

Journal of



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[Vol. VI]

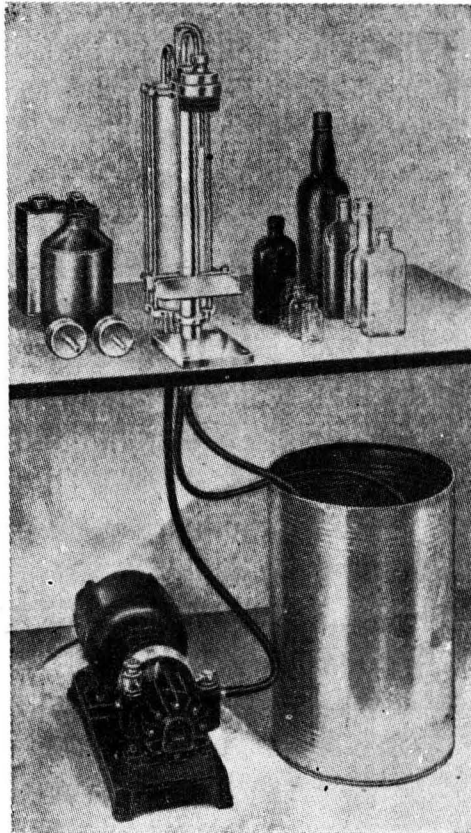
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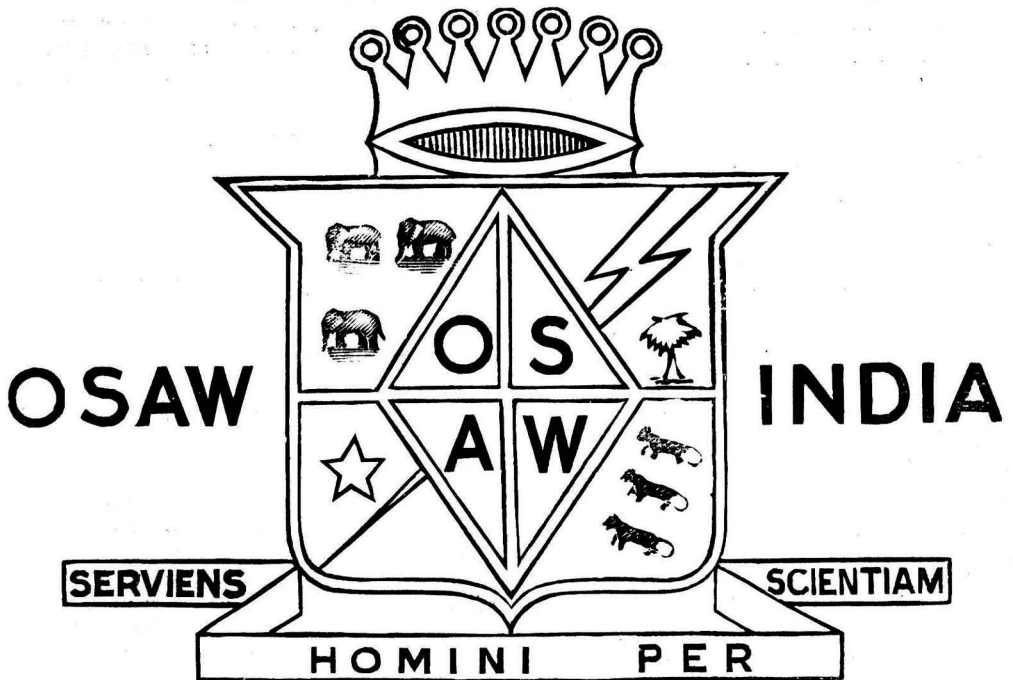
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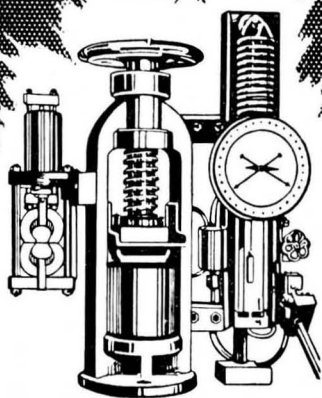
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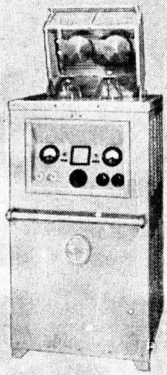
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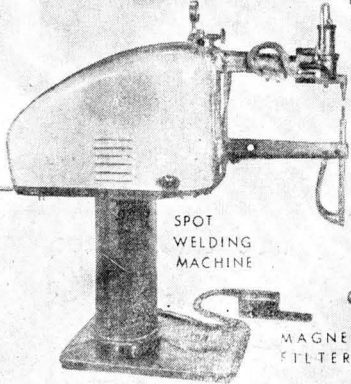
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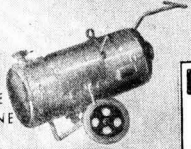
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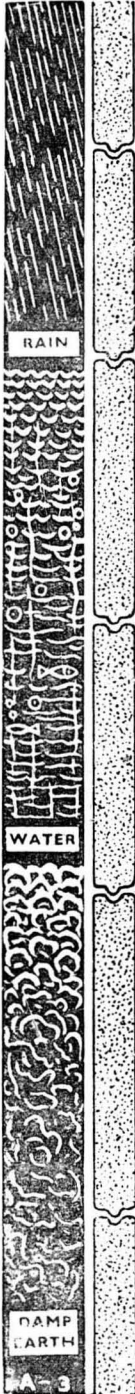
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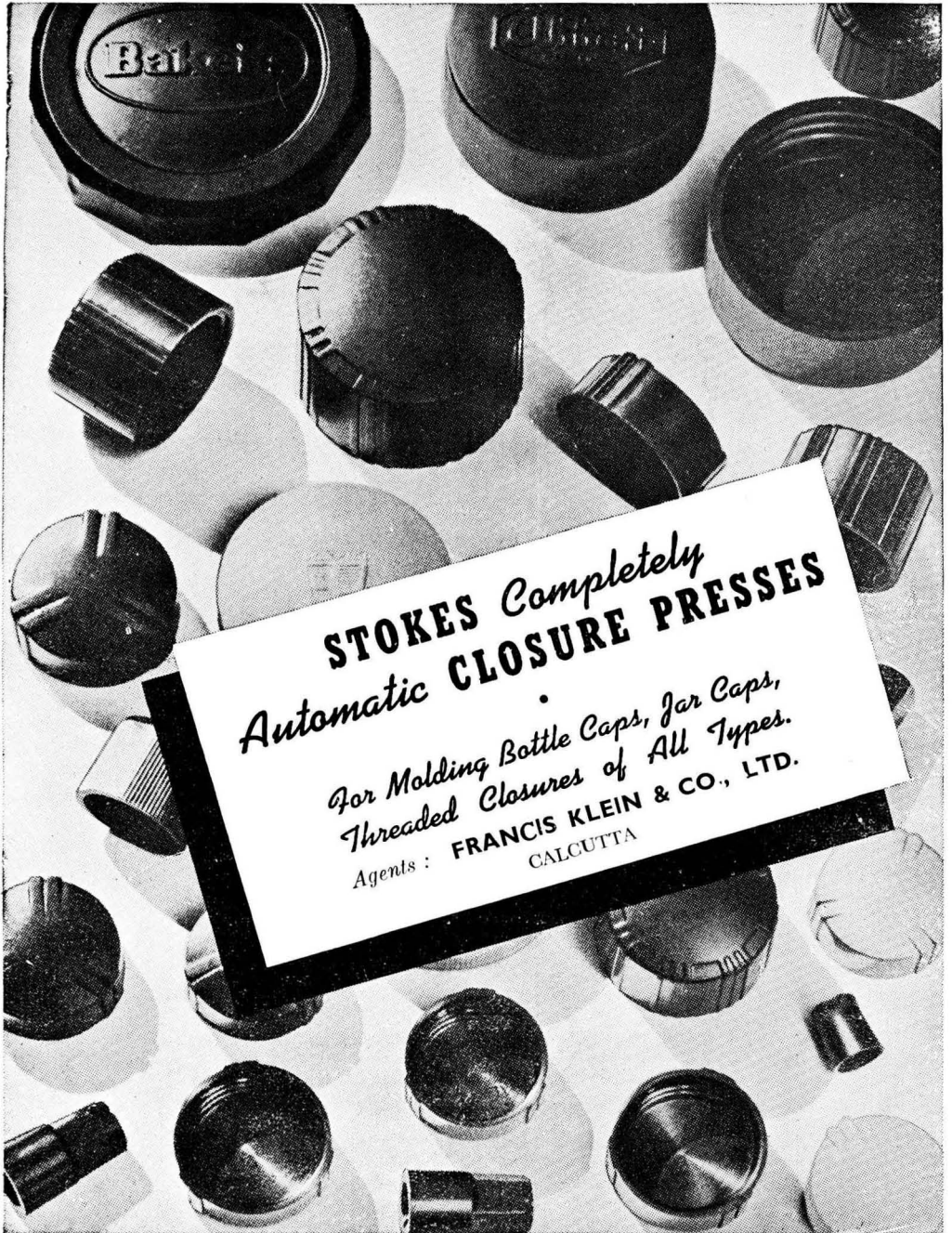
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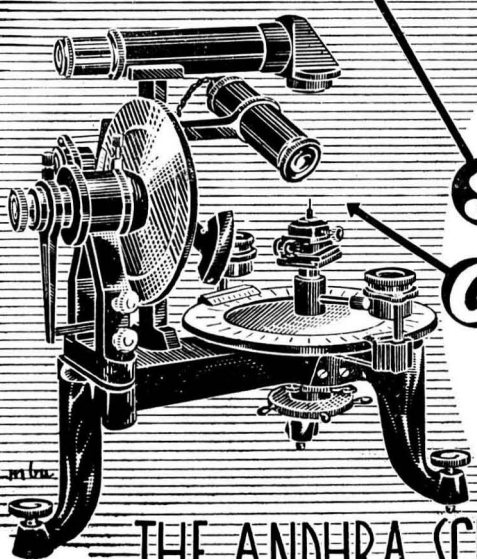


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“IMPROVEMENTS IN THE PROCESS OF TREATING LEATHER FOR MAKING CUP LEATHERS OR BUCKETS FOR PUMPS, HYDRAULIC CYLINDERS OR THE LIKE AND THE PRODUCTS SO PRODUCED” has been left at the Patent Office, on behalf of **THE TATA IRON AND STEEL CO. LTD.**,

The petition may be inspected at the Patent Office, 214, Lower Circular Road, Calcutta. Any person desirous of opposing the grant of extension of the term of this patent should on or before the 31st October 1947 lodge with the Controller of Patents and Designs, at the above address a notice on Form 6 of the Indian Patents and Designs Rules, 1933, and should at the same time serve a copy of such notice upon the petitioners.

