copolymer), are being extensively used in Hawaii. The latter is effective in decreasing the volume of settling mud. Addition of 0.5 to 20 p.p.m. of the polymer to limed juice after heating enhances the settling rate by as much as 80 times and reduces the settling volume by 50 per cent. Cationic types of resins may perhaps be more effective than the anionic types.

The design principles and performance of continuous clarifiers were discussed in four papers. Continuous discharging solid bowl centrifuges are effective in removing solids of all sizes present in cane juice, but high initial and maintenance costs make their use uneconomic. When mechanically harvested cane is used, the removal of soil particles can be economically carried out with equipment of the sand-separator type. Cyclone separation is considered most effective in removing finely divided soil particles and sand, but the economics of the use of cyclone separators have yet to be worked out.

A peripheral feed clarifier, designed by Mirrless Watson Co. Ltd., Glasgow, is available in sizes of diameter 12-55 ft. The clarifier is a cylindrical tank provided with 3-7 trays, in which the scum and mud are separated from the juice by gravity; the clear juice is drawn off continuously and the mud concentrated and metered out. The time taken for the juice to pass through the tank is about  $2\frac{1}{2}$  hr. A clarifier designed by Dorr-Oliver Incorporated, U.K., has high efficiency and enables a substantial saving in capital investment and reduces clarification losses. The design principles and performance of a new clarifier — the Ibanez clarifier — were discussed in a paper. In this clarifier, mud removal is effected at a number of points at the periphery of the thickening compartment, thereby effectively avoiding mud pockets inside the thickening chamber. Another special feature of the clarifier is that juice removal is also peripheral.

The factors affecting the design and operation of juice heaters and their cleaning formed the subject of a paper. The chemical and mechanical resistance of the metal is of greater importance than its thermal conductivity, since tubes made of all metals scale and the total resistance to heat flow by metal is small in comparison with the resistance offered by scales. Copper tubes as cupronickel are more resistant to fatigue cracking and to the action of acids than brass tubes. From the point of resistance against mechanical cleaning, two copper alloys, i.e. 70/30 and 60/40 brass, have been found to be suitable. Tubes tinned outside provide a smooth surface.

### Sugar engineering

This section was presided over by Mr. K. S. Arnold (U.K.), and fifteen papers were discussed. Some of the subjects covered were: Power requirements in cane milling, causes of evaporator tube failure, vacuum pan design in relation to performance, cane carriers, efficient burning of bagasse, boiler plant in sugar mills, sugar factory lubrication, self-feeding characteristics of experimental sugar mills, and condensing plant cane sugar factories.

In his opening address, Mr. Arnold briefly referred to the recent developments in sugar engineering with special reference to machinery. Cane crushing mills with faster crushing rates, i.e. from 30 ft./min. to 75 ft./min.,

are now being used. In order to assist the feeding of fast running mills, various devices have come into use and the fitting of feeder rollers is becoming a standard practice. Automatic operation cane carriers, steam turbine drives, hydraulic pressure systems and roller bearings on mill rollers are among the new innovations in sugarcane factories. There have also been advances in respect of steam plant. The tendency is to employ high pressure steam plants in conjunction with steam turbines for driving mills. New types of bagasse furnaces with high combustion efficiency and new methods of feeding bagasse into the furnace have also been developed.

Developments in vacuum pans relate to devices for promoting faster boiling by rapid circulation of massecuite and for ensuring low head of massecuite. Ribbon type heating elements are becoming increasingly popular in sugar refineries. Advances in sugar centrifugals have been mainly in the direction of high speed automatic operation.

Studies on power requirements for sugarcane milling have shown that for a given degree of compression the power required is much greater with rapid than with slow compression. Data collected from a number of factories in India show that the average power requirement for milling varies between 7 and 8 h.p. per ton of fibre/hr. per compression.

The application of Ward-Leonard drive for cane carriers has overcome the difficulties encountered in changing over from the steam engine drive to electric motor drive, particularly with reference to the control of carrier speed. In addition to the improvement in the steadiness of operations associated with cane preparation, the pol per cent bagasse of the last mill is more uniform.

The nature of information which a prospective purchaser of a vacuum pan should provide the designer was discussed in a paper. The information should be related to condition under which the pan will operate, both in the initial stages and after expansion, and include data on type of sugar to be produced, purity and Brix of massecuite, purity Brix and temperature of material to be boiled, method of forming grain, quantity of massecuite to be produced per unit time, and the type of condenser and vacuum control available. In comparing pans of various designs, efficiency of save-all, volume and free dis-

charging of pan bottoms and design of discharge gate are also important considerations.

The self-feeding characteristics of an experimental sugar mill developed at the University of Queensland were described in a paper. Experiments on the influence of such variables as cane preparation, speed of mill and precompression pressure on mill performance indicate that the type of grooving has little effect on the feeding rate of mills, but the performance depends on the stage of prepared cane and the roller speed. Precompression aids mill feeding and the magnitude of pressure is immaterial in the range of 2.5-7.5 lb./sq. in. Improved productivity and good juice extraction are obtained by improving the compression ratio, provision of juice grooves and higher milling capacity by the use of larger rolls.

In the paper entitled "A recent development in the efficient burning of bagasse", it has been shown how the evaporative rate of boilers could be improved by introducing simple modifications in existing types of bagasse furnaces. In the new Thompson-Eisner furnace, which is similar to stepped grate furnaces, the fire bars are replaced by a bed of bagasse and the full width of the boiler is utilized. Arrangements for forced draught as well as for secondary and tertiary air are also provided. The output of the boiler is regulated by the regulation of forced draught, the furnace being kept full loaded at all times. Provision for air heaters is also made. The advantages of the furnace are: only the air fed to the furnace is controlled whereas in other furnaces both air and bagasse feeding have to be controlled; since the feeding of bagasse is automatic, the use of rotating feeders is unnecessary. Other advantages of the furnace are: greater burning area; operation from one week-end to another without the necessity for stoppage for cleaning in between; a reserve fuel up to 20 min. feed is available which is appreciably greater than that of other furnaces; maintenance is negligible.

An interesting symposium on recent developments in sugarcane mills was also held under this section. The topics covered cane shredders, mill feeding devices, intermediate carriers, mill roller bearings, hydraulic pressure systems and mill drives.

### Sugarcane agriculture

This section was divided into five subsections: (1) Agronomy, (2) Cane breeding, (3) Plant pathology, (4) Entomology, and (5) Soil science. A symposium on cane price was also held.

*Agronomy* — Thirty papers were presented to this section.

In the opening address, Dr. Khanna (India) revealed that there was a definite indication that micro-nutrients produce a positive response when ammonium sulphate was the only fertilizer used. This response was not observed in the presence of lime or phosphate fertilizers.

Increasing the amount of nitrogen, in general, increases the yield of cane and its sucrose content, but no significant difference in the sucrose content has been observed by using different types of nitrogenous fertilizers. Potash also increases significantly both cane yield and sucrose content of cane. Phosphorus has no significant effect on the sucrose content of cane. Anhydrous ammonia applied to the soil undergoes nitrification more completely than ammonium sulphate.

The nitrogen content of the third, fourth, fifth and sixth leaves of cane, from the top, provides a reliable index for predicting the yield of cane. Foliar diagnostic analysis is reliable for assessing the manurial status of a soil.

Satisfactory control of nut grass has been achieved by repeated application of the amine and the ester of 2, 4-dichlorophenoxyacetic acid. Spraying the foliage with the same compound raises the sugar content of cane.

*Cane breeding* — In his presidential address to this section Dr. T. S. Venkataraman (India) observed that the time has come not only to work for larger recoveries of sugar from cane, but also to produce cheaper sugar. He stressed the necessity of achieving greater certainty into cane breeding operations by a thorough investigation into the fundamental problems. Twenty papers were presented. The subjects covered fundamental aspects of cane breeding and progress in breeding programmes in various countries. Advances in breeding techniques were also discussed.

The problems of breeding cane hybrids of high sucrose content were discussed in two papers. Trials carried out in Queensland (Australia) have revealed that in evolving commercial varieties of cane containing high

sugar content, each country should work out its own combination of parents. There is no substitute for progeny testing for selecting the parent. In breeding for increased cane yield, in the absence of recognized diseases, the factors which have to be borne in mind are: occurrence of unrecognized pathogens which may become major pests, exploration for new germ-plasm sources and development of new potential parental material, ample genetic diversity in seedling populations, testing of seedlings over a range of environmental conditions in commercial sugarcane growing areas, etc. That temperature during the flowering season has a distinct bearing on the fertility of sugarcane flowers in subtropical countries has been demonstrated. Investigations carried out in Australia have also shown the limiting influence of low temperatures on fertility.

The leaf squash technique for the study of somatic chromosomes may be found useful in the study of sugarcane cytology. The 'squashes' are well-suited for the preparation of permanent slides.

Some of the recent improvements in cane breeding techniques at the Sugarcane Breeding Institute, Coimbatore (India), formed the subject of a paper. Alkathene bags are now used in place of tile pots for artificial rooting on standing canes. The advantages are that the moisture in the rooting medium is preserved effectively and the formation of roots can be watched. Alkathene has also been used for despatching canes over long distances. Special Trayon paper bags fitted over thin bamboo strip cages have been used with success for controlled crossing and for safeguarding the crossed arrow from foreign pollen. The bags are strong and do not tear as easily as muslin or paper bags. High humidity and fungal growth, and consequent poor seed setting associated with paper or muslin bags, are obviated.

*Plant pathology* — Dr. B. L. Chona (India) presided over this section in which 17 papers were read and discussed. The subjects covered were ratoon stunting disease, red rot, Fiji disease, downy mildew and smut, and methods for controlling them.

In the paper on procedures for testing sugarcane varieties against Fiji disease and downy mildew, techniques for efficient transmission of the diseases were described by which it is possible to separate susceptible and resistant varieties after a single trial.

A new species of *Helminthosporium* causing disease in sugarcane and grasses in Florida was reported. The parasite is commonly associated with Para grass leaf spots. A new disease of cane, known as the 'sugary disease', has been reported from India. The disease destroys ovaries in infected arrows.

Studies on *Sclerophthora* disease of sugarcane in Louisiana have revealed that the fungus responsible is *Sclerophthora macrospora* (Sacc.), which is transmitted in the seed piece. Infection is also obtained by placing the germinating sporangia in the spindle of healthy cane.

Investigations into, and the practical control of, ratoon stunting disease at the Bureau of Sugarcane Experiment Station, Brisbane, have shown that plantations made with diseased settes treated in water at 54°C. for 1 hr., at 52°C. for 1½ hr., or at 50°C. for 2 hr. were free from the disease; the last treatment was found to be least detrimental to germination. Another important factor in the elimination of the disease is the effective sterilization of cutting knives and instruments. Antiseptics such as Dettol, Lysol, phenol and potassium permanganate have shown promise as effective sterilizing agents.

*Entomology* — Twelve papers were presented to this section over which Dr. K. B. Lal (India) presided. The papers discussed the following insect pests: Thrips (*Fulmekiola serrata*), *Chilotrea infuscatellus*, *Aeneolamia portica*, *Coleomegilla maculata*, *Pyrilla* and stem borer. Methods of pest control in sugarcane cultivation, particularly of borers of different kinds, were discussed in many papers.

In his presidential address Dr. Lal observed that termites are a serious pest, largely in tropical countries, including India. The older methods of pest control, based on mechanical and cultural operations, have been replaced by newer methods based on the use of chemical insecticides, particularly organic insecticides of the chlorinated hydrocarbon group. These insecticides are effective against surface feeding pests, such as *Pyrilla* and thrips, but not against borers. He emphasized the need for research into methods of biological control and their utilization in dealing with sugarcane pests. He also referred to the work carried out in India on the possibility of employing *Trichogramma* against some borers. The need for assessing damage in terms of yield or cash value or

both caused to cane by various pests was stressed.

Work on sugarcane borer control in Louisiana has revealed that the pest can be controlled by dusting the crop with undiluted cryolite or Ryania. Trials have shown that these insecticides are useful in controlling borer in tropical cane-producing countries. Many soil arthropods which attack sugarcane roots can be controlled by the application of Chlorodane (5 lb./acre) or Endrin (1 lb./acre). Treatments of soils with these insecticides effect a substantial increase in the yield of crop during the second year of cultivation. The insecticides give a better performance on heavy soils than on light or sandy soils.

*Soil science* — Dr. B. K. Mukherji (India), presiding over this section, stressed the need for the setting up of an international committee of sugarcane soil workers for co-ordinating the available data and for the standardization of cane soil survey and analysis. He reviewed the recent advances in soil survey and explained the application of tracer elements to assess mineral transformations in soils and the influence of subsoil cultivation and manuring on cane production. Eleven papers were presented which dealt with the nature of soils from Mexico, Louisiana and India, soil changes under different cultural practices, relation between nature of soil and chemical composition of cane, application of phosphatic fertilizers and ammonia to soils, and classification of sugarcane-growing soils.

In acid soils, the application of phosphatic fertilizers is more effective than either di or tricalcium phosphate under both limed and unlimed conditions. In Deccan (India) soils, which are highly calcareous, the application of superphosphate helps the availability of phosphate at a steady rate and for longer periods; phosphate fixation is also avoided.

A system of classification of sugarcane-growing soils with particular reference to Bihar soils reported is based on accessible soil

characters, such as mineralogical composition of clay fraction, variations in climate, nature and age of parent alluvium, characters of subsoil material, texture of surface layer, etc.

In a paper discussing the nature of soil and the chemical composition of sugarcane juice, it was pointed out that adequate attention is not paid to the amount of minerals present in soils for which a given variety of cane is recommended and the extent of removal of major mineral nutrients from the soils by cane.

In the distribution of varieties for a tract, due consideration should be given to the removal of major nutrients by the cane variety in relation to soil potentialities. The release of varieties suited to the mineral nutrients set up in the soil is considered to be a better way of ensuring optimum yields for longer periods than supplementing the nutrients removed.

The Hawaiian sugar industry has made a rapid change-over to the use of aqueous ammonia for supplying the nitrogen requirements of cane. Substantial savings in cost of material and cost of handling and application have been responsible for this change-over. The bulk of ammonia is used on irrigated lands and it is applied both through irrigation water and by injection equipment.

*Symposium on cane price* — Seven papers were presented at this symposium, presided over by Sardar Lal Singh (India), Vice-President, Indian Central Sugarcane Committee. A system based on the quality, nature of planting and period of supply was suggested. Another procedure was to base price fixation on juice quality of cane in a given area. A third method suggested was price fixation on the basis of crusher's juice in the factory; a sliding scale of payment, fixed on recovery basis, was also suggested. Of the several methods for assessing the quality of cane, the method based on analyses of primary juice was considered to be the ideal method.

# Radioactive Isotopes for Study of Tropical Meteorology & Oceanography

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**R**ADIOACTIVE isotopes, by virtue of the fact that they can be detected even in minute quantities and in very small concentrations, offer a very promising tool for investigating certain problems of tropical meteorology and oceanography. The purpose of this note is to detail some of the outstanding problems for whose solution such radioactive isotopes could be pressed into service effectively.