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University Buildings, Delhi.

1. At the instance of the Scientific Man-Power Committee of the Government of India the National Institute of Sciences of India proposes to assess the ‘drift of leakage’ of scientific talents in the country. All persons, who possess scientific and technical qualifications, and are either unemployed or engaged in non-technical or unproductive occupations are requested to send the following information in tabular form :

Name ; Age ; Permanent and present addresses ; Scientific or technical qualifications and experience ; present occupation ; whether the qualifications possessed by the candidate are being used to best advantage in his present occupation ; whether conditions or work in the present occupation can be improved and if so, how.

2. It is also proposed to compile under the auspices of the National Institute of Sciences of India a National Register of Scientific and Technical Personnel, available in India. All persons, who possess scientific, technical or engineering qualifications, are requested to send full information in tabular form regarding :

Name ; Age ; Permanent and present addresses ; qualification and experience ; Present occupation and nature of work.

3. These enquiries are confined to persons possessing the following *minimum* qualifications :

B. Sc. (Hons.) or post-graduate degree in Science ; Diploma in technology or engineering ; Diploma or degree in medicine, agriculture, animal husbandry, veterinary and related subjects.

Replies to this questionnaire should be sent in *duplicate*—one copy to Prof. S. P. Agharkar, C/o Law College, Poona, to whom all subsequent correspondence should be addressed, and the other copy (of *information only*) to the Secretary, National Institute of Sciences of India, University Buildings, Delhi.

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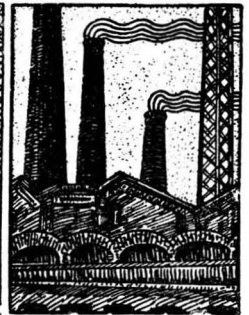


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A Rice Board for South-East Asia

THE Conference of the Rice Study Group of the Food and Agricultural Organization (F.A.O.) which was held in Trivandrum during May and June, served to focus the attention of the world in general, and of the South and East Asian countries in particular, to a food grain which had not so far received adequate attention. The purpose of the Conference was to consider, at the expert level, the rice situation in all its aspects, especially the problems confronting the rice producing and rice consuming countries of Asia, and to prepare a report embodying specific suggestions for such action as may be needed internationally and within national units. The discussions had direct relevance to the objectives outlined at the Copenhagen Conference (1946), *viz.*, "To develop and organize production, distribution and utilization of basic food; to provide diets and health standards for the people of all countries; and to stabilize the agricultural prices at levels fair to producers and consumers alike." The F.A.O. Preparatory Commission on World Food Proposals

which considered the broad aspects of this resolution made a number of recommendations whose relevancy to the rice economy of Asia was to be examined by the Rice Study Group. The Conference brought together the available statistics of production, trade and prices, data relating to marketing methods and plans for increased production, price stabilization and famine reserves, and scientific information relating to rice culture, milling practices and storage. Experts from many countries discussed the rice problem informally and fully, and while their findings are not binding on the Governments represented, their recommendations for action will be considered at a conference which will be called later to consider them.

The importance of rice among food grains has not been adequately recognised. Rice constitutes the most important staple diet of nearly a third of the world's population. It is not a surplus crop, and unlike other agricultural crops, *e. g.*, maize and corn, and money crops like cotton and sugarcane, for which international organizations have been

set up and are functioning, rice has not so far received any attention at the international level. About ninety per cent. of the rice producing and rice consuming areas lie in South and East Asia. The rice eating populations are less adaptable to changes in diet than those whose staple diet is wheat or millets. The augmentation of rice production and its equitable distribution among people who need it most, under conditions which would enable hungry people to buy it, present problems demanding very special consideration. The F.A.O. has roused world attention to the serious and complex problems of food distribution, and its attempt to ameliorate the situation caused by chronic shortages persisting in vast regions of the world, by making member nations jointly responsible for feeding the under-fed populations, has met with notable success. The decision of the F.A.O. to consider the problems connected with rice has not come a moment too soon and the discussions at the expert level held at Trivandrum are likely to yield results of considerable significance to the rice producing and rice consuming people of the world.

Rice Shortages will continue

A factual examination of rice shortages reveals that people dependent on rice as staple food did not, even before the war, have enough to live on. Rice production greatly suffered in the countries occupied by the Japanese armies, and despite serious efforts made since the end of the war to rehabilitate the rice economy of these countries, pre-war production has not been attained so far. The demand for rice has outstripped total availabilities. The analysis made by the Rice Study Group shows that chronically deficit countries like India, China, Japan and Ceylon will continue to experience an acute shortage of rice for at least four years to come. The gap between total demand and total production in 1950-51 is estimated at two million tons, assuming that additional production will be realised and that the present level of rations will be maintained. In seven years' time, the gap between supply and demand will exceed three million tons. A great deal of uncertainty prevails with respect to the pace of rehabilitation and to the practical possibilities of intensifying rice production in the war-affected countries. Men, money and materials are in short supply; fertilizers are difficult to procure and cattle are deficient in numbers.

Even assuming that all the difficulties would be overcome and that additional production would be achieved, still the deficit of production over consumption at the existing sub-minimum ration level is alarmingly high.

Science shows the Way

The Rice Study Group points out that there is only one path for meeting the serious rice shortages which are likely to persist for some years, and that is the use of science to raise the level of production. This can be achieved by improving irrigation, providing good seed and adequate quantities of chemical and organic manures, introduction of mechanised methods of cultivation, eradication of pests and diseases and spreading knowledge concerning improvements in rice culture, processing, storage and transport, through demonstration and propaganda. These suggestions are by no means new; they are being discussed for years.

The present knowledge relating to these measures, however, is still meagre. Generally speaking, scientific studies on rice have not been either extensive or intensive. The funds available to support research programmes have been limited and a considerable amount of work remains to be done before our knowledge of the crop and of the economic factors involved in its production and utilization, are adequate for undertaking extensive development programmes. In India, for instance, which produces nearly 30 million tons of rice out of a world total of 110 million tons per annum, a Central Rice Research Station for the promotion of scientific research and development on rice culture and technology was set up only recently (1946). Before this, rice research was conducted under the auspices of a few of the provincial agricultural departments, and such research was largely uncoordinated.

Even more important than knowledge gained through scientific research is the application of such knowledge to large scale rice production. Thus, although several improved varieties of rice have been evolved in India through breeding only 6 per cent. of the rice area has been covered by such varieties. Experience in different countries indicates that the yields obtained under field conditions is considerably less than those obtained in experimental plots, indicating the manifest urgency for intensifying development research. Such research presents many problems in the rice growing

areas where subsistence farming is the rule and illiteracy among cultivators is widespread. Valuable results in this direction can be secured only through Government aid; properly trained and adequately sized extension staffs should be provided, and finances should be allotted for large scale demonstrations on cultivators' plots operated under local conditions. There is considerable need all over the rice producing areas for fertilizers, tractors and other equipment, and Governments have to supplement information and demonstration work by making essential supplies of improved seeds, fertilizers and implements on a subsidized basis to the farmers.

A Rice Board should be established

These problems are of crucial concern to producers and consumers of rice, and the proposal, sponsored by the Indian Delegation to the recent Conference to establish a Rice Board offers a new approach to the study of problems affecting the rice economy of South-East Asia. The Rice Board will function as the central organization "to collect, collate and disseminate statistical information on rice; to organise, encourage and co-ordinate research on production, processing, storage, marketing and distribution of rice; to keep under continuous review the constantly changing situation with regard to supply and demand, market and trade conditions, transport, consumption and nutritional requirements

of rice; and to identify and analyse new problems as they arise and inform Governments concerned about their nature, scope and importance". The need for the formation of such a Board, working in collaboration with the F.A.O. and other Commodity Boards when formed, is uncontroversial. The Board should have its headquarters in South-East Asia, as ninety per cent. of rice is produced and consumed in this region, and it stands to reason that those who have a major stake in rice should also have a major say. It is hoped that this proposal will find support from all the member nations at the forthcoming Rice Conference.

It was emphasized by Sir S.V. Ramamurthy, leader of the Indian Delegation, that important as the formation of a Rice Board in South-East Asia is, even more important and basic is the need for a new will, a new spirit. "The basic remedy for production in South-East Asia," he pointed out, "is freedom." The need is for straight thinking and for developing self-reliance and economic realism in the field of production. Economic realism, it has been stated, consists in planning for a future which is in sight, prescribing targets which can be attained and setting up an organization which takes into account the availability of human and material resources to achieve the targets. Our fundamental problem is admittedly the problem of production, and this problem must have the highest priority in the programmes of national development.

The Centenary Celebrations of the Chemical Society, London

DELEGATES from 28 countries, including Russia, attended the memorable and historic event,—Centenary Celebrations of the Chemical Society, London,—which was founded in 1841. These celebrations, postponed from 1941, were now attended amongst others by Prof. Timmermanns of the Societe Chimique de Belgique; Prof. Fan-Hsuei Lee of the Chinese Chemical Society, Nanking; Prof. Wheeler of the Royal Irish

Academy, Dublin; Dr. Zaki of Fouad I. National Research Council, Egypt; Prof. Delaby of the Societe Chimique de France, Paris; Prof. Marotta of Societa Chimica Italiana; Prof. Berner of the Norsk Kjemisk Selskop, Oslo; Prof. Achmatowicz of the Polish Chemical Society, Warsaw; Prof. Hevesy of the Royal Swedish Academy of Sciences; Prof. Karrer of the Swiss Chemical Society, Basle; and Dr. Noyes and Colonel Bogert of

the American Chemical Society. The Soviet Union had sent three delegates; their leader was Academician Nesmeyanov, who recently received Stalin Prize for Chemistry, and Prof. Agayev and Kvaskinov. Nesmeyanov was formerly Director of the Institute of Organic Chemistry in Moscow, and is now the acting Secretary of the Chemical Section of the Academy of Sciences. Prof. Agayev is the editor of *Acta Physica Chemica*, one of the leading journals of physical chemistry. India was represented by Dr. S. Krishna of Dehra Dun.

The celebrations, at which about 1,500 chemists were present, took place in the Central Hall, Westminster, on Tuesday, July 15th, Prof. C. N. Hinshelwood, President of the Chemical Society, London, presiding. The opening was preceded by a reception at which the distinguished visitors and delegates, representing kindred societies and organizations from overseas and from Great Britain were received by the President and the Council. Prof. Raymond Delaby, President of the Chemical Society of France (Founded in 1857) read a message of congratulations to the Society on the achievement of its hundredth anniversary, on behalf of all the delegates from overseas. Representatives of societies from overseas then presented their written addresses of congratulations. This was followed by greetings by Sir Robert Robinson, President of the Royal Society, London, on behalf of the sister societies in the United Kingdom.

To mark the event, an exhibition was opened on July 14th at the Science Museum by Prof. Hinshelwood, Mr. George Tomlinson, Minister of Education, presiding. Mr. Tomlinson described the gathering as an expression of international friendship and co-operation at its best. The exhibition is in three sections: historical, a display illustrating chemistry in everyday life, and a selection of books on chemistry. The historical section, arranged by the Chemical Society, is concerned with the achievements of British Chemistry during the past century and includes, among its exhibits, many historic pieces of apparatus. The range is from Faraday's experiments on the liquefaction of gases down to Sir Alexander Fleming's discovery of penicillin. Between these extremes lie such things as Perkin's discovery in 1856 of the dye 'mauve', and Bragg's work on crystal analysis. In the section on "Chemistry in Everyday Life" which has been organized by the Department of Scientific and Industrial Research, an interesting sequence of exhibits shows how chemistry is today

affecting domestic life, agriculture, industry, medicine and the like. It includes sections dealing with such themes as textiles, buildings, roads and transport, fuel, power, health, and food. The exhibition constitutes one of the most comprehensive displays in the history of science yet seen in the United Kingdom.

Before an audience described as the "most representative and distinguished gathering of chemists ever seen in London", Sir Robert Robinson delivered the Faraday Lecture on "the Development of Electro-Chemical Theories of the course of Reactions of Carbon Compounds", and received the Faraday Medal, the highest honour that can be bestowed by the Chemical Society. The lecture was preceded by a dignified ceremony at which Prof. N. J. Bjerrum (Denmark), Prof. J. N. Bronsted (Copenhagen), Sir Henry Dale (Britain), Prof. George C. Hevesy (Stockholm), Prof. P. Karrer (Zurich), Prof. L. C. Pauling (U. S. A.), and Prof. L. Ruzicka (Zurich) were formally admitted to the Society as Honorary Fellows. The most dignified of all the ceremonies was the Graduation Ceremony at which the London University conferred Honorary Degrees of Doctor of Science (*Honoris Causa*) on Profs. Bronsted, Hinshelwood, Karrer and Pauling. This was followed by a dinner by the Duke of Athlone, the Chancellor of the University.

The Prime Minister attended the Centenary Dinner of the Chemical Society, at the Dorchester Hotel on 15th July. He said that "the party to which he belonged had for many years been anxious to make changes in the organization of the society, but the changes it was carrying out were insignificant compared with those brought about by the chemist". As a politician, the moral he drew was that the Government must keep in close touch with the chemist. Mr. Attlee concluded his speech by saying that "Science, like music and art, was international. It should be one of the things which bound the peoples of the world together, not something which separated them". Responding to the toast, Prof. Hinshelwood said that "Chemistry, like all sciences, was a tree of good and evil. The powers that it conferred were mighty, and they could be terrible. The control of them was a matter for the general conscience of mankind". Further on he described "as a welcome sign in the past few years the increasing number of scientific papers published from the chemical industry, clear evidence that leaders of that industry were showing understanding of the intellectual needs of the men

who served it". "One can only hope", he added, "that the whips of commercial secrecy will not be succeeded by the scorpions of military security". At a luncheon given by His Majesty's Government, Mr. Herbert Morrison, Lord President of the Council, said that "Young chemists should pursue fundamental research but the modern world required that the time-lag between scientific discovery and application must be short."

During the celebrations which lasted three days (15th to 17th July) visits were arranged to the British Drug Houses; the Distillers Company Ltd., Epsom; Kodak Ltd., Harrow; the Wellcome Research Institute, Beckenham; Chemical Research Laboratory, Teddington; and the Fuel Research Station, East Greenwich.

Receptions were held by the Imperial Chemical Industries, the Royal Society, and the Royal Institution.

The Centenary Celebrations were followed (17—24th July) by the XI International Congress of Pure and Applied Chemistry which opened at the Central Hall, Westminster, on 17th July. Lord Leverhulme, addressing 2,000 delegates from almost all over the world, said that the Congress was a "significant act of international co-operation. A better understanding of the world might well be promoted by a gathering like that which had brought together men and women from nearly 30 countries all united in one common purpose—the progress of the science of chemistry". Nearly 400 papers were presented, but a significant omission was that of any direct reference to nuclear energy. This was explained by Sir Wallace Akers, who was Director of Research in atomic energy during the war, to the press saying that "the Government that had knowledge of these particular developments had decided to impose an embargo on that knowledge until some other arrangement was made. It is well known to chemists engaged in atomic energy research that their information was only a fraction of what was known, and it was impossible for an honest person to present to the Conference anything that purported to make a serious contribution to the chemical aspect of the development".

Conferences of the 14 sections were held simultaneously in separate rooms at the Imperial College of Science and Technology, South Kensington. The Sections were the following with the name of their presidents in brackets:— (1) *Inorganic and Geo-Chemistry*

(Prof. H. V. A. Briscoe), (2) *Physical Chemistry* (Prof. S. Sugden), (3) *Organic Chemistry* (Prof. A. R. Todd), (4) *Bio-Chemistry* (Prof. A. C. Chibnall), (5) *Chemistry in relation to Agriculture and Applied Botany* (Prof. T. Wallace), (6) *Chemistry in relation to Applied Zoology and Veterinary Sciences* (Dr. W. R. Woolridge), (7) *Chemistry in relation to Food and Nutrition* (Sir Jack Drummond), (8) *Chemistry in relation to Medicine and Therapeutics* (Dr. C. H. Harington), (9) *Chemistry in relation to Fuel, Power and Transport* (Sir Alfred Egerton), (10) *Chemistry in relation to Natural and Artificial Textiles* (Sir Robert Pickard), (11) *Chemistry in relation to Elastomers, Plastics, Glass and Ceramics* (Prof. H. Moore), (12) *Chemistry in relation to Metals* (Mr. S. Robson), (13) *Chemical Engineering* (Dr. A. J. V. Underwood), *Chemistry in relation to Essential Oils, Flavouring Materials and Cosmetics* (Mr. R.K. Allen).

The discussions covered a wide field, for example, in section 7, addresses were delivered on the experiences of groups of men who were deprived of adequate diets in occupied territories, prisoners-of-war camps and elsewhere during the war. The chemistry of underground gasification of fuel was discussed by Dr. Demart of Belgium. The paper on the control of tsetse fly was of interest from the point of view of development of food production in Africa. The raw materials of rayon manufacture were discussed by Dr. Levenstein, and uses of seaweed rayon by Prof. Speakman.

Apart from the sectional paper reading, there were several congress lectures. These were delivered by the following:—

(1) Prof. L. Pauling (*U.S.A.*) on the nature of bonds in metals and intermetallic compounds, (2) Sir Henry Dale (*U.K.*) on the part of chemistry in the new therapeutics, (3) Prof. P. Karrer (*Switzerland*) on some recent advances in organic chemistry, (4) Prof. A. Tisalius (*Sweden*) on the recent developments in electrophoresis, (5) Prof. L. Hackspill (*France*) on La Corbura de calcium et ses propriete's reductrices, (6) Sir Howard Florey (*U.K.*) on some biological properties of chemotherapeutic antibiotics. Sir Robert Robinson delivered the closing address.

The next Congress will be held in 1949 in Holland, and the one after in 1951 in the United States of America. (*Courtesy, Dr. S. Krishna.*)

The Organization of the New Zealand Department of Scientific and Industrial Research

By **E. Marsden**

THE New Zealand Department of Scientific and Industrial Research was constituted in 1926 by Act of Parliament, and is in the charge of a Minister of the Crown, official relations with the Minister being maintained through the Permanent Head of the Department who also acts as Secretary of the Council of Scientific and Industrial Research.