A knowledge of the ultimate origin of air streams or ocean currents in the tropical regions is of considerable theoretical and practical interest. Medium range forecasting of weather in the tropical and sub-tropical regions would be assisted by such knowledge. Ordinarily, the equator acts as a sort of barrier against the transport of air or sea water across it. But under certain conditions there is a definite transport of air or sea water across the equator; e.g. during the S.W. monsoon in India, air crosses the equator at intervals from the south Indian Ocean<sup>1-3</sup>, and in the northern winter, there is a reverse crossing from the north to the south in the Indian Ocean. There is also an equatorial crossing of air before the formation of westward moving tropical cyclonic storms and, often, during their progress westwards<sup>1-3</sup>. In the temperate latitudes, the air streams that are responsible for any weather phenomenon belong to a single hemisphere, either north or south as the case may be, and the origin of air streams or of air masses is uniquely determined. In tropical meteorology, however, divergent views have been expressed from time to time on the role of air streams from the same or from the other hemisphere in the causation of weather phenomena like the monsoon or a tropical cyclonic storm. Owing to large stretches of sea areas, meteorological observations from fixed spots are not easily available. In such circumstances, a

well-accepted criterion to identify the air streams would be of great importance and utility.

The climatic features of the three equatorial oceanic areas, namely Indian, Pacific and Atlantic, are not identical. In the Atlantic and in the S.E. Pacific Ocean near S. America, the seasonal high pressure area extends from the southern hemisphere almost up to the equator and no tropical storms form there. Over the rest of the Pacific Ocean, there is a belt of minimum pressure near the equator and the pressure rises relatively rapidly on either side of it. In the Indian Ocean, however, during the S.W. monsoon in India, the seasonal low pressure area occurs over N.W. India and W. Pakistan. At the same time, the pressure gradient across the equator becomes negligible. During the northern winter, the seasonal low in the Indian Ocean region is shifted to near-about Australia, with the same small pressure gradient near the equator, as in the summer of the north. Due to this marked difference of conditions in the oceanic areas, while the basic theories of any meteorological event would be the same, the details and, therefore, the intensity of the phenomena would often differ.

In the formative stages of tropical cyclonic storms and the onset or breaks during the S.W. monsoon, the air streams have to be traced individually for each region. It would, for example, be worth knowing whether the air that has crossed the equator is transported to the head of the Bay of Bengal or to the North Arabian Sea to form monsoon depressions there or whether the northward latitudinal displacement is limited. It is equally necessary to know whether the S.W. monsoon stream in India has its origin essentially in the S.E. Trades or whether a part or the whole of it is traceable to the stream in the *roaring forties*; i.e. just south



of the sub-tropical high pressure belt of the south hemisphere or to streams across equatorial Africa.

In the winter months in India, the questions that pose themselves are: (1) the N.E. monsoon and (2) winter depressions in N. India with their secondaries, usually denoted as western disturbances.

The exact mechanism of the N.E. monsoon has not yet been fully clarified. A picturing of the phenomenon as due to low pressure areas or 'pulses' in the field of N.E. Trades which feed into the monsoon in the south Indian Ocean or to tropical cyclonic storms<sup>1-6</sup> would lead to specific points of investigation.

Though it was usual to assume that the field of activity of western disturbances in Indian area had little to do with equatorial circulation, the author<sup>7</sup> put forward the idea that the precipitation due to a western disturbance and its several secondaries appreciably increased when "a low pressure wave had previously entered the south of the peninsula from the east". This idea of the N.E. Trades feeding into a western disturbance or its secondary was expressed more explicitly later by Malurkar<sup>1,3,8</sup> and others and the utility of observations from the southern hemisphere was emphasized. When there was a westward moving tropical cyclone in the south Indian Ocean or the monsoon was more than usually active in the southern hemisphere, a western disturbance over India in about the same longitudinal sector would be drier than without such activity in the monsoon of the southern hemisphere. The extra precipitation of the western disturbance or its drying up was attributed respectively to the infeed of the N.E. Trades into the disturbance or their diversion away from it. The latter happened concomitantly with monsoonal activity in the southern hemisphere or with the westward movement of a tropical cyclonic storm in the south Indian Ocean<sup>1,3,8</sup>. Due to paucity of observational data, differences of view on this question are possible. In investigations of such problems as have been mentioned above, the new tools available in the shape of radioactive isotopes would be most useful. By distributing the isotopic material at predetermined places and by looking for the material over a sufficiently wide area, including the expected regions, after a given time interval, i.e. mapping the dispersion,

one could hope to obtain answers to such problems.

In tropical oceanography also, a solution of the problems of the origin of the streams at various levels of the sea would be equally valuable. It would be interesting to determine, for example, whether with every passage of monsoon air across the equator there is a similar passage of sea water, with perhaps a definite time lag, and whether the equatorial water would penetrate far away from the equator.

By dispersing the isotopic material at various levels in the atmosphere and in the sea water, one would be able to study the streams in the horizontal (advective motion), eliminating the effect of transport of the material due to large meridional cells. The mapping will have to be three dimensional.

*Regions of initial dispersal* — For a study of the origin of the monsoon streams or the equatorial maritime air in the Indian S.W. monsoon period, the regions of initial dispersal would have to be in a locality in the following limits: (1) long. 100°E. to 120°E. and lat. 5°S. to 15°S.; (2) long. 90°E. to 100°E. and lat. 30°S. to 40°S.; and (3) the equatorial region. The detection would have to be between 7 and 20 days after dispersal. For facility in mapping, the three distinct regions may be taken up in successive years unless different isotopes are used. To locate the *Far Eastern transitional air* or the N.E. Trades belt, the initial dispersal would have to be in the China Sea, Gulf of Siam and later in the south Bay of Bengal for the S.W. monsoon, post-monsoon and winter periods respectively. The mapping in the Indian area will have to be done 3-7 days after dispersal. The same dispersal in the Gulf of Siam and the south Bay of Bengal could be mapped 7-10 days later in the south Indian Ocean for study of the *southern monsoon* there in the post-monsoon and winter periods of India. In Indian winter, if the dispersal is over east and south Bay of Bengal, the mapping over the Indian area, particularly above 15° latitude, would provide an answer to the question of infeed of the N.E. Trades to western disturbances and their secondaries.

If during the period of monsoon depressions and cyclonic storms in India, similar dispersals are made with a certain degree of anticipation, it would be possible to study

the role of various air streams that go to form these disturbances. If the dispersal is made over a much smaller region in the low latitudes about the time of the northward passage of the air across the equator and mapping undertaken after 3 or 4 days over the Indian area, the progress of equatorial maritime air could be determined with a greater degree of certainty.

In the case of oceanography, the mapping will have to be done in similar places; i.e., the belt of the S.E. Trades, etc., but the time lapse before mapping would have to be two to three times greater.

The isotopic material to be used should have at least a 'half life' greater than the order of periods indicated above. The mapping would have to cover a reasonably wide area to verify theories and stimulate new ideas. The published lists give a very large choice of the isotopes but the cost and availability of equipment and experienced personnel would narrow down the number

and type of isotopes for each investigation.

The above is a statement of a few problems in the tropics, particularly for the Indian region. Prof. B. Peters remarked at Gulmarg in May 1955 that the use of isotopic material  $Be_7$  for dating had commenced in India. One should hope that valuable data would be available by suitable collaboration of isotopic experts, meteorologists and oceanographers.

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## Bonding Characteristics of K(1) Bentonite

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THIS investigation was undertaken at the instance of the Tata Engineering & Locomotive Co. Ltd., Tatanagar, to determine the bonding characteristics of K(1) bentonite used by them. The optimum amount of bentonite required for bonding washed Rajmahal sand to obtain a composition possessing requisite physical properties for use in moulds and the optimum working moisture content in such mixtures for green sand moulding in steel foundries have been determined and the results are reported in this communication.

#### Materials and methods

*K(1) bentonite* — As received, the sample consisted of pea-size lumps, pale bluish green in colour, and with a moisture content of 10-15 per cent. It was dried and pul-

verized in a pot mill to yield a product, the bulk of which passed through 200 mesh sieve. The product was dried at 110°C. and analysed:  $SiO_2$ , 52.44;  $Al_2O_3$ , 17.72;  $Fe_2O_3$ , 1.14;  $TiO_2$ , 0.14; CaO, 2.11; MgO, 4.60;  $Na_2O + K_2O$ , 0.86; and loss on ignition, 20.90 per cent.

The bentonite showed poor swelling properties, its swelling index being 2.63. The Fullers' Earth Union method<sup>1</sup> was used in these determinations.

Suspension of bentonite (1.5 g.) in distilled water (100 cc.) showed marked alkalinity. The pH values of the suspension, immediately after preparation and after standing for 24 hr., were 8.35 and 7.70 respectively.

The fusion point of the sample, determined according to the standard P.C.E. test<sup>2</sup>, was

1,290°C. Considerable expansion was observed in the pyrometric cone sample during testing.

**Rajmahal sand** — The sand was washed according to the A.F.A. method. Sieve analyses and cumulative grading of the sample are recorded in Table 1 and Fig. 1 respectively. The grain shape of the sand was mostly sub-angular to round.

**Bentonite-sand mixtures** — The bonding characteristics of bentonite were investigated by preparing sand-bentonite mixtures containing washed Rajmahal sand as base and 3 and 5 per cent of bentonite.

The sand-bentonite mixtures were compounded in an 18 in. Simpson laboratory sand mixer. The base sand was milled dry with bentonite for 2 min., the mixture being scraped at the end of the first minute. Requisite quantity of water was then added and milling continued for another 5 min.,

the mixture being scraped at the end of the second and fourth minutes. The mixture was aerated and left in airtight jars for 3 hr. before testing.

The sand-bentonite mixtures were tested according to the methods specified by the American Foundrymen's Association<sup>3</sup>.

**Results and discussion**

The bonding characteristics of sand-bentonite mixtures containing 3 and 5 per cent bentonite are recorded in Table 2.

Table 2 shows that mixtures containing 5 per cent bentonite possess better strength, permeability and shatter index, and are satisfactory. When knocked out sand forms a major part of the mixture, addition of 3 per cent bentonite may be sufficient.

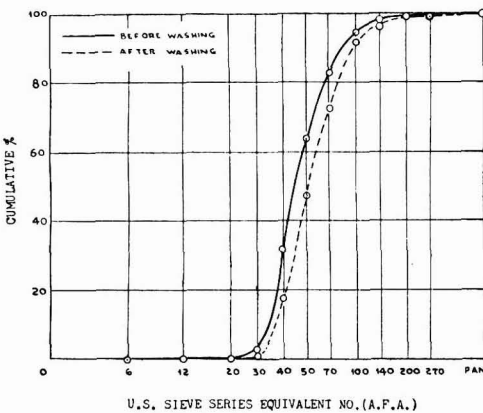
Experiments were also carried out with mixtures containing 5 per cent bentonite but with different moisture content (2.5-6.0 per cent). The results given in Fig. 2 show that the green compressive strength of mixtures decreases as the moisture content in the samples increases. Maximum green

**TABLE 1 — MECHANICAL GRADING OF WASHED RAJMAHAL SAND**

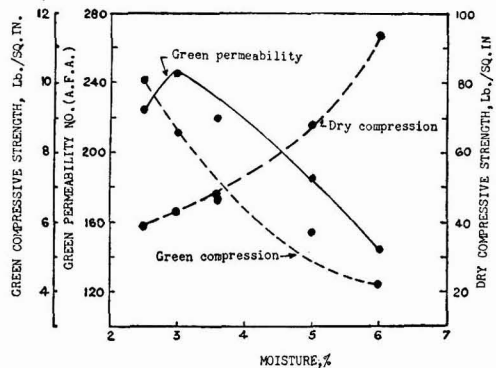
U.S. SIEVE SERIES No.	% RETENTION
6	nil
12	nil
20	0.04
30	1.54
40	16.18
50	29.64
70	25.58
100	18.64
140	5.80
200	1.20
270	0.20
Pan	0.28
Max. retention on 3 consecutive sieves	73.86
A.F.A. grain fineness No.	52
A.F.A. clay grade, %	1.02

**TABLE 2 — PHYSICAL CHARACTERISTICS OF MIXTURES CONTAINING 3 AND 5% BENTONITE**

	BENTONITE IN MIXTURE	
	3%	5%
Green permeability	215	225
Green compressive strength, lb./sq. in.	3.8	10.1
Green shear, lb./sq. in.	0.8	2.2
Mould hardness	75	84
Flowability	83	77
Shatter index	27.6	49.1
Dry compressive strength, lb./sq. in.	32	39
Sp. gr.	1.524	1.505



**FIG. 1 — CUMULATIVE GRADING OF RAJMAHAL SAND**



**FIG. 2 — BONDING CHARACTERISTICS OF K(1) BENTONITE**

compressive strength (10.1 lb./sq. in.) is observed in the sample containing 2.5 per cent moisture. Permeability decreases with increase in moisture content, and flowability is not affected by variation in moisture content. The shatter index values (53-58) do not show much variation in mixtures containing between 3 and 5 per cent moisture. The dry strength of the mixtures is between 39 and 47 up to a moisture content of 3.6 per cent and beyond it, it steadily rises and reaches the maximum value of 93.5 lb./sq. in. at 6 per cent moisture content. These results show that the optimum moisture range for working such sand mixtures is between 3 and 3.6 per cent.

### Summary

Synthetic sand-bentonite mixtures made with washed Rajmahal sand as base and 5 per cent K(1) bentonite possess optimum

bonding characteristics in respect of strength, permeability and shatter index.

The optimum moisture content for working such mixtures has been found to be between 3 and 3.6 per cent.

### Acknowledgement

The authors wish to thank the Tata Engineering & Locomotive Co. Ltd. for financing this investigation and for the supply of raw materials. Thanks are also due to Mr. B. V. Somayajulu for technical assistance and to Mr. S. R. Srinivasan for the chemical analyses.

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## Mechanism of Olfaction

**A**TTEMPTS to formulate a precise theory of the mechanism of olfaction have so far been unsuccessful due to certain broad gaps in our knowledge of nervous excitation at the physico-chemical and physiological levels. A consideration of the nature of the difficulties inherent in such studies on olfaction and a critical examination of those branches of physics and physiology to which we must look for explanations, form the contents of a 28-page monograph entitled "Olfaction" by L. J. Mullins, published by the New York Academy of Sciences [*Annals of the New York Academy of Sciences*, **62** (1955), 247-76].

According to current knowledge of histology, the olfactory cell in man is a primary neuron. Some 10-20 million of such receptors are distributed over 25 sq. cm. surface in the epithelium which also contains, along with the rest of the nasal surface, bare nerve fibre receptors signalling, by pain, the presence of many types of chemical compounds. Despite interpretation difficulties discourag-

ing the use of the electro-physiological methods, studies of olfactory processes may further our understanding of membrane structure and mechanisms of drug action by throwing more light on the obscure nature of the processes whereby chemically inert substances produce nervous excitation. In general, very small and very large molecules do not have odours, but correlation between odour and other physical and chemical properties like vapour pressure and surface activity are misleading.

### Concept of olfactory threshold

Based on a parallelism observed between narcosis and lipoid solubility, it had been possible to predict accurately a parameter designated by  $A_{Nar}$ , called the threshold thermodynamic activity of a substance required for narcosis, and to account for the shape of the  $A_{Nar}$ -chain length curve in a homologous series, using an expression that relates the cohesive energy density (hereafter denoted by  $\delta$ ) of a liquid to the loga-

rithm of the activity coefficient that a given substance will show in membranes of various  $\delta$ . Similar treatment of the Allison and Katz data for olfactory thresholds, expressed as thermodynamic activity  $A_{olf}$ , yielded much more constant values than those expressed as weight per unit volume. But this apparent constancy diminishes in a homologous series which is more suitable for purposes of analysis. This may be due partly to the fact that while the basic assumption for the above treatment, namely that the process is an equilibrium phenomenon, is fulfilled in the case of narcosis, there is no theoretical hint or experimental evidence to suggest that olfaction is a similar process. It may be a steady-state phenomenon, but even that over only short periods of time. However, 'adaptation', i.e. cessation of odour sensation after some seconds (even at the threshold), which follows olfactory stimulation, may be considered to be an equilibrium effect.

#### Olfactory threshold studies

Measurement of olfactory threshold (o.t.) presents a considerable technical problem, as the term is to be given a precise definition to represent a measure of the effectiveness of a substance in causing olfaction. There is difference of opinion regarding whether the threshold is reached when a subject can tell that there is 'something there' or when he can identify the test substance. The results of preliminary experiments on this point by ventilating the oral cavity with various substances, while holding the nose closed, seemed to indicate the necessity of defining the o.t. in terms of the lowest concentration of a substance that still permits of its recognition and differentiation from other odorous substances.

A critical study of data on o.t. values in the case of a variety of homologous series of liquids of different  $\delta$ s is a profitable method of attack upon the problem of the mechanism of olfaction in that they permit some inference as to the nature of internal attractive forces between the molecules of the receptor membranes.  $A_{olf}$  values in men taking highly pure samples (in olfactory studies reagent purity is very important especially with inherently weak olfactants) of the *n*-paraffins ( $\delta = 7$ ), *n*-alcohols ( $\delta = 14.5$ ) and the *l*-chloroparaffins ( $\delta = 8.5$ ) have been determined.

From the values obtained it was clear that, while small and large molecules may have similar thresholds for narcosis and olfactory stimulation, molecules of a size represented by 4-5 aliphatic carbon atoms have optimal characteristics for olfactory stimulation. Cross-adaptation experiments, i.e. where a subject was adapted to a paraffin at 10 times the threshold concentration and when he reported the disappearance of the odour he was tested for threshold with alcohol, revealed that adaptation to paraffins does not influence the thresholds for alcohol and vice versa. From these results it was concluded that there should be present in the olfactory epithelium at least two types of membranes and most probably more, with different values. These different types of receptors are thought to be selectively excited by molecules of the olfactory substances having the greatest similarity in value. It was found that  $\delta = 12$  is a common value for peripheral and  $\delta = 10$  for synaptic membranes; values of  $\delta = 8$  have not been noted. Detailed analysis of the results of threshold studies suggested that (1) adaptation to odour is equivalent to the narcosis of some of the  $\delta = 8$  receptors and (2) olfactory stimulation requires the activity of the  $\delta = 8$  and  $\delta = 12$  receptors in concert. It is possible to dissociate olfaction from narcosis in the case of very small molecules and a threshold value of molal volume ( $V_m$ ) of about 100 cc. per mole appears to exist for optimal olfactory effect.

#### Molecular shape and size and odour

Molecular shape affects the qualitative nature of odours. But little is known about the effect of shape factors on the olfactory threshold. Geometrical factors are very important in an oriented liquid such as the receptor membrane appears to be. To test the effects of molecular shape on o.t., all the substances should have the same  $\delta$  and  $V_m$  value while presenting a wide variety of invariant shapes. These conditions are approximately obtainable in the *n*-butane and its unsaturated derivatives. Lacking any quantitative mathematical method of representing molecular shapes and a physical characterization of the cell membrane, it is only possible to look at types of shapes of molecular models that seem to favour olfactory stimulation. In the above experiments there were observed, in general, 3 groups of

molecules of weak, intermediate and high stimulating power. It appears that for optimal membrane excitation "it may not be so much hindered penetration as improper shape that is involved", as exemplified by the results for butane and transbutene-2. Predictions of thresholds and odour similarity on the basis of shape were experimentally verified in the case of transbutene-2, and butyne-2 and the planar molecule ethylene.

In most homologous series of flexible molecules, the odour becomes more and more indefinite and difficult to observe from  $C_{12}$  on and ceases at  $C_{14}$ . But a variety of odours are observed in the series of ring ketones, terminating with  $C_{16}$  (musk) and  $C_{17}$  (civet), both with a similar but distinct odour. With the addition of more and more carbon atoms, the  $\delta$  value for organic compounds settles to a constant value of 8.5 so that beyond  $C_{10}$  molecular size and shape are the determining factors for the distribution of molecules to different receptors. Thus in these ring compounds the odour is determined by the number and not by the type of atoms making up the ring. Unlike aliphatic compounds, where the possible number of configurations in which the molecule can exist increases with increasing number of carbon atoms, the unique and rigid configuration of the ring compounds helps in making all the molecules available for penetration into receptor membranes and thus gives a musk odour even in compounds containing 15 carbon atoms.

#### Mechanism of olfaction

A chemical agent lowering the threshold to the point of self-excitation before finally causing narcosis is an acceptable model for explaining certain aspects of olfaction. In view of the limited scope of the adaptation experiments, a precise plot of the number of receptors vs.  $\delta$ -values is not possible. But based on the deductions from results on butane, butanol and butyl chloride, many olfactory phenomena can be satisfactorily dealt with by the simplified model, that distribution of 8 and 12 receptors is equal, and that 10 receptors are fewer than the other two.

In olfactory processes, if a mere sorting out by the olfactory epithelium of the molecules occurs, such that the latter are distributed to the membranes of those receptor cells with the greatest similarity in  $\delta$ , it is difficult to understand how a large variety

of odours could be recognized and how a chemical substance is recognized as a specific odour at widely different concentrations. This difficulty may be overcome by assuming that simultaneous stimulation of all three types of receptor cells is required for a substance to produce any odour. Then, specific odours are detected by the central nervous system by analysing the differences in time between the start of excitation in the various types of receptors. Thus, the problem, instead of being one of equilibrium considerations, becomes one of prediction of the kinetics of uptake of molecules by receptors of varying  $\delta$ . From experimental recordings from the olfactory bulb, there is evidence that electrical activity exists in the presence of sub-threshold odour concentrations. The threshold for the stimulation of a single type of receptor could not be specified. But olfaction always requires about 10-100 times the activity required for the stimulation of single receptor types. When an analysis of the sequence of stimulation pattern to be expected for each alcohol, as judged by the similarity of alcohol  $\delta$  to receptor  $\delta$  was made and was related to their respective odours in the case of *n*-alcohols and *n*-paraffins, the findings tallied with this interpretation for the mechanism of olfaction.

#### Electrophysiological evidence

Indirect evidence for understanding the mechanism of olfaction can be obtained by recording the electrical activity of the olfactory bulb with each inspiration of the odorous substance. The records obtained in the case of acetone, amyl acetate and pentane, each with a different  $\delta$  value, show considerable degree of specificity and consisted of small and large spikes, or a combination of both, with varying durations of the burst from 0.1 to 0.3 sec., interpretable on the basis of part synchronous and part asynchronous stimulation by the 8, 10, 12 receptors, depending on their  $\delta$ -value. Experience indicates that these recording methods, while capable of resolving the main receptor responses with respect to cohesive energy, will miss the finer discriminations that give odours their individuality.

#### Nature of nervous excitation

Another point on which present understanding is obscure is how exactly an excitable structure is altered to permit the

propagation of an action potential. It may be presumed that there occurs first a process of driving cations into the membrane where they bring about a local randomization of its structure. While nervous excitation may be brought about by a variety of mechanisms — thermal, mechanical and optical — it seems most probable that this local randomization, propagating in advance to the electrical disturbance, is common to all. A surface layer of cylindrical macromolecules of diam. 40A and length 100A, arranged in regular hexagonal packing with a series of interspaces of varying size, is a most satisfactory model of the cell membrane. Taking the molecules to be spherical, the odourlessness of very small and very large

molecules and the shape of the curve for threshold olfaction over the entire range can be adequately accounted for with the following reasonable assumptions. They are (1) a given molecule can cause narcosis if it occupies sufficient number of sites and (2) it can excite the membrane, provided its size corresponds closely to that of the site it occupies. With the present state of knowledge of the liquid state, it is most likely that the ability of a molecule to create membrane disorganization determines the sensitivity of a membrane to excitation, a view supported by the recent studies on correlation of olfactory thresholds of certain substances with their ability to accelerate haemolysis by saponin in red blood cells.

## A New Place for Fundamental Data

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THE ever-increasing volume of worthwhile technical manuscripts with its attendant editorial, production and budgetary problems renders the task of fulfilling the basic objective of any technical journal, viz. "to provide the greatest service to the largest number of readers", increasingly difficult. In a recent issue of the *Industrial & Engineering Chemistry* [48 (1), (1956), 99A] a novel plan, proposed by its editors and authorized by the American Chemical Society (ACS) to take effect from July 1956, was outlined. The plan, which is to be tried out, in the first instance, with *Industrial & Engineering Chemistry*, envisages a convenient and purposive re-division of the packaging of the journal's published material, aimed at achieving maximum, effective, reader service. The plan, meant to pilot plant a larger scale operation, may be eventually extended to all ACS publications.

The volume of material published yearly, under the broad and general classification of *fundamental data*, though important either for current use or permanent reference, has only a restricted reader interest. Printing thou-

sands of copies of material used regularly by only a small fraction of the readers boosts production costs. One of the ways in which this situation was sought to be remedied partially was to encourage authors to deposit a considerable portion of their supporting data with the American Documentation Institute (ADI). But it has been considered preferable to contain the entire material of *fundamental data* articles in one piece to a scattering of it between the ADI and the different technical journals.

The suggested plan takes a step forward in this direction, enabling publication of complete articles with less critical limits of space and no deposition of a part of the material elsewhere. The new scheme seeks to channel all the articles under this *fundamental data* category into a separate volume published twice a year similar to the semi-annual review supplements published by a number of technical journals, leaving the pages of the regular journal to be devoted to articles likely to attract wider reader interest, and dealing with significant scientific and technological advances and their applications in the

chemical industries. The *fundamental data* articles have been classified into two general categories for publication which will be bound separately and made available either separately or together. These two volumes deal with (1) Phase Equilibria, Transport and Thermodynamics, and (2) Physical Properties and Evaluation of Compounds respectively. The first issue of the *fundamental data* volumes will appear in July 1956.

The first group will include articles consisting essentially of data obtained through known concepts and methods or extensions

of such data. It will *not* include those which present data as a means to an end, e.g. the introduction of a new equation, which can have relatively broader reader interest and can well go into the regular issues of the journal. Included in the second category will be those articles which deal with physical properties as an end in themselves or aids to other studies. Articles which present physical properties only as an adjunct to the explanation of a new process or the overall picture of a particular compound will be *excluded* from this group.

## The Central Laboratories for Scientific & Industrial Research, Hyderabad

IN ACCORDANCE WITH THE DECISION OF THE Council of Scientific & Industrial Research and the Government of Hyderabad State, the Central Laboratories for Scientific & Industrial Research, Hyderabad, have been taken over by the Council with effect from 1 April 1956.

This step assures the full development, as

originally planned, of the laboratory, which had been held up during the last four years for lack of adequate funds.

The institution, under its new name, the Regional Research Laboratory, Hyderabad, is the first regional laboratory of the Council. Dr. S. Husain Zaheer will continue to be the Director of the laboratory.



# REVIEWS

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NUMERICAL ANALYSIS by Zdenek Kopal  
(Chapman & Hall Ltd., London), 1955.

Pp. xiv + 556. Price 63s.

The ever-widening front of application of mathematics to natural phenomena and the need for producing quantitative answers to concrete problems has resulted in making the techniques of numerical mathematics more and more indispensable in a wide variety of scientific and technical fields. However, the number of currently available text-books on the subject is, unfortunately, not commensurate with the extensive use to which the techniques are put to. The appearance of a new book on the subject is, therefore, welcome. According to the preface of the author, the book is based on courses given by him to students of science and engineering at the Massachusetts Institute of Technology. The scope and contents of the book are indicated by the following extract from the author's preface: "Following an introductory chapter in which the present status and achievements of numerical analysis are placed in historical perspective, Chapter II contains those elements of the theory and practice of interpolation (based on polynomial approximation) which are necessary for numerical integration and differentiation, for the solution of ordinary differential equations of any order or degree for initial-value problems, and of linear differential equations of any order for boundary-value problems (Chapters III-VI). Chapter VII presents a systematic introduction to the study of mechanical quadratures, which are applied in the subsequent Chapter VIII to an algebraization of integral and integro-differential equations and to their replacement by equivalent systems of algebraic equations (for integral equations), or of ordinary differential equations (in the case of integro-differential equations). Each chapter is concluded by Bibliographical Notes, containing a list of the principal sources and more detailed investigations of the respective subjects, and which, though by no means complete, can serve the interested

reader as a guide for further study. A few historical remarks of possible interest have also been occasionally included. A series of Appendices containing auxiliary numerical data, as well as details of certain processes (trigonometric interpolation), which would have proved too discursive in the main text, conclude the volume." Attention may be drawn to the following special features which enhance the value of the book: In the chapter on interpolation the use of Courie's device of throw-back in association with the Bessel and Everett interpolation formulae is discussed and exemplified, the true genesis of the throw-back factor as a Tchebysheff polynomial being traced in Appendix II, to its connection with optimum-interval interpolation. A separate chapter is devoted to variational, iterative and other methods for the solution of boundary-value problems. The chapter on Mechanical Quadratures contains, in addition to the classical Newton-Cotes formulae, an extended treatment based on the theory of orthogonal polynomials of Gaussian quadrature, Christoffel's, Mehler's and other weight functions, Radau's and Tchebysheff's formulae and a brief account of recent 'Monte Carlo' methods. The discussion of the numerical solution of integral and integro-differential equations in the last chapter includes a brief treatment of integro-differential equations met with in astrophysics. The solution of algebraic equations of higher degree and of systems of algebraic equations is completely omitted but a selected bibliography on these topics is given in Appendix V. The text contains many worked out numerical examples illustrating various points and each chapter is followed by sets of problems intended for the reader who would become proficient in the art. Several of the problems are quite interesting and "could result in research theses". It is evident that Prof. Kopal has written a most useful book on numerical analysis which will serve not only as an advanced undergraduate text-book but also as a handbook of reference for persons engaged in research.

V.R.T.

**MODERN PETROL ENGINES** by Arthur W. Judge (Chapman & Hall Ltd., London), 1955. Pp. x + 564. Price 56s.

The development of the petrol engine is so rapid that the attempt made by the author to compile, in a single volume, its outstanding characteristics together with the broad foundations, is to be welcomed. The fact that the book describes also some modern and noteworthy constructions makes it even more valuable.