Under the Scientific and Industrial Research Act, a Council of Scientific and Industrial Research was constituted functioning as an advisory body to the Minister and exercising general supervision over research work. The Council submits an annual programme of work to the Minister, together with estimates of the cost thereof for each scientific institution and service under Departmental control. With Ministerial approval the Council appoints committees to oversee the work of the various research associations and services. The Council is an advisory, not an executive body, the Department being the executive organization through which the Council carries out its functions.

The Permanent Services

When the Department was first constituted in 1926, it assumed control of the then existing scientific services operated by the Government. These comprised the Geological Survey, the seismological, time and magnetic observatory services, the chemical laboratory and the meteorological office. Today, the meteorological office is under the jurisdiction of the Air Department and the permanent services have been considerably extended in other directions. A physical laboratory has been added in recent years.

Research Committees and Associations

Fundamental work on agricultural and industrial problems is undertaken, as the need arises, by research organizations within the Department. These are under the immediate direction of advisory committees responsible

to the Council, which must approve all proposals for research and the expenditure involved. The committees are concerned with investigations which of necessity affect all units of any particular industry. The Wheat Research Institute, for example, under the direction of the Wheat Research Committee, copes with the problems of growers, millers and bakers; the results of investigations are available to all interested, not only to those contributing financially.

On the other hand, Research Associations, again under Council control, are formed by distinct units of industry which desire to co-operate for the purpose of research, and which are prepared to make direct contributions of funds for the purpose. The results are available only to members of the Association.

A number of research and service undertakings operate under the direct control of the Head Office of the Department. The most extensive of these is the Soil Bureau, other branches in this category being the Information Bureau, Biometrics Section, and Plant Chemistry Laboratory.

Personnel

The Council members are appointed from among the leading scientists in the Dominion, while personnel of Research Committees is drawn from the industry concerned and from Departmental officers. All appointments to the staff of the Department's professional, technical and clerical branches are made by the Public Service Commission.

Finance

Funds are derived from an annual appropriation from Consolidated Fund of Government. Recoveries are made from industry, by contribution of Research Associations or by payment for specific work undertaken, and from other departments or organisations for routine investigations or special research. The various Research Institutes of the Industrial Research Associations and Committees

are supported by contributions from the respective industries, subsidised £ for £ from the Consolidated Fund.

Policy and Functions

The general policy of the Department is to encourage, organize and co-ordinate scientific research in New Zealand, having particular regard to the needs of both primary and secondary industries. The Dominion-wide co-operation necessary between the Department and other research organisations is secured through the Research Council. Research covers practically all sections of the primary industries; all aspects of milk, butter and cheese production are under investigation on behalf of both the individual farmer and the national economy; through the Research Committees active assistance is given to many manufacturing industries.

Grants-in-aid for research are made to the Cawthron Institute, and the University Colleges (including Massey and Canterbury Agricultural Colleges) in New Zealand, and to the Imperial Agricultural Bureaux and the Imperial Institute in the United Kingdom. Special statutory grants are made to the Carter Observatory Board and the Royal Society of New Zealand.

Research is encouraged by the provision of National Research Scholarships to be awarded to graduates of the University of New Zealand or other qualified persons, to enable independent research to be carried out.

Activities

Work carried out by the Department falls into two main categories: that performed directly for primary and secondary industries, and secondly the maintenance of the permanent scientific services of Government.

Research Organizations.—The Research Institutes and Associations are investigating problems arising in the production of raw materials and finished articles in the case of many New Zealand industries. Tobacco, leather, wheat, dairy produce, fats, wool, fruit, pottery and ceramics production are guided by the work of the corresponding research organization, while assistance to manufacturers in general is provided through the Manufacturers' Research Association. Problems of industrial psychology are under investigation.

The Plant Research Bureau.—The Plant Research Bureau was formerly controlled by a committee of the Council, but the scope

and complexity of its operations rendered this unworkable. The Bureau is controlled by a Chief Executive Officer who is also Deputy Secretary. Under its jurisdiction plant and related investigations are handled by divisions dealing with the botanical, plant diseases, entomological, grasslands and agronomy aspects.

Permanent Services.—The function of the permanent services is to undertake routine and specific examinations as required. The chemical problems of Government Departments and industry are referred to the Dominion Laboratory, while the Dominion Physical Laboratory and the Auckland Industrial Development Laboratories tackle problems on the physical and industrial engineering side. The Soil Bureau, Geological Survey and Magnetic Observatory are operating long-term, Dominion-wide surveys and a regular time service is provided by the Dominion Observatory.

The guidance of the Biometrics Section is available to all branches on the layout and interpretation of statistical experiments.

At present in operation is a twelve months' programme of fundamental research in radio meteorology in which Great Britain and the United States are co-operating.

The Department maintains close relations with the two agricultural colleges of the University of New Zealand and the Cawthron Institute (which is carrying out mineral deficiency work and fruit research).

Liaison Officers overseas are located at London, Washington and Melbourne.

Information Bureau.

In addition to providing information services for industry and research workers, the Bureau is responsible for the Department's publications. These comprise the *New Zealand Journal of Science and Technology*, which publishes accounts of original research in two sections, Agricultural and General, each appearing in alternate months; original accounts of large scale studies are published in the form of bulletins. *The Industrial Bulletin*, published jointly with the Department of Industries and Commerce, contains abstracts of current industrial developments. Soil and geological maps are compiled and published as the survey work of each district is completed. Full details of all aspects of Departmental research are published in the *Annual Reports*.

Geophysical Surveys in Mysore*

By **M. N. Suryanarayana Rao**

(Mysore Geological Department, Bangalore.)

THE Mysore Geological Department, the oldest among the State Geological Organisations in India, instituted enquiries as early as in 1929 to ascertain if some of the foreign companies would come forward to help the Department by geophysical explorations in the mineral development schemes. But the terms quoted by them were unacceptable and therefore the question had to be dropped. Eight years later there arose an opportunity of getting an officer of the Department trained in geo-electrical methods of survey with a view to starting a Geophysical Survey Section in the Department itself. Mr. B. Rama Rao, the present Director of the Geological Department, with his farsightedness and zealous interest in the mineral expansion schemes of Mysore, provided an opportunity to Mr. M. B. Ramachandra Rao, then a Sub-Assistant Geologist, to work for sometime with the geophysical survey party conducting intensive investigations for gold-bearing quartz, under the direction of Mr. A. Broughton Edge, Ex-Director of the Imperial Geophysical Experimental Survey, in the Manighatta Schist belt during 1937. Mr. Ramachandra Rao, after his training, secured the requisite apparatus and began conducting geophysical investigations in 1939, employing some of the well-known electrical methods, and succeeded in locating concealed sulphide ores and graphite deposits and determining the depths of water table in a number of instances.

Subsequently in 1944, the Madras Government sought the help of the Mysore Geological Department to elucidate the depth of hard rock along the different lines proposed for the construction of the Ramapadasagar Dam across the Godavari river near Polavaram. The geophysicist, whose services were lent to the Madras Government, successfully detected the bed rocks at 150'-160' below the surface by detailed electrical surveys, which was proved by core drilling with a margin of error within

10 per cent. of the estimated depths.

During the regime of Mr. B. Rama Rao, the Mysore Geological Department entered a new phase of development in 1944. The Government of Mysore sanctioned the reorganisation scheme of the Department, as a result of which three Divisions were formed for carrying on intensive exploratory work to develop the potential mineral resources of Mysore. It was then that the Geophysical Survey Section was founded on a permanent basis as an adjunct to the State geological organisation. Since then, this Section with Mr. M. B. Ramachandra Rao, as geophysicist and Mr. M. N. Suryanarayana Rao as assistant geophysicist, has been conducting intensive surveys in the mineralized zones in the State.

During the 7 years, 1939-46, the geophysical method has been used in 20 instances for different purposes and at various localities. Out of 20 cases, 11 of them were for the location of either fresh mineral deposits or for tracing the continuity and extent of known ores hidden beneath debris. The determination of the underground water table was the purpose in 4 other cases. The remaining 5 are purely of an experimental character.

The electrical methods have failed, however, to give any reliable indications on the oxidised lead antimony-arsenic lodes which had been located by ordinary exploratory survey and prospecting, though the lodes are well-defined yielding from 2 to 9.5 per cent. of lead, 0.5 to 2 per cent. of antimony, and 1 to 5 per cent. of arsenic in the several samples of the lode material analysed. The investigations were also not successful in detecting segregated patches and bands of coarse scaly and crystalline graphite, forming ore bodies at the edges of an ultra-basic rock at its contact with the kyanite-graphite schists. The methods were found unsuitable to delimit the chromite ore bodies from their enclosing serpentine country rocks.

The methods adopted were quite successful

* Published with the permission of the Director of Geology in Mysore, Bangalore.

in locating concealed graphitic ore bodies composed of argillitic schists charged with fine particles of granular graphite; in locating sulphide ore-bodies charged with 30 to 40 per cent. of pyrites at depths of 10' to 85' from the surface and in locating underground water tables in a number of cases.

A few details of the outstanding results so far obtained by these surveys deserve special mention :

- (1) The detection of a promising pyritiferous ore body at a depth of about 80' below the surface, at Guddarangavvanahalli, in the Chitaldrug District. The ore indicated by the electrical surveys requires to be further explored by deep underground prospecting operations before estimating the available quantity of the material.
- (2) The discovery of a large body of graphitic schists, estimated to yield 50,000 tons of the ore, hidden under debris at a depth of 10' to 15' below the surface. The ore body, containing some 12 to 20 per cent. carbon, is of some commercial importance as it could be used for pencil making, lubricants, paints, foundry facings, electrodes, etc.
- (3) The discovery of an extensive series of pyritic beds hidden beneath a thick cap of debris and ferruginous gossan at Ingaladhah in the Chitaldrug schist belt. About half a million tons of pyritic material, with a varying sulphur content of 25 to 42 per cent., are estimated to occur in an area of about 100 acres geophysically surveyed. It may be possible to utilise the ore located at Ingaladhah and Guddarangavvanahalli areas for the manufacture of sulphuric acid by suitable methods of roasting. Utilization schemes for this ore are being considered by the Department.