The first chapter outlines briefly the history of the four- and two-stroke internal combustion engines and mentions particularly the development of the early aircraft and automotive power plants. Chapters II and XIV to XVI deal with the combustion process, detonation, fuels and combustion chamber designs. These chapters are closely linked together, and in a future edition, these could perhaps be brought closer. Chapter III is devoted to fundamental thermodynamics and makes frequent reference to the discrepancies between theoretical conceptions and actual engine processes which determine engine performance (a subject which is covered in the next chapter). This is followed by an outline of the methods and means employed for achieving outstanding results, such as supercharging in its various forms. Frequent references to earlier investigations are made in the text although Continental research might have deserved more attention. Air and liquid cooling is exhaustively covered in the next two chapters and a store of useful information is presented. The creation of the combustible mixture by carburation or injection of the fuel follows next. The new trend towards fuel injection on the Continent and in America gives ample justification for the thorough treatment of the fundamentals and implications. In the next edition, this chapter may perhaps be moved closer to the chapters dealing with combustion and combustion chambers, followed also by the chapter on ignition, which now forms Chapter XII and is closely related to the combustion characteristics and the general performance of the petrol engine. The two-cycle and the sleeve valve engine are dealt with in Chapters IX and XI, and interspersed, however, by a chapter on engine types and fields of applications. The new valve gear of the German racing car engines might have been mentioned here as also the new Omega engine. This chapter,

again, is closely linked to the last chapter on engine developments with which it could be merged. There is no special account of engine mechanics, vibrations and balancing, which could have thrown light on design principles, and where the subject of lubrication, now forming Chapter XIII, could have found its place.

The value of this informative volume will be greatly enhanced if the subject is presented in a more harmonious sequence.

H. A. HAVEMANN

**EXPERIMENTS IN ORGANIC CHEMISTRY** by Louis F. Fieser (D. C. Heath & Co., Boston), Third Edition, 1955. Pp. 360. Price \$ 5.25

This latest edition of Prof. Fieser's book on experimental organic chemistry is easily one of the best laboratory manuals now available. Like Prof. Fieser's text-book on organic chemistry this volume makes a delightful and instructive reading. Apart from instructing a beginner in the methods of organic chemistry in a lucid and easy manner and providing detailed preparative instructions, involving some typical preparations, he has taken good care to acquaint the student with inexpensive multipurpose laboratory equipment illustrated with colour plates, diagrams and photographs. This book is of equal value to students of advanced organic chemistry; it deals with details of literature sources and fundamentals of practical organic chemistry and takes in its sweep some advanced techniques.

The book is divided into two parts. The first part deals, in 42 chapters, with methods of practical organic chemistry and of some preparative methods, chromatography, enzymatic resolution, qualitative analysis, etc. In the second part, in six short chapters, the student is introduced to the use of literature, micro-techniques, glass blowing, preparation of pure solvents and physico-chemical data of some of the common reagents. The instructor's manual outlining the costs and supply sources of some of the chemicals and notes on experiments is a very welcome addition to this volume.

There are very few mistakes and only one could be detected in the present reading, the last word of the second line on page 43 should obviously be 'funnel' and not 'flask'. The get-up of the book is excellent.

M. L. DHAR

SYNTHETIC DRUGS by H. Ronald Fleck (Cleaver-Hume Press Ltd., London), 1955.

Pp. viii + 380. Price 70s.

The writing of this handbook for chemists, physicians and pharmacists has undoubtedly involved considerable hard work as it meant assembling of valuable information on the rapidly expanding subject of synthetic drugs. This volume covers, in its sixteen chapters, a variety of subjects such as amoebicidal drugs, anaesthetics, analgesics and antipyretics, antibiotics, anticonvulsants, antihistamines, antimalarials, antituberculosis drugs, autonomic drugs, cardiac drugs, hormones, etc. It is not, however, understood why the important group of drugs, the sulphones, and the piperazine derivative, Heterazan, which have played a vital role in the treatment of leprosy and filariasis respectively, have not been included in this volume.

The choice of drugs in the different chapters is peculiarly selective. One wonders why such important drugs as chloroquin, conessine and the tetracyclin antibiotics have not received even a passing reference as amoebicides. It is surprising, indeed, that 6:9-dimethoxy acridine lactate and the antibiotic subtilin should be classed as 'accepted compounds' for the treatment of amoebiasis in a volume published as recently as 1955. There are similar omissions in other chapters: Flaxedil and Mytolon, the synthetic neuromuscular blocking agents, have not been mentioned in the relevant chapter. The important group of digitalis and other cardiac glycosides do not in the author's words "concern a treatise on synthetic drugs" (p. 148) and have not even been mentioned, yet the chapter on hormones is full of information on the methods of preparation of various hormones from natural sources. It is difficult to appreciate and reconcile the logic in the planning of these two consecutive chapters.

There is considerable, though not uniformly accurate, information for the chemist in each chapter. Structural formulae have been given generously and there are five hundred of these in this volume. It does seem rather unfortunate that sufficient care has not been given to the writing of the structural formulae. The very first structural formula in the book, that for emetine on page 6, is incorrect; no attempt has been made even to distinguish an aromatic ring

from a hydroaromatic ring in the emetine molecule.

Synthetic routes have been liberally given though it is doubtful if the space devoted to outlining the synthetic procedures of simple intermediates and the analytical figures, which appear monotonously in every all too brief column on analysis and testing, has been usefully employed.

For the physician the information is scanty and in some cases not particularly accurate, e.g. on page 185, excess of insulin is reported to give rise to diabetic coma.

There are some scattered references to original literature, but in a really useful volume one would expect a more comprehensive bibliography to at least important monographs and review articles.

The writing of this book is not particularly distinguished and proof-reading has clearly been hurried. One cannot help observing that the effort involved in writing this large volume deserved a more logical planning and careful execution. In its present form, this volume does not satisfactorily justify its title as a *Handbook on Synthetic Drugs for Chemists, Physicians and Pharmacists*.

M. L. DHAR

LAW AND THE ENGINEER by Christopher S. Mayson (Chapman & Hall Ltd., London), 1955. Pp. xx + 470. Price 63s.

The author was a practising electrical engineer before he became a barrister at law. The aim of the book is to present to engineers those aspects of law which are of interest and concern to them in their professional duties. This has been done in a practical and understandable manner. The present-day professional engineer comes across many situations where knowledge of fundamentals of contract law would be of immense help. Although the author takes care to give a warning that the book is mainly based on English law it certainly contains much that is fundamental.

The book is in three parts. Part one gives an outline of the English legal system, including chapters on the scope and machinery of civil law, the tendering and value of evidence and documents.

Part two relates to the law of contract including chapters on the formation of contract, the composition of parties to a contract, factors which nullify contracts or enable them to be avoided, contract terms,

the performance of contracts, their completion, acceptance and payments, and their final discharge. Remedies to breach of contract, the meaning of agents and agency, hire purchase agreements, export contracts, contracts of employment, monopoly and agreements in restraint of trade are chapters which would be of useful interest to the manufacturer and exporter.

Part three relates to the Law of Negligence, with particular emphasis on responsibilities of employers, of occupiers of premises, the factory acts and regulations, compensation for personal injuries, which are of general interest to engineers.

Appendices contain standard conditions of engineering contracts as drafted by professional bodies, tables of Acts of the British Parliament, Statutory Regulations and cases decided in English courts.

In the absence of an authoritative book based on Indian law, this book should prove of great use to engineering students, practising engineers and consultants who are often called upon, as witnesses in courts, to give expert opinion.

H. SUNDER RAO

STEELS FOR THE USER by R. T. Rolfe (Chapman & Hall Ltd., London), 1955. Pp. xvi + 399. Price 45s.

The 1955 edition of this book is a great improvement over the earlier edition. There have been many valuable additions to the text. In this book a highly technical subject is presented in such a clear, simple and lucid manner that it can be ranked as one of the best of its kind.

There are 12 chapters in this volume in which diverse subjects like mechanical properties of steels, effects of chemical composition on these properties, heat treatment of steels, use of steel at elevated temperatures and fatigue testing, and general principles on selection of steel have been discussed at length. While the author has refrained from entering into intricacies of isothermal transformation characteristics and evaluation of hardenability thereon, he has admirably succeeded in securing a balanced outlook of the old and new concepts, and has presented to the general reader the subject in a clear, understandable and practical form.

The subject of abnormality met with heat treatment of carbon and alloy steels

could have been advantageously introduced. Also, since the title of the book is *Steels for the User*, more data could have been furnished on alloy steels, the effect of different alloying elements on the properties of steels and their general terms of application. The particular case of steels at elevated temperature has been singled out in this connection. The chapter on fatigue testing could probably have been coupled with the first chapter on mechanical quality and assessment.

The book is excellently printed and very well got-up. It should be a valuable addition to all scientific libraries and should find a place in the shelf of every industrialist, engineer, metallurgist and student.

B. R. NIJHAWAN

FRONTIER TO SPACE by Eric Burgess (Chapman & Hall Ltd., London), 1955. Pp. xvi + 174. Price 21s.

The earth's atmosphere gets more and more tenuous as we ascend, but there is detectable matter even at a height of 1,000 km. above ground. The idea of a rocket capable of reaching altitudes much higher than those reached by balloons goes back to R. H. Goddard (Smithsonian Institution Publication, 1919). Now, people are talking of sending a rocket to the moon or even to the Mars, and there are Interplanetary Societies in several countries. H. Oberth, a German engineer (1928), worked out the details of a rocket propelled by liquid fuel, and the Germans, under the stimulus of World War II, developed their V2 rocket, which was used to bombard London. At the end of the war, the unused V2 rockets fell into the hands of the U.S. Army, and in the next few years they used these missiles to study the properties of the upper atmosphere and the various phenomena taking place therein. The rocket itself has undergone many modifications and lighter versions of it such as the Aerobee and the Rockoon (a rocket launched by a balloon after it has reached a height of about 10 miles in the atmosphere) have been developed for the study of problems which can be tackled with lighter equipment. The greatest height so far reached by a rocket is 390 km., which is well in the  $F_2$  region of the ionosphere.

The rocket has been used to study (1) the distribution of temperature, pressure and of different constituents in the upper atmo-

sphere; (2) the spectrum of the sun above the ozone layer, including the Lyman H<sub>γ</sub> region in the extreme ultraviolet and the soft X-ray spectrum; (3) cosmic-ray primary particles and their interactions with nuclei; (4) the magnetic field of the earth in the E region of the ionosphere; and (5) air-glow from the high atmosphere during daytime.

The information gathered by the instruments carried in a rocket is either recorded photographically or telemetered to ground by means of a radio transmitter. One of the limitations of the rocket as a tool of upper air research is the short time for which it stays at high levels. In the last chapter of the book, the author discusses the problem of launching a vehicle carrying instruments as a satellite round the earth. With multi-stage rockets, this is now believed to be possible and the U.S.A. and U.S.S.R. have announced that many satellites will be launched during the International Geophysical Year 1957-58. The U.S. satellite will be a small spherical body of 30 in. diameter and will go round the earth once every 90 min. in a nearly circular orbit at heights varying from 200 to 800 miles above the surface of the earth.

Mr. Burgess presents in this book a very readable account of a new tool of research and the fascinating fields of knowledge which its use has opened up or clarified. The presentation is non-technical and the book can be read by any intelligent layman interested in the outer limits of the earth's atmosphere and beyond. The book has many illustrations and an index.

K. R. RAMANATHAN

PROCESS ENGINEERING ECONOMICS by Herbert E. Schweyer (McGraw-Hill Book Co. Inc., New York — Toronto — London), 1955. Pp. xiii + 409. Price \$ 7.50

*Process Engineering Economics*, written by Herbert E. Schweyer, Professor of Chemical Engineering, University of Florida, not only serves as a text-book for training students in metallurgical, chemical, petroleum, ceramic, food and other engineering fields dealing with the processing of materials, but can also be used as a reference book by practising engineers and other personnel in the process industries.

The first part of the book covers economic principles and elementary accounting procedures and the second part illustrates the techniques in applying these principles to various types of problems encountered by the process engineer in practice.

The theoretical part provides a composite coverage of theoretical engineering economy: value of money, depreciation, depreciation accounting, capital requirements, the balance-sheet, the theory of costs, allocation of indirect cost (too briefly), profit and earnings and economic production charts.

In the second part of the text each chapter covers a group of related problems involving specific applications of economics. In Chapters 6 and 7, the use of the basic economic equations for selecting the best of two or more alternatives for doing a given job is illustrated.

Chapter 8 deals with the general procedure of economic balance in process engineering: economic balance equation, cost variations and maximum economic return. The three major types of economic balance studies are discussed in detail in the following chapters by means of charts and mathematical relations: economic balance in cyclic operations (Chapter 9), economic balance in yield and recovery (Chapter 10), and economic balance and inventory in process operations (Chapter 11). Chapter 12 illustrates the general principles of economic analysis of a complete process.

In appendices cost data are presented covering cost of materials, selected equipment, construction and operating costs and estimated life of certain equipment. These cost data are based on American industry and are not generally applicable, but it gives some idea about the relationship between different groups of cost element.

The book covers 410 pages of valuable material on economics. The text is simple and easy to teach, and explains the practical use of cost data. The combination of theory with actual practice is a distinctive feature of the book. Other outstanding features are the presentation of separate principles concisely in a single volume and the inclusion of material and worked problems from current literature for the first time in book form.

OLLE RIMÉR

## Low-temperature research

RECENT ADVANCES IN THE FIELD of low-temperature physics were presented and discussed at the Sorbonne University, Paris, during 2-8 September 1955, at a conference which was attended by about 250 delegates from 15 different countries.

A significant result obtained in connection with the measurement of electronic specific heat in the superconducting state,  $C_{es}$ , of vanadium and aluminium, is the experimental support lent for the existence of an energy gap in the single electron energy level spectrum. This has been stressed by many workers for a theoretical (as contrasted with the currently adopted analytic) description of superconductivity.

The magnetic powder technique, recently developed, is a powerful method for investigating the structure of the intermediate state in superconductors. Diamagnetic superconducting niobium powder was spread over the surface of the discs or plates of the samples under investigation and a magnetic field was applied to bring the sample into the intermediate state. The powder remained on the superconducting regions but was forced out of the normal regions through which magnetic flux passed. From measurements on the domain spacings of the photographed patterns the surface energy at the supernormal boundary, an important theoretical parameter can be derived. The surface energy for vanadium was found to be about 1,000 times larger than that for tin, indium and lead.

The conclusion that helium in superfluid flow does not carry the phonon entropy with it, which was previously arrived at by more indirect evidence from second sound velocity measurements, was confirmed by the results obtained from new measurements on (1) the heat of transport of superfluid helium II and (2) the fountain pressure in helium II at temperatures down to  $0.2^\circ\text{K}$ .

Observations on the attenuation of second sound propagated laterally across a rectangular helium-filled tube carrying a

longitudinal heat current and on the time delays in establishing steady values of attenuation after switching the heat current on or off, showed that the flow of the superfluid is turbulent above a critical velocity. Benson and Hallett also reached similar conclusions about the appearance of turbulence at sufficiently high velocities, from their work on torsional oscillations of a sphere in helium II. Vinen and Hall tested this hypothesis by rotating the entire assembly of a second sound generator together with its heater and thermometer placed in a liquid helium can. Attenuation was found to be accurately proportional to the angular velocity. Hence, it was concluded that the frictional forces causing the attenuation are a general property of the rotational states of the liquid.

Extension of measurements on the specific heat and magnetic susceptibility of pure liquid  $\text{He}^3$  down to a temperature of  $0.23^\circ\text{K}$  by a number of workers confirmed the previous interpretation advanced by other researchers on the superfluid state of liquid helium. This is:  $\text{He}^3$  does not show a liquid-liquid transition to superfluidity in the range  $0.3^\circ\text{--}2.3^\circ\text{K}$  but an anomalous specific heat that is associated with nuclear magnetic ordering exists, the anomalous maximum occurring between  $0.15^\circ$  and  $0.3^\circ\text{K}$ . Theoretical proposals towards interpretation of this peculiar behaviour, distinctly different from that of  $\text{He}^4$ , were put forward at this conference by a number of workers engaged in this field.

In the sphere of nuclear spin systems oriented partially in space, the direct magnetic polarization of the nuclei in indium metal by an external field is of special interest. Thin plates of the metal were maintained in a magnetic field of 11,150 gauss at temperatures below  $1^\circ\text{K}$ . A maximum nuclear polarization of about 2 per cent was observed to occur at  $0.043^\circ\text{K}$  by noting the changes in the transmission of a beam of polarized neutrons.

An interesting magnetic method of temperature measurement below  $1^\circ\text{K}$  was reported by Wolf

and others. In this method, the paramagnetic substance whose absolute temperature is to be determined was in the form of a thin spherical layer of powder glued in good thermal contact around a tiny single crystal sphere of the thermometric substance, cerium magnesium nitrate which obeys Curie's law down to  $0.006^\circ\text{K}$ . The whole assembly was magnetically cooled below  $1^\circ\text{K}$ . Simultaneous susceptibility measurements on the composite specimen made along and perpendicular to the axis of the thermometric crystal readily allow the derivation of both the absolute temperature ( $T$ ) and the magnetic temperature ( $T^*$ ). Values for iron ammonium alum and neodymium magnesium nitrate have been determined in this way.

A resolution recommending the adoption of a new temperature scale, designated as  $T_{55}$ , which represents a significant advance on the older  $T_{48}$  scale in absolute precision, was adopted at the conference. It was based on a thermodynamic formulation of the vapour pressure of pure liquid  $\text{He}^4$  as a function of the absolute temperature and was assessed to have a maximum possible error of only  $0.003^\circ\text{K}$ . The formula is to be used in conjunction with a correction curve representing the most probable deviations from the formulation to be expected under certain defined methods of experimental measurement of the vapour pressure [*Science*, **123** (1956), 190].

## Absorption of radio waves by emission nebula

DRS. B. Y. MILLS, A. G. LITTLE and K. V. Sheridan of the Commonwealth Scientific & Industrial Research Organization, Sydney, Australia, have reported, for the first time, the absorption of radio waves by an emission nebula. This finding was the result of a study of 14 nebulas at 3.5 m. wavelength using a 1,500 ft. radio antenna. Six nebulas were observed in emission, seven were not detected at the wavelength used and one was found to be an absorber. The discovery means that radio-astronomers can isolate individual objects by their radio absorption bands just as astronomers optically analyse a stellar composition by absorbed light. The discovery is valuable in that it eliminates dependence on optical measurements which may be un-

reliable due to obscuring dust and haze intervening between the observer and the object for obtaining data on the physical characteristics of emission nebulas. The radio method gave the nebula's temperature as 6,500°K., slightly lower than that estimated from optical measurements. The position of the nebula determined by this method was found to be in good agreement with previous optical sightings and with the position obtained by radio location using 1 cm. waves which the object was earlier known to broadcast [*Sci. Newsletter*, 69(6) (1956), 94].

### Transition points from refractive index

TRANSITION POINTS OF PURE liquids and of salts in solution are usually determined from the abrupt changes in the values of some physical properties like density and viscosity at such temperatures. From the intimate connection between the density and refractive index of a solution, a knowledge of the latter can be expected to yield information on transition temperatures. Experiments conducted at the Chemistry Laboratories, Meerut College, Meerut, on some aqueous solutions of hydrated inorganic salts in the temperature range 20°-55°C. have shown that transition points could be determined with a reasonable degree of certainty from a knowledge of the refractive index of the solution.

Solutions of sodium chloride, sodium carbonate and magnesium sulphate (A.R. quality) of four different concentrations were studied, the same sample of conductivity water being used for the different dilutions. Refractive index was determined over the range 20°-55°C. using a critical angle refractometer, whose vernier was capable of reading angles up to one second, with a sodium lamp as the light source. The temperature of the experimental solution was controlled within  $\pm 0.2^\circ\text{C}$ . and maintained for 15 min. at that value before a reading was taken. In the case of sodium chloride, no sudden variation of change was observed in the refractive index with temperature. Literature also shows no change in the degree of hydration in the temperature range studied. Sodium carbonate showed abnormal changes in the regular variation at 32° and 34° which correspond to the transition temperatures. The transition tem-

peratures were found to be slightly influenced by concentration in both dilute and concentrated solutions. These values agreed well with those obtained by previous workers for different hydrates. In the case of magnesium sulphate solutions the transition in composition was observed to be influenced by the concentration as well as temperature. Two transition points, 42° and 49.4°C., for concentrated solutions and only one, 49.4°C., for the less concentrated solutions were observed as against 50° and 48.5°C. cited in the literature. Preliminary experiments on sodium and zinc sulphates also show similar results. Attempts being made to determine the composition of the salt while in solution at either side of the transition point indicate that the refractive index of salt solutions at different concentrations provides an easy approach towards the study of composition changes with variation of temperature [*J. Indian chem. Soc.*, 33 (1956), 149].

### Structure of vitamin B<sub>12</sub>

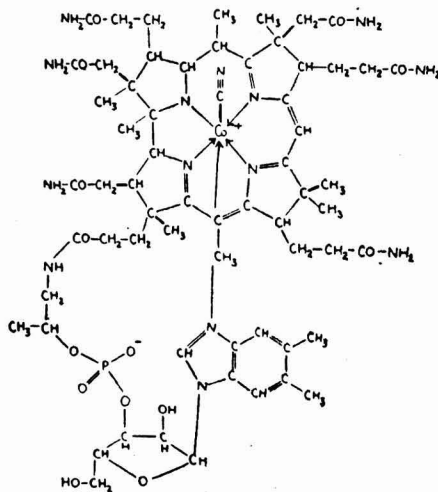
THE STRUCTURE OF VITAMIN B<sub>12</sub> has been established by two teams of biochemists working in collaboration in U.K. and U.S.A. The new molecular formula assigned to vitamin B<sub>12</sub> is C<sub>63</sub>H<sub>90</sub>N<sub>14</sub>O<sub>14</sub>PCo.

Vitamin B<sub>12</sub> represents a new type of compound ring structure similar to, and yet significantly different from, the tetrapyrrole ring structure of the porphyrins

such as chlorophyll, heme and the cytochromes. The vitamin B<sub>12</sub> structure likewise consists of four linked rings each of which is composed of 4 carbon atoms and one nitrogen atom; but each ring has at least one tetra-substituted carbon atom and, therefore, lacks the typical double-bond structure of the pyrrole ring.

As in the porphyrin structure, the four rings in the vitamin B<sub>12</sub> molecule are joined by three —C— bridges, but the final closing linkage that unites rings A and D is thought to be a direct one. The single cobalt atom of the molecule occupies the centre of the tetra-ring structure, like magnesium in chlorophyll and iron in the hemes and cytochromes. It bears a cyanide group; hence the name cyanocobalamin is sometimes applied to the vitamin.

Electron density maps and crystallographic data, as well as chemical analysis, now show more detailed features of the attached side chains on the ring. Three acetamide and three propionamide and six methyl groups are attached to the rings and two methyl groups to the carbon bridges. Ring D bears another propionic acid side chain, which is combined with a propanolamine residue that forms an ester linkage with the phosphate group of a nucleotide that is also co-ordinated with the cobalt atom. Both groups of workers agree on the formula C<sub>63</sub>H<sub>90</sub>N<sub>14</sub>O<sub>14</sub>PCo, arranged as shown in (I).



(I)

To work out the details of structure of so complicated a molecule is truly a triumph of scientific ingenuity. It opens the way to greater insight into the metabolic activities of this vitamin [*Science*, **122** (1955), 823].

### Gonyleptidine — a volatile antibiotic

A VOLATILE ANTIBIOTIC HAS BEEN discovered in the secretion of cephalothoracic glands of a South American arachnid of the *Gonyleptidae* family. Named as Gonyleptidine, it consists of simple benzoquinones. It is effective against at least 18 genera of bacteria and protozoa. These simple benzoquinones are said to be considerably more promising, with respect to potency and retention of activity *in vivo*, than other quinones previously investigated [*Chem. Engng. News*, **33** (1955), 4518].

### New research reactors

TWO NEW RESEARCH REACTORS, Zeus (zero energy uranium system) and Zetr (zero energy thermal reactor), are now operating at Harwell. Zeus has been built to check the nuclear calculations on which the design of the fast reactor being built at Dounreay in the north of Scotland is based. Zetr uses a nuclear fuel in solution and is intended to provide information about the quantities of fuel required for large-scale reactors using such solutions.

The cylindrical core of Zeus, which is roughly 20 in. in diameter and 20 in. long, is made up of uranium highly enriched in  $U_{235}$ . The core of Zeus is surrounded by many tons of uranium in which plutonium is formed gradually as the pile runs. The amount of  $U_{235}$  needed to permit the nuclear reaction to start was found to be very close to the predicted value [*Chem. Age*, **74** (1956), 258].

### Zirconium in atomic energy work

THE MODIFIED KROLL PROCESS, originally developed for making titanium, has been found promising for the production of zirconium also. Zirconium has several properties that make it a desirable construction material in the field of nuclear energy. It is almost as strong as steel but lighter; it has high corrosion resistance and an extremely high melting point of

3,350°F. Because it does not absorb and thus waste neutrons needed to sustain a chain reaction, it is used in building atomic reactors [*Chem. Age*, **74** (1956), 246].

### New transistor for high frequencies

A NEW TRANSISTOR CAPABLE OF satisfactory response at three times the frequency of the latest of existing ones has been developed and made at the Bell Telephone Laboratories, New York. The technique involves a new fabricating method which uses the diffusion process to control minute amounts of impurities. The heart of the new amplifying device is an extremely thin (50 millionths of an inch) 'base' layer of silicon which was sandwiched with very carefully controlled minute amounts of impurities of germanium by diffusion. The narrower the base layer, the higher will be the frequency response range of the transistor.

While available transistors have a frequency cut off at about 10 Mc/s., the new ones work up to 600 Mc/s. Experimental units of the new development have amplified, by 100 to 1, currents across a 20 Mc/s. wide band. Either amplification or the number of communication channels can be made three times that of other transistors. If only half the frequency band is utilized, power amplification can be doubled.

The newly developed transistor broadens the field of application in television to include both black and white and colour television transmission. Its extended frequency operation is a highly desirable quality recommending its widespread use in guided missiles and high speed electronic computers [*Sci. Newsletter*, **69**(5) (1956), 67].

### Aluminium dry cells

ALUMINIUM DRY CELL BATTERIES with storage life equal to conventional zinc batteries have recently been developed. The development has been made possible through the use of new aluminium alloys coupled with a new electrolyte combination.

Conventional electrolytes were not found suitable for the new cells as they cause perforation of aluminium through local action. Aluminium chloride showed much promise and a 1:1 mixture (by

weight) with ammonium chromate was found most satisfactory. A satisfactory cell was accomplished by use of the clad principle which consists of a bond of two alloys, one of which is more corrosion resistant than the other, in turn making a more corrosion-resistant product. A conventional cathode, manganese dioxide and acetylene black was used. The resulting aluminium dry cell has a potential of *c.* 1.6 V. with African ore and 1.7 V. with synthetic ore [*Chem. Engng. News*, **33** (1955), 4646].

### New corrosion-resisting compound

A FIBRE-REINFORCED PLASTIC material, which can be applied by brush on metal surfaces as an effective and economical protection against the corrosive effects of atmosphere, sea water and a wide range of chemical agents, has been developed by a firm in U.K. The material which is of special interest to all those concerned with the maintenance of chemical processing plant and structural steelworks consists of a mixture of a synthetic resin or latex with high-alumina cement, the whole being reinforced with a tough woven fabric by a patented process.

It is applied in two layers, interspersed with woven fabric, to a total thickness of about  $\frac{3}{8}$  in. It is cold setting, and the weight of the complete coating is *c.* 9 lb./sq. yd. Very little preparatory treatment is required — removal of loose scale and rust by wire brush being sufficient.

The compound is impermeable and yet flexible, shows no softening at elevated temperatures and has a particularly good impact strength, comparing favourably in this respect with standard concrete. The adhesion strength is also very satisfactory. Because of the toughness of the layer produced, this new 'compound' is likely to be particularly applicable for structures composed of thin sheeting, since it will afford them extra strength as well as corrosion protection [*Chem. Prod.*, **19** (1956), 124].

### New cuprammonium finish

A NEW CUPRAMMONIUM PROCESS for finishing short-staple cotton fabrics is described. Processes using ready-made cuprammonium solution suffer from the disadvan-



tage that the solution is sensitive to light, air and temperature and has to be stored in dark and at a low temperature. In the new process, the cuprammonium hydroxide solution is formed *in situ* on the fabric.

The fabric is padded through a solution of caustic soda of less than mercerizing strength. The caustic solution impregnated fabric is squeezed and padded through copper sulphate solution, when a blue precipitate of cupric hydroxide is formed on the fabric. The fabric containing the precipitate is squeezed and passed through a trough containing a strong ammonia solution, when cuprammonium solution is formed on the fabric. After a predetermined time, the fabric is squeezed to force the cuprammonium cellulose solution into the fabric, where it is reprecipitated by souring in dilute sulphuric acid when copper and ammonia are removed. The fabric is then washed and dried. The effect of this treatment on the cloth depends on several factors, such as (1) concentration of caustic soda, (2) concentration of copper, (3) time of contact of the fabric with the cuprammonium solution, (4) degree of squeezing, and (5) use of wetting agents. The optimum conditions for all these factors have been determined.

The treated fabric has a cleaner and more lustrous appearance due to the cleaning of the interstices and removal of the loose surface fibres due to the solvent action of the finishing agent. This results in better dyeing and printing properties of the finished material. The treated fabric has a linen-like feel and possesses a fuller handle due to the reprecipitation of dissolved cellulose. The treatment results in an increase in tensile strength to the extent of 5 to 10 per cent. The treated fabric is stiffer and the weave becomes more pronounced [*J. Indian Chem. Soc. (Industr. & News Ed.)*, **18** (1955), 187].

### Tin-coated iron

TWO NEW PROCESSES FOR TINNING iron are described which do not require complicated pretreatment steps needed in the hot dipping process.

In the first method, tin may be sprayed on to cast iron in very much the same way as zinc, by means of the Schori Model 50 pistol. The normal pretreatment for metal spraying is to clean and

slightly roughen the surface of the article by shot blasting. In the Schori process the metal, in the form of powder, is ejected through a suitable flame and the resulting heated particles adhere to a clean metal surface.

Pea plating, the second method, is suitable for various metals including tin, zinc, cadmium, brass, etc. For tin plating it is usually sufficient that the articles are free from grease. They are put into a hexagonal tumbling barrel with an impacting material, a promoter solution, the coating material in the form of dust, and water. Plating is usually completed in less than 45 min., and the thickness of the coat is determined only by the amount of metal dust put into the barrel in the first place. The particles of metal dust are welded on to the objects by the hammering action of the impacting material and pore-free coatings are obtained. The plating efficiency of tin is very high and is usually well over 90 per cent.