For detailed reports on the investigations and the results obtained, reference may be made to the several Records (1940, 39, *et. seq.*) published by the Mysore Geological Department. It may be pointed out that Mysore is making pioneer attempts in this branch of scientific exploration and has already achieved considerable success.

General Principles and Methods

Of the various electrical methods generally used in geophysical surveys the following

4 have been employed in the explorations carried out by the Department.

- (1) Spontaneous Polarisation.
- (2) Earth Resistivity.
- (3) D. C. Equipotential Line Method.
- (4) D. C. Potential Drop Method.

(1) *The Spontaneous Polarisation Method.*—The Spontaneous Polarisation, the Self Potential or the Natural Potential method utilises the natural flow of current in the earth and requires no external current to be introduced into the ground. It is one of the simplest of the electrical methods which under favourable conditions, can indicate the existence of an ore body, especially metallic sulphides in a state of oxidation. The method is dependent on the fact that differences of potential are set up in and around the ore body due to oxidation processes. The upper zones of the ore body are usually in a state of chemical activity different from that of the lower zones and this difference leads to a flow of current which spreads through the ground for considerable distances and passes through the ore body itself. The ground immediately above the ore-body will be in an area of negative potential with respect to all adjoining points on the surface.

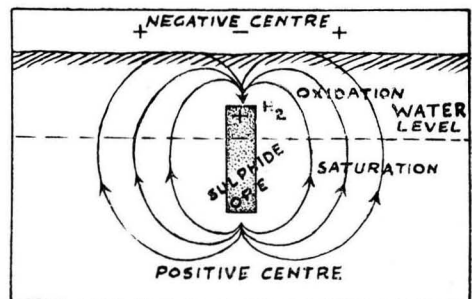


Fig. 1.—Diagrammatic representation of Spontaneous Polarisation.

The maximum negative potential in such an area is known as the "negative centre". Since the ore body will usually be found to lie beneath such a negative centre, it is the location of these centres that is the objective of this method. With a suitable pair of non-polarising electrodes for making contacts with the ground and a portable D. C. potentiometer to measure the potential difference, the natural earth potentials are easily determined along a series of traverse lines over the area. When any important anomaly of negative potentials is noted, the exact negative centre may be located either by directly tracing the equipotential lines on the ground or by

interpolations, in the plane of the potentials determined over a series of connected traverse lines in the vicinity of the anomaly.

Earth Resistivity Method.—The earth resistivity methods are based on the measurement of the apparent specific resistances of the earth. The existence in the ground of a body whose specific resistance differs from that of the surrounding material will affect the apparent specific resistance to an extent which depends upon a number of factors such as the size and depth of the body, the ratio of the specific resistance and the homogeneity of the materials. The measurement of the apparent specific resistance, therefore, affords a means of detecting the presence of bodies which possess marked differences in electrical resistivity as compared with their surrounding medium.

The underlying principle in the various systems of earth resistivity determinations is to introduce a known amount of current into the ground by two electrodes and to determine the potential difference set up between any two selected points and to obtain a measure of the apparent resistance of the portion midway between the potential pickups. A simple relation which enables the resistivity of the ground to be measured is due to Wenner who has shown that if the four electrodes be placed along a straight line at equal intervals of a cms. and the resistance measured is R ohms, the specific resistivity P (in ohm. cms.) is given by the formula.

$$P = 2 \pi a R.$$

Various modifications of the arrangement are possible to suit particular problems to be investigated by resistivity determinations.

The following arrangements have been commonly adopted in the Department:

(a) *Fixed Electrode Separation.*—A fixed separation of the electrodes is maintained with the centre of the system moving successively at suitable intervals along a series of traverse lines over the ground under investigation. From a number of observations, it is possible to obtain much useful information of the conductive (and resistive) zones in the area.

Three types of traverses are usually carried out to suit the nature of the details to be investigated: (i) *Equal Electrode Separation traverse.*—This is adopted when sub-surface features under shallow cover are to be unravelled. The 4 electrodes at equal intervals are moved successively along the traverse line at stations whose interval is equal to the electrode separation. (ii) *Overlapping Elec-*

trode Separation traverse.—The electrode separation is greater than the interval of the stations on which the system of electrodes is successively moved. This enables the determination of resistivity of deeper portions at closer intervals, so that narrow conductive or resistive bands are favourably delineated. (iii) *Unequal Electrode Separation Overlapping Traverse.*—This is a further modification of 'traverse (ii). In this, the configuration of the four electrodes is so varied as to keep the current spikes at distances larger than those between the inner potential spikes. The entire system is moved successively at convenient intervals along the test lines.

The resistivity is given by the formula :

$$P = \pi b \frac{(a+b)}{a} R$$

where a is the distance between the potential electrodes, b that between the current electrode and the nearer potential pick up. This procedure is particularly employed when searching for thin bands or veins.

(b) *Expanding Electrode Separation.*—In this system, the four electrodes are spaced at equal intervals and the measurements taken at successively varying electrode separations, the centre of the system being fixed at the point about which the resistivity variations are to be determined. The resistivity determined may be taken to refer to a block of ground whose dimensions are comparable with the electrode separation and the resistivity may be regarded as pertaining to the electrode separation. The method can be employed to indicate the depth of horizontal or nearly horizontal formations possessing distinctly different resistivity, and under favourable circumstances can be adopted to determine the depth of underground water table, thickness of overburden, and generally speaking to locate any extensive discontinuities involving appreciable resistivity changes.

(c) *Single Electrode Probe.*—Out of the two current electrodes one of them, known as the Home Electrode, is placed at the point on the ground where the resistivity values are required, while the other, the Far Electrode, is at a large distance away from the first. Observations are then carried out in the vicinity of the Home Electrode employing two potential electrodes which are moved in successive equal steps along any one particular straight line passing through the current electrode. Information regarding resistivity changes at gradually increasing depths can be obtained. The resistivity value is obtained from the equation,

$$P = 2 \pi R \frac{a b}{a - b}$$

Where *a* and *b* are the distances in cms. of the two potential electrodes from the home electrode, *R* and *P* have the same significance as before.

This method, like the Expanding Electrode Separation, may be employed to determine the depth of any extensive discontinuity involving appreciable differences in electrical resistivity. The interpretation of the observations is based on abrupt changes in the curves plotted against the apparent resistivity and the mean potential distance, the greatest rate of change of slope giving the depth of the discontinuity.

3. *D. C. Equipotential Line Method.*—The distribution of the equipotential lines is traced when a direct current is passed conductively through the ground between two widely separated electrodes. The potential distribution around each electrode and throughout the intervening country can be represented by a series of equipotential surfaces, the traces or outcrops of which at the ground level are known as the equipotential lines. In a homogeneous ground these lines are hemispherical near the electrodes, but at larger distances, they become almost straight lines in a plane perpendicular to the line joining the electrodes. Characteristic distribution in the equipotential lines will occur in regions marked differences in resistivity than the neighbourhood of any local body possessing surrounding medium. The method can be employed to locate conductive bodies like metallic sulphides.

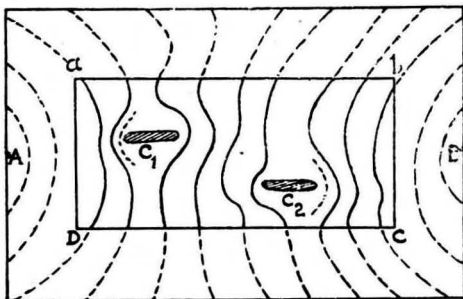


Fig. 2—Equipotential line distortions around conductive bodies.

Fig. 2 shows diagrammatically the characteristic distortions of the E. P. lines that are generally noticeable in the region of conducting ore bodies when the current is passed parallel to the strike of the lodes.

4. *D. C. Potential Drop Method.*—The

method is employed when making a closer and more detailed investigation of the surface potentials than is possible in the E. P. line method.

The layout of the current electrodes is the same as that in the E. P. line method, but the electrodes are disposed in such a manner that the current flows across the strike direction of the expected lodes. The general theory of the method is based on the fact that the potential differences between successive pairs of stations spaced at equal intervals along a given traverse line within the area chosen, will be nearly equal if the ground is homogeneous. But in passing over discontinuous structures, such as a lode, vein or band whose resistivity is different from the adjoining medium, characteristic potential drops are recorded.

Apparatus employed

The apparatus required in the various electrical measurements outlined above are (1) Direct current potentiometer; (2) Non-polarising electrodes, (3) H. T. Battery and Milliammeter set, (4) The Megger Earth Tester, and (5) The Geophysical Megger Earth Tester.

(1) *Direct Current Potentiometer.*—The potentiometer is the basic instrument for all types of work involving direct current measurements. The instrument used by us is the latest design of Mr. A. Broughton Edge, the main potentiometer having four ranges 0-10, 0-20, 0-50 and 0-100 millivolts, operated by two switches. The instrument has combined in it, an auxiliary compensating circuit for balancing out the natural earth currents. The instrument is useful not only for measuring spontaneous polarization potentials but also for carrying out potential measurements in earth resistivity, direct current E. P. line and potential drop methods.