On completion of the plating run, the contents of the barrel are emptied on to a vibrating sieve which separates the impacting material from the treated objects. The impacting material is returned to the barrel for the next plating run. The thinner coatings of tin applied by this method may be flowed in exactly the same way as electro-tinned coatings. Pea-plated coatings are bright and have characteristic appearance and a distinctive structure [*Chem. Tr. J.*, **137** (1955), 1764].

### Filter materials from glass fibres

FILTER PAPERS SUITABLE FOR FILTRATION of aerosols have been successfully made from glass fibres of 1  $\mu$  or less diameter by the Owens Corning Fiberglas Corp. and Glass Fibers Inc., U.S.A. The paper possessed ample strength to be handled on ordinary paper mill equipment. The fibres were broken apart and dispersed in water (by acidifying to pH 3.5 or lower or by adding certain dispersing agents) in a standard Holland beater and then the slurry was diluted further with water and pumped directly to the wire of a Fourdrinier paper machine. One important exception in handling glass fibres is that high contact pressures which might crush the fibres cannot be used.

The behaviour of glass fibres in filter papers is related to fibre diameter, pH of slurry, dispersing agents and binders. As average fibre diameter decreases, air flow resistance increases in proportion to the square of fibre surface area. The surface area of glass fibres per unit weight has been found to be almost directly proportional to the ability of a glass paper to filter fine aerosol particles. When paper is formed at sufficiently low fibre concentrations from fibres that have been specially dispersed, its tensile strength increases over fivefold but filtration efficiency is significantly reduced.

The average fibre diameter of a paper may be altered after the paper is formed. The presence of binders or surface active agents can greatly influence the apparent fibre diameter and consequently affect the filtration efficiency of a given fibre sample [*Industr. Engng. Chem.*, **48** (1956), 219].

### Sulphur from flue gases

THE GASTECHNIK PURIFICATION process for the removal of H<sub>2</sub>S from flue gases is described. The essential feature of the process, which is a development of the original German patent taken out by Walter Raffloer in 1927, is that tall cylindrical towers are filled with special oxide pellets, forming a continuous compact bed. These pellets, approximately  $\frac{1}{2}$  in. in diam. by  $\frac{1}{2}$  in. long, will flow easily under gravity and can be charged and discharged from the main vessel by means of gas locks, without interrupting the main gas flow. Thus the purification is continuous, although the handling of the pellets is carried out intermittently.

The towers themselves are plain cylindrical shells with a cone-shaped bottom reducing the pellet outlet to 8 in. d.am. The pellets are charged at the top of the tower by means of a gas lock and are removed from the bottom by similar means. The handling of the pellets is carried out in bottom opening skips, the capacity of these and the gas locks being similar so that each acts as a measuring vessel.

It has been found that concurrent flow in the first two towers enables complete internal oxidation to be achieved even with high H<sub>2</sub>S contents, and so eliminates the necessity for a separate regeneration system.

The porosity of the pelleted material is the prime factor governing both the reactivity and the degree to which the material can be enriched with sulphur. It is possible to produce pellets of adequate strength having a porosity of 50-60 per cent. These pores fill with sulphur during the purification process, and hence their reactivity and capacity are reduced, until at 30 per cent of sulphur it is not economic to re-use them without first restoring the porosity by extracting the sulphur.

The extraction process developed utilizes perchlorethylene as the solvent. The pellets containing 30 per cent of sulphur are treated with successive batches of solvent at its boiling point (121°C.). The hot sulphur-laden solutions are filtered from dust and then distilled, the condensed solvent being returned to storage. The sulphur accumulates at the bottom of the still as a molten layer which is run out into the moulds after removing the final traces of solvent with live steam [*Chem. Tr. J.*, **138** (1956), 275].

#### Oxygen process for calcium carbide

A PROCESS FOR THE ECONOMIC production of calcium carbide, which makes use of oxygen instead of electricity, has been developed at the Ludwigshafen works of the Badische Anilin- und Soda Fabrik, Germany. The process has been tested on a pilot plant scale with furnaces capable of producing 70 tons of carbide a day. The furnaces are of the shaft type with their walls lined with graphite blocks. As the reaction proceeds the compact mass of lime, coke and carbide deposited on the blocks further protects the furnace from the high temperatures experienced. The furnace is charged to about half its height with coke and burnt lime and the oxygen feed is through water-cooled tuyeres. The necessary heat is furnished by the combustion of part of the coke in the oxygen and the use as preheat of the combustion gases of the carbon monoxide formed. The liquid carbide is tapped off intermittently from the inner part of the furnace.

Hitherto, owing to the high temperatures needed for the reaction, the calcium carbide industry has been wholly dependent upon electricity as the source of heat

and this has restricted the development of the industry in many cases. With greater availability of tonnage oxygen, and the development of this new process, a way has been opened to the economic production of carbide in areas without cheap and adequate electric power [*Chem. Tr. J.*, **138** (1956), 328].

#### Production of *p*-xylene

THE CONTINUOUS FRACTIONAL crystallization process for the separation of high-purity *p*-xylene from crude mixed xylenes is being employed on a large scale by the Phillips Chemical Co., Texas, a subsidiary of the Phillips Petroleum Co. which has developed the process. The capacity of the plant is 5 million pounds a year.

The *p*-xylene content of the crude feedstock, containing 16-18 per cent paraxylene mixed with *o*-xylene, *m*-xylene and ethyl benzene, is first raised to 65 per cent by a primary chilling crystallization and filtration. The filtrate is cooled to about 0°F. in a second bank of scraped-surface chillers. This produces a thick crystal slurry which is then compressed into a compact crystal bed by a descending piston in a column. Impure liquid in the slurry feed squeezes out and passes through filters built into the column wall. At the same time, the piston pushes the crystal bed down on to an electrical heater at the bottom of the column. The heater melts the lower surface of the crystal bed and yields the liquid *p*-xylene product.

The product flows from the base of the column through a back-pressure regulating valve. By maintaining a pressure on the liquid in the column base, some of the pure liquid product is forced up through the descending crystal bed and flows out through the filters in the column walls. In effect, this upflow of pure product performs the same function as reflux in a distillation column. Liquid side streams are drawn off towards the top of the column while progressively purer product—first in the solid and then in liquid form—flows down the column. As a result of the counter-current action, crystals of 98 per cent *p*-xylene can be produced continuously just above the heater. Routine production gives about 98.5 per cent *p*-xylene but with suitable adjustments 99 per

cent purity or better can be obtained [*Chem. Tr. J.*, **137** (1955), 1703].

#### Surfactant-treated mineral fillers

TREATMENT OF MINERAL FILLERS such as kaolinite or wollastonite with small controlled quantities of selected surface-active agents (fatty quaternary ammonium salt and a fatty amine) is found to improve the strength and stiffness of plastic or elastomeric products containing 50 per cent by weight of filler. Compositions were prepared by suspending the filler in water, adding the surface-active agent and the resinous material, the latter as an aqueous emulsion, coagulating the solids, filtering off the water, and drying; and compression moulding and/or curing the product at elevated temperature and pressure. Surfactant treatment causes a reduction in the strength and stiffness of compounds based on resins in which the filler disperses readily without treatment.

Surfactant treatment of mineral fillers permits the preparation of highly filled (90 per cent by weight of filler) plastic compositions with good physical properties. The role of filler treatment in this application appears to be enhancement of uniformity of distribution of the binding resin, and a preferential wetting of filler particles by resin. Filler treatment also appears to improve water resistance of these highly filled compositions [*Industr. Engng. Chem.*, **48** (1956), 297].

#### European chemical industry

THE OEEC (ORGANIZATION FOR European Economic Co-operation) report for 1954-55 records a high level of activity in nearly all sectors of European industry. Chemical production, which represents about 3 per cent of total national production for OEEC countries, showed an increase of 15 per cent as compared to 1953. The total increase for all industrial production for the same period was 9 per cent.

For the eight countries for which figures are available (Belgo-Luxembourg Economic Union, France, Italy, Netherlands, Norway, Sweden, United Kingdom and Western Germany) investments in the chemical industry during 1954 amounted to about \$ 775,000,000

as against a value added of about \$5,000,000,000. Investments largely went to the basic sectors of the industry (in particular to petroleum chemicals) and to fertilizers, plastic materials and synthetic detergents. Investment in the chemical industry is mainly financed from the industry's own resources, a large part of profits, particularly of large concerns, being ploughed back for this purpose.

A more detailed analysis of the chemical industry has been given in the following 11 sections of the report: basic chemicals, petroleum chemicals, dyestuffs, tanning materials, paints, pigments, varnishes and related materials, medicinal and pharmaceutical products, soaps and detergents, fertilizers, plastic materials, miscellaneous chemical products, and photographic and cinematographic supplies [*Chem. Age*, 74 (1956), 17].

### New nitric acid unit

A NEW 16,000 TONS PER YEAR nitric acid concentration unit is being set up at ICI's Nobel Division at Ardeer, U.K., to concentrate weak nitric acid from 60 per cent to 99-100 per cent strength. In this new plant the entire process will be carried on in one building 110 ft. high and covering a relatively small ground area. The absorbing substance for the water from the weak nitric acid instead of being sulphuric acid is a solution of magnesium nitrate which is simply reconcentrated in the same building. This plant will be the first unit in the world to make a commercial application of the principle. This process has certain advantages over current processes which suffer from high maintenance costs and obnoxious effluents [*Chem. Age*, 74 (1956), 388].

### Directory of Aluminium, 1955

THE NEED FOR A COMPREHENSIVE publication dealing with all aspects of aluminium industry and trade in India has long been felt, and the proposal to bring out a *Directory of Aluminium* by the India Section of the Electrochemical Society was a sequel to the Aluminium Centenary Celebrations organized by the Society in Bangalore during September 1955. The *Directory* has been issued as a supplement to the *Bulletin of the India Section of the Electrochemical Society*, 4 (1955).

The *Directory* is divided into three sections: Technical Section, Reference Section and Directory Section. The Technical Section contains the following interesting articles: Bauxite resources of India; Aluminium in the consumer industries in India; Aluminium in telecommunication industry; and Some aspects of aluminium research in India. The Reference Section presents tabular statements of the physical properties of aluminium and its products such as castings, extrusions, forgings, wires, tubes, etc. It also lists Indian patents and Indian Standards relating to aluminium and the researches undertaken at the various universities and research institutions in the country on aluminium. The Directory Section lists industrial establishments concerned with the mining of bauxite, production and fabrication of aluminium, producers and importers of aluminium products, and scientific and technical societies.

This informative publication is well got up with an attractive aluminium tinted cover.

### Mineral Resources of Rajasthan

THIS PUBLICATION (BULLETIN 4, Department of Mines and Geology, Government of Rajasthan, price Rs. 5/8) gives an up-to-date and complete account of the mineral resources of the State. Though broad geological surveys and regional studies have been undertaken by the Geological Survey of India, systematic studies of selected zones or mineral-containing areas have been carried out by the State Government through its Department of Mines and Geology. The information collected by the Department have so far been published in four cyclostyled publications. The present volume has been prepared with a view to cover the subject more fully.

After describing the physiography and geology of the State, the publication sets forth the fuel (coal and lignite) and metallic and non-metallic mineral resources of the State in 24 chapters. Mineral Survey and Departmental Prospecting and Mineral Administration has also been dealt with. The minerals described are those which are industrially important and include beryllium, copper, iron, lead, zinc, silver, manganese, tungsten, asbestos, barytes, bentonites, calcite, fullers' earth,

glass-sand, gypsum, kyanite, limestone, marble, etc.

### Journal of the Franklin Institute

TO COMMEMORATE THE 250TH birth anniversary of Benjamin Franklin, a special issue of the *Journal of the Franklin Institute* [261 (1956), January] has been brought out to record the 'Panorama of Progress' in the entire field of modern science in the past 250 years. The papers in this issue are planned to give a broad picture of the advances made in the physical sciences (both pure and applied), in the social sciences and in economics. The papers contributed by well-known scientists are written in a non-technical manner and highlight the tremendous progress man has made in the physical and social sciences since the beginning of the 18th century. Some of the notable contributions included in this issue are: Changing concepts in science by Lord Adrian; Benjamin Franklin and one Plutonic year by Harlow Shapley; Pioneers in electrical communications by Eligio Perucca and Vittori Gori; How medicine became a science by Sir Zachary Cope; Science and agriculture by Firman E. Bear; Some aspects of Franklin's life in England by E. N. da C. Andrade; and The good citizen of the world by B. Bubert Cooper.

### High Voltage Electron-beam Processing

THIS BULLETIN, PUBLISHED BY the High Voltage Engineering Corporation, Cambridge, Massachusetts, is an authoritative survey of radiation machines and their application in chemical processing, sterilization and industrial research. The booklet aims at presenting in some detail the technical and economic factors that must be considered in applying electron-beam radiation to industrial processing, and to describe electron accelerators manufactured by the firm, which are claimed to be the most advanced radiation sources available.

### Announcements

■ Prof. G. B. B. M. Sutherland, now Professor of Physics and Director of the Biophysics Research Centre in the University of Michigan, has been appointed to

be the Director of the National Physical Laboratory, Teddington. Prof. Sutherland is a leading authority on infrared spectrum analysis.

■ *Sir Cyril Hinshelwood*, Dr. Lee's Professor of Chemistry in the University of Oxford, has been elected the new President of the Royal Society. Sir Cyril is well known internationally both for his researches as a physical chemist, and as Foreign Secretary of the Royal Society since 1950. His researches on complex chemical reactions have thrown new light on fundamental processes in biological systems.

■ *Award of Doctorate Degrees*—The following persons have recently been awarded the Ph.D. degree by the University of Poona: (Miss) Tripti B. Biswas (*Ferns of the Bombay State: The structure and life history of Anisogonium esculentum Presl and some Acrostichoid ferns*); M. S. Chennaveeraiah (*Cytoembryological studies on the genus Dipcadi medic (Fam. Liliaceae) and Hyphaene gaertn. (Fam. Palmae), with a note on the Karyotypes in the Marsileaceae*); Keshav Ramchandra Phadke (*Measurement of atmospheric noise interference to broadcasting in 3 and 5 Mc/s. bands at Poona*).

M. L. Sen Gupta (*Treatment of groundnut oil with clays and its chromatographic separation on alumina*) has been awarded the D. Phil. degree by the University of Calcutta.

(Miss) Nirmal Narang (*Morphological and embryological studies in Ephedrales*) has been awarded the Ph.D. degree by the University of Delhi.

(Late) P. N. Srivastava (*Further contributions to the knowledge of Glossopteris flora of India*) has been awarded the Ph.D. degree by the University of Lucknow.

■ *Colonel Amir Chand Trust Prizes for Medical Research*—The Indian Council of Medical Research will award during 1956 six prizes of the value of Rs. 300 each for the best research papers in medical science published by workers during the year 1955 (1 January to 31 December 1955).

Candidates may submit 10 reprints of their papers published during 1955 so as to reach the Director, Indian Council of Medical Research, 'P' Block, Raisina Road, New Delhi, not later than

1 August 1956. The papers should be accompanied by a short biographical sketch and two copies of passport size photographs of the authors.

## INSTRUMENTS AND APPLIANCES

### GAS MULTIPLIER

A new type of electron multiplier, called the 'gas multiplier', has been devised and constructed by C. H. Vincent of the Department of Engineering, University of Edinburgh. The device, while using the Townsend  $\alpha$ -process for electron multiplication, is practically free from the positive feedback effects which set an upper limit to the gas amplification by employing a stage-by-stage system operating under highly stable conditions.

The chamber containing the gas is divided into stages by equally spaced plane, parallel electrodes ensuring a uniform field throughout the working volume of the multiplier by the application of a specified voltage per stage. The only communication between successive stages is through small holes in a central circular area in the intervening electrode. These holes are closely spaced and uniformly distributed and occupy only a fraction B of the total working area; the electrode thickness (0.013 cm.) was small compared with the hole diameter (0.079 cm.) to minimize field distortion. At sufficiently low pressure and with a fine hole pattern with a suitable random method of arrangement of the holes in successive electrodes, approximately each electrode may be taken to intercept all but a fraction B (0.125) of the particles or photons approaching from each side.

For satisfactory stable operation of the multiplier it is essential that each stage should have a suitable margin of stability by itself and that, in operation, the positive ion and photon flux reaching a stage from a later stage should decrease markedly with increasing number of stages. These conditions will be fulfilled if  $\gamma e^{2\alpha} \ll 1$  and  $G.B. \gg \frac{1}{2}$  where  $\alpha$  and  $\gamma$  are the usual Townsend coefficients and G, the stage gain.

The results of even the not-so-accurate preliminary experiments undertaken to demonstrate the action of the multiplier showed no appreciable delay or distortion other than a rise-and-decay time

of less than 10  $\mu$ sec. (considered to be mainly due to the collection of positive ions in the last stage) provided the output current did not exceed 20  $\mu$ a. This value of the current is of the order at which space charge effects are to be expected with an input pulse longer than the collection time [*Nature*, **177** (1956), 391].

### AUTOMATIC FRACTION COLLECTOR

An automatic fraction collector has been designed at the National Institute for Medical Research, London, to meet varied requirements in ion-exchange and chromatographic methods of analysis. The equipment comprises a turntable carrying a circular rack of 100 collecting tubes arranged in a spiral formation. Any size of test-tube from  $\frac{1}{2}$  in. to 1 in. may be handled, the change from one to another being made simply by changing the rack. The turn-table is driven from one tube position to the next by means of a motor controlled by a relay system which will accept an electrical signal of almost any duration from whatever device determining the fraction to be collected. This device is normally a siphon on a balance arm carrying a mercury switch but may also be, for example, a process timer or drop counter.

Practically the whole of the mechanism is enclosed in a box forming the base of the instrument, the top of which is a drain tray; through this projects the turn-table which carries the rack of collecting tubes. Liquid may literally be poured over the instrument and, provided the rate is not more than the final drain pipe will carry, the mechanism will be adequately protected.

The liquid from the column is fed in through a funnel and tube which are carried on an arm pivoted outside the circle of the rack and turn-table. The funnel tube is turned down and drips into the appropriate collecting tube. This arm is coupled to its supporting shaft by a sprung detent clutch so that when removing a rack of tubes it may be pushed clear. When it is returned to its normal position it is located by a ball 'click'. The spiral, on which the tube centres in the rack lie, is repeated on a 'programme' disc underneath the drain tray in the form of a brass rail attached to the disc by chairs, one for each tube position. A second arm

rigidly attached to the shaft carrying the funnel tube arm has a skid on the end of it which is held against the rail by a spring. A second skid lifts as a chair passes it and operates a micro-switch which cuts off the drive and stops the turn-table in the correct position for filling the appropriate tube.

In the event of damage to the column or any failure, effluent falls on to a vitreous-enamelled tray and may be piped into a suitable reservoir. After filling the last tube the turn-table moves on so that the effluent falls through a blank position in the rack on to the drain tray.

Switching off the main switch automatically disengages the drive from the turn-table so that it may be freely rotated both for easy loading and unloading, if the rack has not been removed for that purpose, and also for setting back to the starting position [*Chem. & Ind.*, (1955), 583].

#### CAMBRIDGE TEXTILE EXTENSOMETER

The Cambridge Textile Extensometer has found more extended use than originally designed for and has become a valuable adjunct to research laboratories and production testing departments dealing with fibrous materials—natural and synthetic. The accuracy of the tests carried out on it does not depend on the performer's skill. It can record, in rectangular co-ordinates, the load-extension relationship including such factors as ultimate strength and extension and hysteresis loss arising from different behaviour, during loading and unloading, the load-extension curve of single fibres, yarns and small strips of material either in dry state or in a temperature and/or humidity control cabinet, or whilst immersed in a liquid. Change-over to the operation of constant rate of loading from that of constant rate of extension of specimen and vice versa can be very rapidly effected by means of a switch. The instrument is entirely a.c. mains operated and gas-filled relay valves avoid all electrical contact troubles. In a modified version, the drum carrying the record-sheet is provided with a four-speed gear box which enables to obtain records in which elongation is magnified 1, 5, 10 or 20 times, the changing from one speed to another being effected in

a few seconds. A planimeter device provided with the instrument integrates the area under any curve thus giving a measure of the work done [*Fibres, Natural & Synthetic*, 16(11) (1955), 398].

#### PRECISION POSITION INDICATOR

An important problem in mechanical engineering, the accurate placing of one object relative to another, has been solved by an electronic method which makes use of prismatic gratings consisting of glass strips carrying a line structure. A beam of parallel light is passed through two of such gratings superimposed and their relative movement produces a modulated pattern of light which varies through one complete cycle of light and darkness for a movement of one line width.

For the measurement of movement of a body, e.g. the table of a machine tool, a long grating is attached to the body and two (to enable determination of direction of travel) narrow beams of light are passed through this grating as also through a small stationary grating. Each beam is collected and is transmitted to a separate photo cell which gives an electrical signal whenever the light is unobstructed by the presence of lines. A count of the signals as the table moves gives the exact distance travelled. An accuracy of measurement (governed by the number of lines) of 0.0001 in. with a 5,000 lines/in. grating has been achieved [*Indian east. Engr.*, 118 (2) (1956), 91].

#### EVAPOROGRAPH

Evaporograph, a unique instrument which makes it possible to spot objects in total darkness, has been developed by Baird Associates Inc., Cambridge, Mass. The device, which utilizes no electronic circuitry, is based on the knowledge that different materials radiate varying intensities of infrared radiation, depending upon temperature and surface.

The unit collects radiation emitted from an object and focuses it as an image on to an oil film. The oil then evaporates away from point to point at rates varying with the amount of radiation received at each point. Seen in reflected light, these differences in oil film thickness appear as different colours, like oil films on water. A detailed thermal picture of the

field of view in thus obtained in colour. This picture can be viewed directly or a photographic record can be made with a camera which is incorporated in the apparatus.

The unit is designed to observe radiation ranging from one to several thousand degrees Fahrenheit and features a sensitivity down to about two-tenths of a degree. Accurate temperature measurements can be made either visually or photographically from this image.

The evaporograph presents a number of new areas of application in industry and research. This makes possible to observe simultaneously temperatures over the entire surface of a process vessel or an electronic chassis. The evaporograph also holds promise for the construction industry. A picture of a house in winter, for example, would indicate points where heat was escaping, and where insulation should be added. The instrument has interesting application in medical field also. The temperature differences over the surface of the human body are directly related to health. These differences can be seen in detail with the evaporograph. The picture so taken has as much detail as a regular photograph.

#### FILTER FOR HIGH TEMPERATURE FILTRATION

A versatile sintered filter of new design has been introduced by Purolator Products Inc., Rahway, N.J. Capable of handling fluids at temperatures up to 1,000°F., the new filter can take flow rates comparable to any high temperature filter in existence with lower differential pressures and a better degree of filtration. It can handle differential pressures up to 500 lb./sq. in.

Made of sintered metal, the new filter can remove particles as small as 1  $\mu$  in size from a wide range of fluids, including nitric, hydrochloric, sulphuric and phosphoric acids and strong alkalis.

The one-piece sintered element can be made in a variety of diameters and lengths and its radial fin construction can be supplied in specified depths and numbers of convolutions to give extended area within a confined space. Varying flow rates are also available. Filters of stainless steel, monel and other metals can be made as required. Other features of the new filter are its controlled

permeability and uniform porosity which can be varied as to pore size desired [*Chem. Prod.*, **19** (1956), 88].

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**Errata**

In the article entitled "Studies in Elbs Persulphate Oxidation: Part I—Effect of Substituents on the Oxidation of Some Mono & Disubstituted Phenols", **15B** (1956), page 15, Table 2, column 3, read  $\mu \times 10^{-18}$  for  $\mu \times 10^{-12}$ .

In the article entitled "The Heat Stability of Vitamin A in Ghee and Vanaspati", **15C** (1956), page 49, Table 2, column 3, line 4, read 0.06 for 0.0.



# Progress Reports

## BOSE RESEARCH INSTITUTE

THE ANNUAL REPORT OF THE DIRECTOR FOR THE year 1954-55 reveals considerable progress in the activities of the Institute. The construction of a radiochemical laboratory was in progress and a low energy neutron generator with a high yield of neutrons per deuteron beam current and accelerating potential was constructed during the year and another one with 50 times greater yield was under construction.

Besides the normal research activities, the Institute provided facilities for research training to workers from other institutes on such topics as tracer elements; X-ray irradiation of silk-worms; paper chromatography; measurement of absorption of ultraviolet radiation by yeast nucleic acid solution and its hydrolytic products; and studies on soil micro-organisms. It was decided to participate in the work connected with the International Geophysical Year in 1957.

The following is a brief account of the research work carried out in the different divisions during the year.

**Physics**—A spherical symmetry method for determining the absorption cross-section of thermal neutrons has been developed in which an indium foil is used as the detector. The difference in the activity of the foil when enclosed and when not enclosed in a cadmium foil is taken as a measure of the thermal neutron flux. The  $\beta$ -activity induced in indium is measured by means of a scintillation  $\beta$ -counter using anthracene phosphor. The thermal neutron cross-section of sodium chloride determined by this method (29 barns) agrees well with the value determined by the conventional methods based on the use of neutron radiation from atomic pile.

An apparatus with a sensitivity of 1 mg. wt. has been constructed after those of Cady, Gating and others for studying the absorption of ultrasonic radiation in liquids. It measures independently the radiation pressure in the liquid at different distances from the source as well as the pressure due to the hydrodynamic flow.

An artificial source of fast neutrons has been built up using the reaction  $H_1^2 + H_1^2 \rightarrow He_2^4 + n_0^1 + 17.6 \text{ Mev}$ . Ions of deuterium generated in a radio-frequency type of ion source are drawn out and focussed electronically to form a beam current equal to 2 ma. The beam is accelerated to 50 kV. and made to strike against the target (a zircon deposited copper disc holding tritium in absorption), whereby neutrons are emitted.

**Chemistry**—The counter-current distribution apparatus designed and constructed in the laboratory has been standardized by the distribution of penicillin between ether and phosphate buffer and then estimating the distributed materials by agar cup method of assay using *Streptococcus aureus* as test organism. A simple equation

$$\frac{x^2}{A} + \frac{y^2}{B} = 1$$

where  $x$  is the centre of symmetry,  $r$ , the radius of the zone of inhibition and  $A$  and  $B$  are constants, has been derived governing the distribution of an antibiotic in the counter-current distribution apparatus and the zone of inhibition (min.) produced by the antibiotic present in a tube when assayed against a standard test organism by the agar-cup assay method.

The counter-current distribution of the 2-4 dinitrophenols of ketone bodies has been attempted for the first time. When distributed in a 24-tube apparatus the keto glutaric derivative did not move at all; other dinitrophenols moved in accordance with their decreasing chain length, the derivative of acetone being at the furthest end of the series of tubes.

The distribution of beryllium in the counter-current apparatus in the system ethyl acetate (upper phase) and 2N HCl (5 vol.), liquid  $NH_3$  (1 vol.), butyric acid (4 vol.) showed promise of providing a new method of obtaining very pure beryllium directly from bcryl.

**Botany**—Studies on *Agrobacterium tumefaciens*, the organism responsible for the incidence of crown gall tumours in different plants, indicated a strain of the bacterium *Ps. pyocyanea* to possess fairly strong inhibitory action on the causal organism. A medium of the composition peptone, 10 g.; beef extract, 3 g.; sodium chloride, 5 g.; glycerol, 10 g.; distilled water, 1 litre; a pH of 7.3; and an incubation temperature of 37°C. were found to be the optimum conditions for maximum production of the antibacterial substance.

From the results of experiments carried out using radioactive phosphorus ( $P^{32}$ ) as tracer element it has been concluded that the pattern of glycolytic breakdown of carbohydrate in mung (*Phaseolus aureus*) bean up to the trioso-phosphate stage is essentially the same as in animal muscle, yeast and pea. The comparative ease with which inorganic  $P^{32}$  finds its way into the glycolytic intermediates suggests the presence of the chain of glycolytic enzymes in pea seedlings in a fairly active stage. This opens up the possibility of isolating the enzymes phosphorylase, phosphoglucomutase and hexokinase from vegetable sources, which has not been possible so far.

**Cytogenetics**—Over 400 strains of cotton including reciprocal, cyclic and multiple crosses up to the eleventh generation are under study. The best plant as regards yield, lint length and ginning percentage was a reciprocal cross in the sixth generation; it yielded 64 bolls which is almost 6 times the normal yield. Irradiation of the seeds with X-rays, in general, resulted in an increase in the number of bolls. The maximum yield obtained was 91 bolls from a treatment with 76 ma. hr., an increase by about 11 times over the control.

X-ray irradiation of jute seeds resulted in greater height and earlier flowering of the plants. Four of the improved strains of plants from irradiated seeds

(Continued on page 300)

# INDIAN PATENTS

[A few of the Patent Applications notified as accepted in the Gazette of India, Part III, Section 2, 31 March to 21 April 1956, are listed below.]