(2) *The non-polarizing Electrodes.*—The non-polarizing electrodes are invariably used for making ground contacts in conjunction with the D. C. potentiometer. They are of the nature of half-cells and are very delicate. The common form of N. P. electrodes consists of a copper tube immersed in a solution of copper sulphate with an excess of crystals contained in a jar with a porous bottom. An improved form of N. P. electrodes is constructed in this Department with Ag-AgCl electrodes in salt solution instead of the CuSO₄ system. The essential feature of such a pair of electrodes is to give no internal polarization

effects, which should in no case exceed 1 milli-volt.

(3) *H. I. Battery and Milliammeter.*—The high tension battery set is made up of a series of dry cells in 2 units, each of 60 volts, provided with tappings at every 6 volts by suitable wander plugs. The milliammeter has two ranges 0-50 and 0-500 milliamps, and the instrument can also serve as a voltmeter with ranges 0-5 and 0-50 volt for testing the performance of the batteries.

(4) *The Megger Earth Tester.*—This instrument made by Messrs Evershed & Vignoles Ltd., London, and primarily designed for measurement of earth plates is being used in geophysical surveys with certain adaptations. The ground contacts for use in conjunction with the Megger Earth Tester consist of steel stakes 1.75' long. In measuring the earth resistance a correction has to be applied every time for the resistance which is due to the metal electrode contact and the earth. This

involves the taking of a large number of readings and making several computations.

(5) *The Geophysical Megger Earth Tester.*—This is a new instrument particularly designed (made by Messrs. Evershed & Vignoles, Ltd., London) for resistance measurements which are unaffected by contact resistances. The instrument consists of a hand-driven generator with two reversing commutators geared to the shaft of the generator (rectifier A. C. to D. C. and converter D. C. to A. C.), an ohmmeter, a galvanometer and a potential dividing resistor. It has five ranges of 0-0.3, 0-1, 0-3, 0-10 and 0-30 ohms. It has been so designed that ample testing current can be obtained with current electrode resistance up to 2,000 or 3,000 ohms and the balancing circuit is amply sensitive with potential electrodes of the same value. It is divided into 2 parts, one containing the hand driven generator, the reversing commutators, etc., and the other the ohmmeter, galvanometer, potential dividing resistor and range switch.

Coal Briquetting

By Hugh P. Vowles

CONSERVATION of the world's coal resources, though often neglected, has always been important. In present circumstances it is a vital necessity. One method of economising which has not received the attention it deserves is the briquetting of coal dust, and small coal. As few engineers are familiar with the processes involved. It is hoped that the following notes, based on personal experience, may be of interest.

The British coal briquetting industry has always been mainly concentrated in South Wales. The coals used are powdered and then, with the addition of a suitable binding material, compressed into blocks varying in shape according to requirements. Blocks of the same type should so far as possible be of uniform shape, size, composition, weight and calorific value; they should be waterproof, strong enough to withstand repeated handling and transportation, and should contain a minimum of ash and clinker-forming ingredients.

The coals are first washed to reduce the ash content. Briquettes are made contain-

ing as much as 12 per cent. to 15 per cent. ash, but better qualities contain not more than about 10 per cent. and in favourable circumstances as little as 6 per cent. to 8 per cent. Failure to remove ash has done more to prejudice consumers against the use of briquettes than anything else.

After washing and screening, the material is dried in a dryer, either of the horizontal type commonly used in cement works, or in vertical dryers in which the coal is spread over a series of tables and slowly scraped by rotating vanes downwards from one table to another. Hot air fire gases or steam may be used to supply the necessary heat.

Thereafter the dried coal is crushed to uniform size. For this purpose squirrel-cage disintegrators or alternatively, swing-hammer pulverisers are used. The binding material in common use is medium soft coal-tar pitch, other materials being too expensive, or lacking in some such vital quality as water-proofing. The pitch is also pulverised, in a manner similar to that

adopted for the coal. Owing to the heavy cost of pitch, as little as possible consistent with satisfactory binding must be used. Excellent briquettes have been made with 7 per cent. pitch; but in general practice it is found that 9 per cent. gives the most satisfactory results.

The proportion of the coals used vary according to the purpose for which the briquettes are intended. It is useless to put a high percentage of anthracite into a fuel intended for steam-raising purposes. On the other hand, a much larger proportion of anthracite may be used for a domestic fuel. A good domestic fuel can be made from a mixture of 80 per cent. anthracite, 11 per cent. bituminous coal and 9 per cent. pitch. A good steam-raising fuel, giving a long flame, may be made from a mixture of 65 per cent. steam coal, 10 per cent. bituminous coal, 16 per cent. anthracite and 9 per cent. pitch.

It should be noted that the finer the pitch is pulverised, the further a given quantity will go in coating the coal particles; and if the coal is less finely divided, then it will present so much less surface to be coated.

The dried and powdered coals are conveyed from the pulverisers to their respective storage bunkers. The powdered pitch is not stored in bulk owing to its low melting point. The next step is to measure out the materials in suitable proportions for mixing. The most accurate device for this purpose embodies a horizontal circular rotating table. The material to be measured falls on to the table through a regulating door, and as the table revolves, a portion is scraped off by a knife blade which, being adjustable, can be set to remove to a nicety the exact quantity required.

The mixture of powdered coal and pitch is then conveyed to an oven or "kneader" to which superheated steam is admitted, the mixture being stirred by blades mounted on a spindle passing vertically through the kneader. The temperature should be sufficient to melt the pitch until a plastic mass is produced. Suitable temperatures range from 570° to 660° F. for the steam supplied, the mixture passing out of the vessel at about 180° to 200° F. As these

final temperatures are well above the melting point of coal-tar pitch, and the briquettes when made should be as cool as circumstances permit, it is advisable to pass the mixture over a cooling conveyor before compressing.

Briquettes for use in domestic grates are generally made in egg or "ovoid" form. The plastic mixture is passed between two large rolls having a number of semi-ovoid recesses in the faces making contact. The recesses register, so that as the material falls between the rolls it is pressed into the recesses, producing a number of egg-shaped briquettes. Sufficient pressure is obtained because the rolls cannot open when the material becomes wedged between them; so that the briquettes, though still soft when leaving the press, retain their shape after falling on to the conveyor passing below the rolls.

From this point the briquettes are carried upon slow moving band conveyors: affording time for the ingredients to cool, and for the pitch to set and bind each briquette into a surprisingly hard and durable article.

Steam-raising briquettes are made in rectangular blocks in presses which give a positive action. The plastic mixture falls into rectangular moulds provided in a rotating table. The table rotates intermittently, and during each pause a press stamp is forced into one of the moulds and compresses the material. Suitable means are provided for ejecting the briquettes thus formed, after which they are conveyed away and stacked in an open space to cool.

In some countries,—Germany and Australia for example, lignite is briquetted, and the processes naturally follow somewhat different lines from those adopted for black coals. Thus lignite does not usually require any binder other than that contained within itself in the form of bitumen and water. Again, lignite may contain as much as 60 per cent. water which not only means much more elaborate drying equipment but also leads to the combination of briquetting with mining (or quarrying) the lignite, since it does not pay to transport water.

United States Bureau of Standards Helps Science Progress on World-wide Scale

LITTLE could the fathers of the American Constitution know what benefits to the United States citizen they incorporated in the brief clause which empowered Congress "to fix the standards of weights and measures." They simply felt that a crying need existed for standardization in the interchange of goods. European measures which the settler had brought to America, after being copied and re-copied had become in time quite different from their originals or from each other. Early in the 19th century, a bushel of grain held 68 cubic inches more in the state of South Carolina than in New York; a pound was nearly a quarter of an ounce lighter in Massachusetts than in Maine.

To establish uniformity, an Office of Weights and Measures was set up. Practically from its beginnings in 1832, it has had to expand its activities beyond calibrating measures and branch out into ever broader fields of science, in order to keep abreast or possibly ahead of technical and industrial developments.

Through the more than 100 years of its existence, its work consistently has outdistanced its name. Today's label of "National Bureau of Standards" is no exception as a misnomer for one of the largest research organizations in the country. When an airplane crashes or a train is derailed and prevention of future failures depends on finding in the wreckage the cause of the accident;

When a man can buy any shirt anywhere in the United States knowing it will fit, because size 15 (39) is everywhere the same;

When a radio operator changes from the 25 meter to the 16 meter band, because a chart tells him that for the next 48 hours the shorter wave will work better;

When the dentists all over the world abandon the practice of mixing fillings in the palm of the hand, because the skin's dampness, absorbed by the mixture, will create pain-causing gases in the cavity;

When millions of New Yorkers use the elevators in the 1,250 foot Empire State Building, feeling safe because the cables have been tested and all possible precautions installed;

When—probably before 1947 ends—radio transmitters will have shrunk to the size of a lady's lipstick;

And when in thousands of other instances a scientist or layman stops to wonder why a yard always is a yard, and a pound always a pound; somewhere in the story behind the quality, size and safety of today's products will appear the name "National Bureau of Standards."

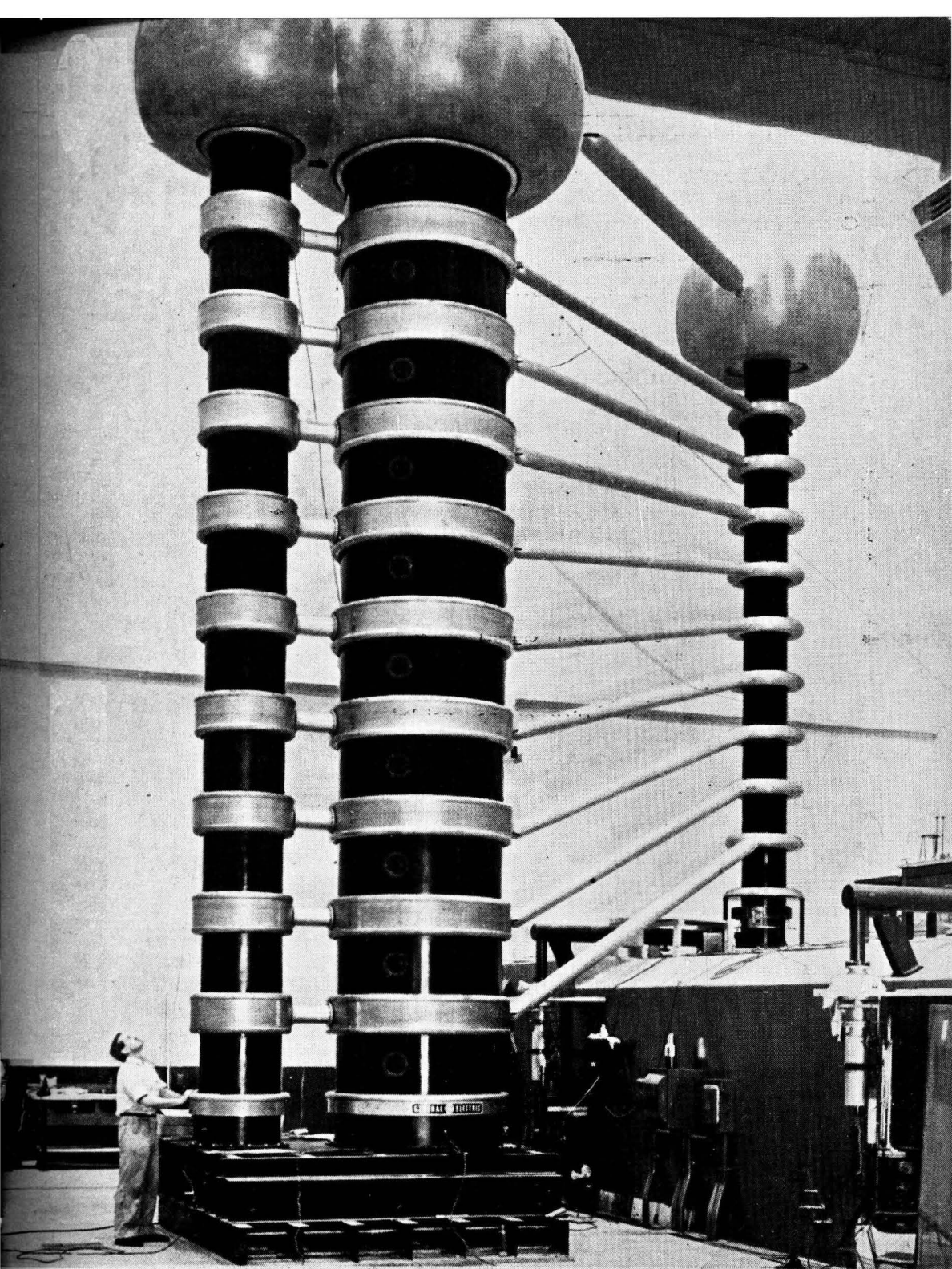
Sets Standard Weights & Measures

As of old, to be custodian of the national standards of physical measurements, in terms of which all working standards in research laboratories and industries are calibrated, is still the Bureau's fundamental function. In a vault under one of its 99 buildings in Washington, D.C., near the city's outskirts, are preserved with great care two pieces of platinum-iridium alloy. One is known to scientists as "Meter number 0.27" the other, more stubby, as "Kilogram number 0.20". They are the nation's standards of length and weight.

"These inert objects," says the Bureau's Director Dr. Edward U. Condon, "function as perhaps the most important of all controls in the complex processes we call industry,—for it is the primary duty of the Bureau to maintain for every industry derived standards based on these national standards. For these tasks the Bureau must develop ever more accurate methods of measurement. It must anticipate the need for new kinds of standards and conduct research of its own in all fields of the sciences."

By the nature of this duty the National Bureau of Standards, a part of the United States Department of Commerce, has become the principal agency of the United States Government for fundamental research in physics, chemistry and engineering. In hundreds of instances it has been a pacemaker for scientists inside and outside the United States.

Testing the huge quantities of material purchased by the government; examining every year the accuracy of all railroad and truck scales in the country; testing some 250,000 samples of measurements yearly; calibrating some 77,000 thermometers; broadcasting continually from its own transmitter time and radio frequency signals, accurate to less than 1,10,000,000th of the intended



The X-ray generator unit, encased in the central column shown in this photograph, is capable of delivering an X-ray excitation current of 25 milliamperes at 1,400,000 volts. Situated in the high voltage laboratory at the National Bureau of Standards, it is part of the equipment used by the Bureau scientists to carry on original research. The column on the extreme right is one of the three X-ray tubes which are used in cooperatives studies with the National Cancer Institute.

value,—such routine work is being overshadowed by the Bureau's research, the results of which become public property and accessible to scientists from all corners of the globe.

Centre for exchange of Knowledge

Since the end of the war the Bureau has resumed a lively exchange of scientific knowledge on a world wide scale. Twelve of its staff members visited foreign countries in 1946. In turn, from foreign nations 11 directors of similar institutions, 14 directors of specialized research centres, an even 100 of research and industrial engineers, and another 100 of university and government representatives have visited the Bureau. Guest workers have done research in the Bureau's laboratories for several months; some intend to stay for a year or two.

As a result of the free scientific exchange, a European university has decided, and others are planning, to establish laboratories which are to be true copies of the Bureau's installations down to the last nail. Hundreds of foreign scientists have taken back with them useful information on the latest achievements of American researchers.

At home, the Bureau also has become a centre for the informal exchange of scientific information. Although an agency of the United States Government, it possesses no power whatsoever to enforce standards or make industry accept the findings of the Bureau's researchers. But, if asked to, the Bureau functions as a clearing house for specific scientific information; it co-ordinates the work of industrial organizations; it may make suggestions and proposals. Quite often, industry and trade not only seek the Bureau's advice, but delegate their own scientists to work and develop under the Bureau's guidance standards to be adopted,—again voluntarily by trade. At times, as many as 100 such research associates on subjects ranging from apparel and kitchen colours to electrical equipment and practically indestructible paper.

Not too many years ago industrialists took a dim view of standardization. They feared regimentation of design, ruin of competitive position, loss of replacement business. Today with a myriad variety of industrial products, standards no longer mean monotony, but savings of millions of dollars. Industry generally has accepted the idea of standards as its Esperanto,—a common language for performance and acceptability. Industry's own American Standards Association, formed by technical and trade organizations, has

approved 864 standards, many of them arrived at with the help of the Bureau, itself a member of the Association.

Responsible for many Discoveries

What the Bureau achieved in war and peacetime research reads like a roll call of modern science. From its electricity division came the radio beacon, the direction finder, and blind landing systems for airplanes. New small and efficient dry batteries were developed. At present the corrosion of under-ground pipes,—often caused by electrical phenomena and costing hundreds of millions in repairs,—and the radio noises originating in interstellar space are under investigation. One of the Bureau's staff members has constructed the radio transmitter housed in a lady's lipstick case; far from being a toy, it makes a perfect portable radio-telephone. World-wide observation of the ionosphere enables the Bureau to issue monthly a forecast of radio disturbances which has materially facilitated war and peace communications.

Practically all of the Bureau's 14 divisions are engaged in new projects. Better aviation fuels and anti-freeze compounds for motor vehicles are being investigated; a vitally needed code for X-ray protection in industry has been completed. A new electrical method of drilling holes less than 0.0015" in diameter was developed which might completely change the world's diamond tool industry. New dental material is being sought in a laboratory so efficient that the American Dental Association recently decided to merge its own laboratory with that of the Bureau.

In sharp contrast to often prosaic tasks such as standardizing thermometers and men's shirt sizes, stand the Bureau's contributions to the epochal achievement of American science, atomic energy. The project that started the atomic age was first handed over to the Bureau's former director, Dr. Lyman J. Briggs. In its laboratories was tested the micrometric purity of uranium destined for fission, leading to what might turn out to be the first "atomic standard". When atomic energy becomes available to industry, scores of other standards and measures, such as for the safety from radioactivity, will be needed. Already standard methods of measuring radioactivity have been developed for medical and nuclear physics laboratories. Another wide new field has opened up in which the Bureau is destined to serve science for years to come.—*U. S. I. S.*

Electronic Computers

MACHINES which think with inhuman rapidity and perform calculations of the highest mathematical order in a fraction of a second, have introduced a new age of mechanization in the United States.

While for centuries machines were built to save muscle power, these new "electronic computers" free the brain power of scientists, engineers, and economists from the drudgery of repetitious, laborious calculations. They solve within minutes mathematical tasks which previously took years or were altogether impossible because no mathematician had the endurance or lived long enough to figure them out. Best of all, the first "computers" operating in the United States have provided the data for building other and better calculating machines.

The United States Bureau of Standards is busy with two machines for a "Computing Laboratory" to which government and private agencies, schools, scientists and industrial engineers can bring their mathematical problems. With the paper work reduced a hundredfold, pure and applied research, economics and social sciences stand on the threshold of new achievements.

The electronic computers outdo, with infinite refinements, the ancient *abacus*, the slide rule and the office adding machine, digest, for example, thousands of weather data and produce the forecast faster than thunder follows lightning. They finish charting a shell's trajectory before the shell hits the target. They are expected to forecast accurately the effects of change in taxes, tariffs, wages or prices upon the economic and social life, and might, in the end, produce the cure for the ills of the world.