## Chemicals, plastics, rubber, paints and allied products

52755. Production of chloro-methylene-tetrahydroindanes: *Chlorinating in presence of ultraviolet light 4, 5, 6, 7, 8, 8-hexachloro-4, 7-methylene-3a, 4, 7, 7-tetrahydro-indane formed by reacting hexachlorocyclopentadiene with cyclopentene* — RUHRCHEMIE AKTIENGESELLSCHAFT
52864. New sulphur-containing compounds: *Reacting a benzthiazole-2-thiol with a substituted benzyl halide* — BOOTS PURE DRUG CO. LTD.
52619. Manufacture of cuprous chloride: *Reacting sulphuric acid, sodium chloride and copper in oxygen-yielding form or with an oxidizing agent* — PARIKH & RAVAL
55717. Improvements in and relating to the manufacture of cuprous compounds, particularly cuprous chloride, cuprous oxide and copper oxychloride, with or without valuable by-products: *Reacting sodium sulphate or sulphuric acid and copper in oxygen-yielding form with a chloride chemically equivalent to but other than sodium chloride* — PARIKH & RAVAL
52880. Continuous manufacture of propyl nitrates: *Keeping an aqueous solution of nitric acid, urea and ammonium nitrate at atmospheric pressure and at 105°-12°C. and introducing separate streams of nitric acid and corresponding propyl alcohol and collecting the propyl nitrate* — I.C.I. LTD.
52881. Adhesive bonding: *A strand of solid non-metallic adhesive material comprising polyethylene on isobutylene polymeric material and a hydrocarbon resin* — B. B. CHEMICAL CO. LTD.
- 52896 and 56330. Production of organically soluble stilbyl triazole compounds: *Organically substituted 2-(stilbyl-4"-)-(4:5-arylo)-1:2:3 triazole compounds are obtained by conversion of the sulphuric acid groups in sulphonic acid aryl ester, sulphonic acid amide, by way of the acid halides.*  
*Coupling a diazotized 4-amino stilbene compound containing a SO<sub>2</sub>R radical in ortho or para-positions to the ethylene bridge, with an azo component and then oxidizing the o-aminoazo dyestuff to 1:2:3-triazole compound* — J. R. GEIGY A.-G.
52944. Improvements in or relating to piperazine adipate and compositions containing same: *Mixing an equimolecular quantity of adipic acid with piperazine hydrate in a solvent* — THE BRITISH DRUG HOUSES LTD.
53236. Improvements in or relating to 3-pyridinols: *Oxidizing in alcohol solution a substituted 2, 3, 4-furane and then subjecting the resulting product to hydrolysis by being stored or heated in acid or neutral medium* — SADOLIN & HOLMBLAD A/S
53424. Manufacture of new colouring matters of the tetraaza-prophin series: *Comprises heating a substance consisting of or containing a metal with appropriate dinitriles at least one of which contains an acid group* — I.C.I. LTD.
53743. Manufacture of new hydroquinone compounds: *p-Quinone is reacted with C-methyl ethyleneimine and the resulting 2, 5-bis-(methyl ethyleneimino)-hydroquinone is isolated* — CIBA LTD.
54185. Production of diammonium compounds: *Reacting ditertiary bis-aminoalkoxy-alkane with 2 molecules of halogen acetic acid alkyl ester* — J. R. GEIGY A.-G.
54752. Process for producing reactive magnesium carbonate and apparatus therefor: *Reacting magnesium oxide or hydroxide containing compound with carbon dioxide at pH between 7.3 and 9.3* — MAGNETRIT A.G.
54874. Manufacture of phosphorus compounds: *Reacting a compound of trivalent phosphorus with an alcohol or a phenol so that trans-esterification takes place* — CIBA LTD.
- 54999, 55000 and 55069. Preparation of steroid substances: 3 β:17 α-dihydroxy-11, 20-diketo derivatives of pregnane and allopregnane are brominated by first forming a hydrogen bromide complex and then brominating the complex.  
3 β:17 α-dihydroxy-11:20-diketo derivatives of pregnane and allopregnane are brominated in the 21-position by first forming a hydrogen chloride complex with HCl and then brominating the complex.  
*Brominating 3 esters of hecogenin in non-polar organic solvent* — GLAXO LABORATORIES LTD.
55053. Separation of the fission products of cumene hydroperoxide: *The products are subjected to fractional distillation in a single plate column in presence of water, withdrawing acetone from the head of the column, withdrawing hydrocarbons together with water from the intermediate plates and withdrawing phenol with dimethyl phenyl carbinol and acetophenone from the base of the column* — SOCIETE DES USINES CHIMIQUES RHONE POULENC
55087. Method of hardening ethoxyline resins: *An alkylene polyamine which contains at least two tertiary amino groups and is free from other substituents capable of reacting with epoxide groups is used as a hardening agent* — CIBA LTD.
55201. Method for preparing glycan polysulphuric acid esters: *A neutral glycan or an acid or basic derivative thereof is reacted with N-pyridine sulphur trioxide or oleum in the presence of formamide* — F. HOFFMANN-LA ROCHE & Co. AKTIENGESELLSCHAFT
55328. Manufacture of methyl (β-picoly)-amine: *Catalytically hydrogenating 3-cyanopyridine in presence of methylamine* — F. HOFFMANN-LA ROCHE & Co. AKTIENGESELLSCHAFT
55402. Electrochemical oxidation of orthotoluene sulphonamide to ortho-benzoyl-sulphone-imide:

*The oxidation is done between electrodes of which the anode, at least, is composed of lead or a lead alloy, and the electrolyte contains a compound of antimony* — FARBWERKE HOECHST AKTIENGESELLSCHAFT VORMALS MEISTER LUCIUS & BRUNING

55628. Process for recovering heavy hydrogen and heavy water: *Deuterium is continuously transferred from a continuous supply of water to circulating hydrogen by catalytic conversion, the water is then separated from hydrogen and the hydrogen is rectified and reused to take up further deuterium from the water supply* — STAMICARBON N.V.

55642. Manufacture of water-soluble phthalocyanine derivatives: *Heating an alkyl or aralkyl ester with tertiary amino phthalocyanine* — I.C.I. LTD.

#### Chemical processes, engineering and equipment

52875. Process for the purification of tar-containing gases: *Contacting gas with a non-metallic multi-substance catalyst* — DR. C. OTTO & COMP. G.M.B.H., KO-WE NIEDERSCHACHTOFEN GESELLSCHAFT M.B.H. & PROFESSOR DR. W. FUCHS

53174. Portable cooling or heating unit: *A metal casing is charged with a fluid and is cooled in a refrigerator and used for cooling other substances* — AIRFLOW (N'CLE) PTY. LTD.

53400. Electroplating apparatus: *Rack having means supporting work pieces to be plated, an electrode fixed to each end of the rack, a tank receiving the rack and having container for electrolyte mounted on each end thereof, each container being arranged to receive one of said electrodes* — W. D. MACLEAN

55426. Method of purifying waste liquids containing organic polluting constituents and apparatus for performing the same: *Feeding raw influent in a zone of active anaerobic bacterial composition and removing solids by gravity* — DORR OLIVER INC.

#### Physics, general

54927. Dry contact rectifiers: *Comprises a baseplate, a selenium layer, counter electrode and means to stack a number of rectifier plates* — STANDARD TELEPHONES & CABLES LTD.

55482. Electromagnets: *Comprising a winding with a hollow non-magnetic core within the winding, a magnetizable element being fixedly placed at the end of the core which is within the field of the electromagnet when energized, opposite the end from which a plunger enters the core* — MATHUR, MATHUR & MATHUR

55580. Improvements in electric circuits including amplitude limiting devices: *Comprising a source of alternating current signals and connected across it a P-N-junction semiconductor diode in series with a capacitor, the diode having constant voltage region in its reverse conduction characteristics for voltages in excess of critical value whilst discharge time of capacitor is at least several times greater than minimum period of signals* — WESTERN ELECTRIC CO. INC.

#### Food and kindred products

52810. Long-time bio-stabilization of dairy products and means for applying same: *The products are treated to be brought in the sporic state, all germs destroyed and then subjected to a permanent gaseous pressure* — J. N. WISER

#### Drugs and pharmaceuticals

52865. New acaricidal preparation: *Comprises benzylthio benzthiazoles with a carrier or diluent* — BOOTS PURE DRUG CO. LTD.

56537. Insecticides: *The products comprise chlorination products when obtained by chlorinating 4, 5, 6, 7, 8, 8-hexachloro-4, 7-methylene-3a, 4, 7, 7a-tetrahydroindane* — RUHRCHEMIE AKTIENGESELLSCHAFT

52221. Production of new aliphatic esters of phosphoric acid and pest control agents made from such esters: *Reacting trimethylphite with trichloroacetic acid ester* — J. R. GEIGY A.-G.

52666 and 56646. Preparation of microbicidal articles: *Microbicidal composition comprises a sparingly water-soluble germicidal silver compound and a sparingly water-soluble light stabilizer for the silver compound.*

*Articles such as fabric are treated with an aqueous solution comprising a water-soluble silver salt and subsequently with an aqueous solution of a water-soluble salt the anion of which forms a sparingly water-soluble silver salt, and with a second sparingly water-soluble metal salt functioning as a stabilizer* — DEPENNING

52951. Insecticidal composition: *The composition comprises a polyhalogen-substituted organic compound, a pulverulent solid carrier and an acid neutralizing agent diffused throughout the composition* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ

54463. Plasma fraction and standard plasma preparation and method of preparing same: *Oxalated bovine or equine plasma is mixed with a plasma fraction obtained from prethrombin-free plasma* — ORTHO PHARMACEUTICAL CORPORATION

54464. Thromboplastic active material and method of preparation thereof: *Finely divided rabbit brain or lung tissue is extracted with aqueous methanol or ethanol (5-20 per cent by volume) in the presence of 0.01-60 per cent by weight of a low molecular weight amino acid, the tissue is separated from the solution and the latter dialysed against distilled water* — ORTHO PHARMACEUTICAL CORPORATION

52583. Preparations for combating noxious organisms: *Comprises a biocidal ingredient in admixture with a non-solvent carrier and/or a surface active agent* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ

53096. Biologically active composition: *An aqueous dispersion of plasticized polystyrene is mixed with an aqueous dispersion or solution of a biologically active ingredient* — MONSANTO CHEMICALS LTD.

53120. Composition for combating trichuris infection in mammals: *A dosage unit containing a mixture of not less than about 30 mg. of 3-methyl-1-pentyn-3 yl acid phthalate or salts thereof and a pharmaceutical carrier is made* — ALLIED LABORATORIES INC.

#### Fuels and lubricants

53152. Improvements in or relating to burners: *Comprising in combination an elongated tube with a combustible fluid under pressure and having at the top open end a nozzle means covering the top open end of the tube and being fixed to the latter for directing the combustible fluid upwardly from the tube* — ATLANTIC INVESTMENT CO. (MONTEVIDEO) S.A.

54081. Liquid fuel injection pumps: *Manually operatable push piece enables governor actuated lever to a position to provide extra fuel for starting the engine* — C. A. V. LTD.

#### Metals and metal products

52505. Improvements in hot blast cupola installations: *Comprising a heating chamber into which hot gases are led and the latent heat contained in hot gases is released for heating air or water for generating steam* — W. STRIKFELDT & Co.

52869. Improvements in or relating to alloys: *Containing 2-15 per cent tungsten or containing 0-001-0-05 per cent boron or mixture of two, each being within the respective range* — WILLIAM JESSOP & SONS LTD.

53230. Method of and apparatus for separating ore: *Subjecting the mixture of particles to an electric field to activate the particles characterized by relatively short electro-levitation times but of a period of duration insufficient to activate other particles* — McCONNELL

53420. Method for smelting fine-grained charge components in a shaft furnace: *Fine-grained ore and fuel are formed into compound pieces by sandwiching fuel layer between ore layers* — KO-WE NIEDERSCHACHTOFEN GESELLSCHAFT M.B.H.

53722. Improved process for protecting ferrous metal articles from atmospheric corrosion: *Treating the surface with an oil-in-water emulsion in which the oil phase comprises a solution in oil of a derivative of orthophosphoric acid* — I.C.I. LTD.

54298. Manufacture of metal articles from tungsten metal powder: *Heating pressed tungsten bars to a temperature to fuse the bar removing the undesirable traces of additives from the porous bar by heat treatment and finally sintering* — EGYE-SULT IZZOLAMPA ES VILLAMOSSAGI RESZVENTY-TARSASAG

54794. Improvements in or relating to the welding of metals or alloys: *Using a continuous welding electrode which comprises wire mesh, the interstices of the mesh being filled with a coating material consisting of one or more metals or alloys in powder form* — THE INDIAN OXYGEN & ACETYLENE Co. LTD.

55518. Production of sintered magnesite from powdered or finely granulated magnesium compound: *Magnesium compound is sintered together with magnesium sulphate acting as a binder, the sintered mass is raised to a temperature above the sintering temperature* — WINTERSHALL AKTIEN-GESELLSCHAFT, KASSEL

#### Leather and leather products

52798 and 52799. Preparation of synthetic tanning materials: *Sulphonating phenol-aldehyde resin with a product obtained by condensing sulphonated non-phenolic aromatic compound with formaldehyde.*

*Sulphonating phenol-aldehyde resin with a product obtained by condensing sulphonated phenolic aromatic compound with formaldehyde* — COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

## PROGRESS REPORTS — Continued from page 297

flowered 67, 67, 66 and 14 days earlier than the control plants without their height being adversely affected.

Irradiation of seeds of sesamum and brassica gave plants with increased number of branches resulting in increased production of seed pods, greater yield of oil and earliness of flowering. The maximum earliness of flowering (7 days) was obtained in the case of a selection of sesamum from the 50 ma. hr. treatment. The oil content in a mutant of the fifth generation was 53.5 per cent as against 41.2 per cent in the control. In the case of brassica, a maximum earliness in flowering of 14 days was observed in a selection of the 100 ma. hr. treated brown *varson*.

**Microbiology** — An exhaustive survey of the antibiotic activities of fungi isolated from W. Bengal soil was undertaken and 50 strains have been identified possessing antibiotic activity, notable among them being *P. variabile*, *P. vermiculatum*, and *P. steckii*. *Curvularia lunata* has been shown to be active against gram-positive bacteria. A strain of *A. candidus* isolated from the soil possesses antagonistic action against gram-positive bacteria.

An exhaustive study has been undertaken of different antibiotic and antifungal substances produced by micro-organisms belonging to the group

*Streptomyces* sp. The production of one of the antibiotic substances isolated possessing remarkable antibiotic properties against gram-positive, gram-negative and acid fast bacteria has been carried out up to the pilot plant stage.

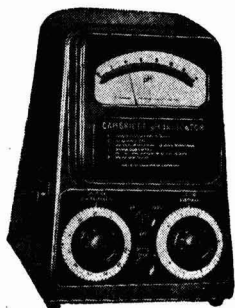
Mutations induced in *Aspergillus niger* by ultraviolet irradiation are being studied. Of the 35 mutant strains investigated, 7 (20 per cent) produced more citric acid than the non-irradiated strain.

Search for active retting micro-organisms for jute fibre have led to the isolation of two strains of *A. niger* with positive action. The retting activity of the cultured micro-organisms was highest when the fungus had no supply of food materials other than that found in jute stem.

**Zoology** — According to a hypothesis proposed for the metamorphosis of tadpoles into froglets, vitamin B<sub>12</sub> secreted by some of the intestinal flora of the larval tadpoles grown in the normal habitat is responsible for this phenomenon. This explanation is based on the observation that metamorphosis of tadpoles can be arrested for periods up to 15 months by immersing them in dilute solution of penicillin and can again be induced by keeping the retarded tadpoles in dilute solution of vitamin B<sub>12</sub>.

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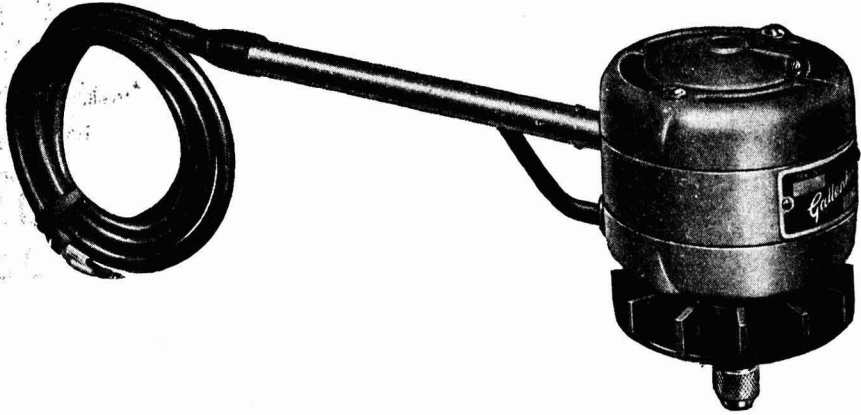
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