Children everywhere often still learn the rudiments of figuring by moving beads of different colours on rods within a wooden frame. The *abacus*, or "number frame", man's first adding machine and used since ancient times, has served the modest needs of the beginner in dozens of variations and in nearly all countries. However, to the modern high school student entangled in mathematical equations, to the statistician, insurance man, tax expert, engineer and chemist, it is at best the source of constant frustration. They struggle daily with unending chains of figures

going into the thousands and the millions; yet, they have to get along with slide rules and desk adding machines,—helpful to be sure,—but inadequate for calculations much more complicated than adding, subtracting, multiplying and dividing. Worst of all fare the scientists. Their flight of thought has remained chained to mathematical computations so inconceivably voluminous as to make an attempt at their solution an undertaking of years, or altogether hopeless.

Abacus, slide rule and adding machine epitomize one of man's failures to parallel the infinite variety of machines saving muscle power with something equally adept in saving brain-power. While the wheel, the lever and new power sources such as steam and electricity have transformed the world's physical mechanism, the simplification of mental processes has seriously lagged behind the complexity of modern society and its motor-driven and chemical techniques.

Mathematical Drudgery slows Science

Nobody will ever know how much science was slowed down by the lack of a thinking machine to unshackle the scientist from the drudgery of calculations by the pencil-and-paper method. United States meteorologists know of mathematical equations which could describe the weather more accurately than anything else but the calculation takes too long. The weather would be here and gone for weeks before the most versatile mathematician could produce the equation's solution by hand. Airplane designers know of a way to determine mathematically the air flow around wing shapes at any given speed; but this mathematical problem borders so closely on the impossible that they prefer the costly trial-and-error method of wind tunnel tests. It took the English physicist Dr. D.R. Hartree 15 years to conclude his mathematical computations on the structure of the atom.

Obviously, intuition is only one part of science. The other parts are instruments and mathematics. Needed in this scientific age is a machine which can take off the thinker's mind the load of numerals under which he labours. A machine that not only counts, adds, subtracts, multiplies and divides,

has the power of logic, reasoning and memory; a robot brain incapable of errors and speedier than the speediest mathematical wizard.

The lack of such a thinking machine provided the greatest obstacle to its own creation. For any mechanical brain requires for its construction computations which belong to the most complicated problems in mathematics and engineering. A few years ago American scientists began to attack the challenge. It took them 4 years to work out the principle. Today several machine brains are operating. By providing designers with the data they need to build other and better mental robots, they have started a development that promises to break an age-old bottleneck, to send pure and applied sciences to new heights.

Calculating Time cut from Years to Minutes

Known under the collective name of "computers", the machines reduce the time required for complicated mathematical calculations from years to hours and even minutes. The latest mechanical brain designed is capable of adding two numbers of ten digits (for example two such numbers as 6,354,276,850) within the flick of $1/10,000$ of a second or, upon order, multiply them in $1/1,000$ of a second. It rejects faulty data or wrong instructions. After receiving the initial orders for hundreds of operations, it selects, on its own volition, the speediest formula and works out the solution—all without any human assistance. While working, it memorizes intermediate results to inject them in the calculating process at the proper time and the proper point within a few millionths of a second, or to store them. Most important of all, it knows when to stop and answer.

High-powered mathematicians designed the mathematical logic of the machine. Equally ingenious engineers and physicists had to translate the mathematicians' plan into mechanical, electro-mechanical, or electronic working parts. Construction is complicated. But the idea on which all machines work is the same and in itself understandable.

With great understatement it might be said that, essentially, robot brains do not differ much from the *abacus*. What all mathematical aids, *abacus*, slide rule, adding machine, and computer, have in common is this: they translate numbers into physical entities such as objects, or lengths, or rotations. On the *abacus*, for instance, different coloured beads

stand for the Ones, the Fives or the Tens. Shoving first two Ones from left to right, and then two more Ones, will result in four Ones on the right side, which means two *plus* two equals four. On the slide rule, figures are expressed in length; in the adding machine they are translated into measured rotations of a shaft; in the electronic computer they are transformed into electrical impulses. Ten steps of shaft rotation, or ten electrical impulses (say in the decimal place of the Ones) initiate one step of rotation or impulses in the next higher decimal order (in the Tens). Once this working principle is established, all that is needed is a mechanism which feeds figures and orders into the machine, and an automatic typewriter for jotting down the results. In the desk machines, the data-feeding is done through a keyboard resembling a cash register. For electric impulses, a mechanism on the order of a telephone dial might do. Actually, however, in the electronic computers, the data are fed by means of punch-cards or on punch-tape related to the perforated cards which strike up a tune on the player-piano.

First Computer started in 1937

What makes the computers a miracle fully understood by only a few experts, is their infinite refinement. Numbers of inventions have gone into the machines, the latest an electronic memory tube. Called the "electron," it retains data given to it by electrical impulses until it is called upon to start thinking. The first machine, begun in 1937 and completed in 1944 at Harvard University in Boston, Massachusetts, was taken over by the United States Navy; later computers by the United States Army. But since the end of the war, the United States Bureau of the Census, the United States Bureau of Standards and the United States National Advisory Committee for Aeronautics have become the main sponsors of computer developments.

The Harvard computer operates electro-mechanically. Another machine employs the telephone type electric relay. But ever since the "ENIAC" (Electronic Numerical Integrator and Calculator) was finished late in 1945 at the Moore School of Electrical Engineering of the University of Pennsylvania, experts have come to believe that electronic machines surpass all others. The 30 ton ENIAC works fully electronically, in absolute silence without any moving part behind its 100-foot (30-meter) panel. An impulse

activating the electronic tubes takes $1/5,000$ of a second. Impulses for Ones, and Tens, etc., are transmitted simultaneously. It memorizes 200 digits; digests and makes use of three different mathematical tabulations at one time, each one containing more than 100 twelve-digit numbers. With 40 different units available—such as “Multiplier”, “Divider”, “Square-Rooter”—the ENIAC’s speed is uncanny. It pours out the results of ten million different additions and subtractions of ten-digit numbers within five minutes. However, compared to the newer machines, the ENIAC has its drawbacks. About every second day one of its 18,000 electronic tubes burns out and must be replaced after check-problems have been run through the machine to locate the faulty tube.

But above all, the ENIAC is slow. By mid-1947 it was expected to be outdone by the EDVAC (Electronic Discrete Variable Calculator), under construction also at the University of Pennsylvania. The EDVAC does not use punch-cards for feeding data, but the faster system of sound, transferred into electric impulses as in radio. It will work about three times as fast as the ENIAC on a mere 3,000 electronic tubes. Still another computer is being built at the Institute of Advanced Studies at Princeton, New Jersey. By a superb piece of logic, this brain-robot will choose, automatically, between several possible courses of action and change operations accordingly.

Bureau of Standards plans two new Computers

The most ambitious computers, however, are being designed under the guidance of the United States Bureau of Standards. Two machines of this type will soon go into construction. They will add two ten-digit numbers (such as 3,246,758,135 and 5,759,363,169) in $1/10,000$ of a second, multiply in $1/1500$ of a second. Its capacity to memorize is to be increased from the ENIAC’s 200, to 50,000 digits or 5,000 individual ten-digit figures. The machines will receive data at a rate of one ten-digit number per $1/1,500$ of a second. Results will be printed at a rate of 12 characters a second.

The two calculators are to be placed in a special “Computing Laboratory”, open to government and private agencies, schools and industry. They will take the space of only a few file cabinets against the $30' \times 50'$ room required for the ENIAC. They will operate

on as few as 600 tubes, compared to the ENIAC’s 18,000. They will store tables of mathematical constants, such as logarithms and trigonometrical functions, at a rate of 35,000 digits per cubic inch.

What these computers can do puts the most gullible admirer of science under a strenuous test. For mapmakers and land surveyors they will solve equations with 400 unknowns, impossible by hand methods. Meteorologists will be able to use their pet equation, previously impossible, its machine calculation will take only a few hours. Wind-tunnel tests for airplanes might become superfluous. Stress and strain of beams and bridges will be known in a few minutes. Important functions of pure and applied mathematics will be recorded and stored. Problems which once took years to figure out will only need to be set up by a scientist; the electronic machines will do the rest.

For science, for industry at large, for census, tax and engineering purposes, the wizardly computers might prove little short of revolutionary. A typical census problem involves the multiplication of 100,000 pairs of five-digit numbers (24,375 by 39,186 for instance) and summing their products. That takes 12 working days at present. The computer will need ten minutes. Each month the United States Census Bureau tabulates some 400,000 declarations of traders on the shipments of 3,500 different commodities from 49 customs districts to 150 different destinations: a total of 25,000,000 possible combinations. By hand, the tabulation requires 1,800 working hours, keeps some three dozen mathematicians busy for a full week. The computer finishes in $3\frac{1}{2}$ hours.

Whether mechanical and electronic brains will create problems of employment remains to be seen. The machines are too new for this to be known. But certainly new fields will be pried open which had been closed to man’s search by barriers of impossible calculations. Among these, experts believe, will be economics and the social sciences. As much as new theories in physics, chemistry, medicine and all other pure and applied sciences will be tested mathematically, so will the effects of economic policies, of taxes, tariffs, prices and wages, become calculable and known ahead of application. In the end, the electronic brain might yield the “open sesame” to a cure of the world’s ills, which the human brain has been searching for since ancient times.

Indian Vetiver (*Khus*) and its Oil*

By A. K. Menon and C. T. Ittyachan

MR. P. A. Narielwala, Chairman of the Essential Oil Advisory Committee, in his 'Foreword' to the above report has pertinently observed as follows:—

"No development of essential oil industry in India is possible unless and until, as a first step, a systematic and patient research is carried out on the available resources of the country in aromatic raw materials." In view of the importance of *khus* oil in the perfumery and allied industries in India and all over the world, the Essential Oil Advisory Committee at its first meeting in July 1942, recommended to the Council of Scientific and Industrial Research that a survey be made of the existing position in India of the cultivation of *Khus* roots and the oil distilled from them. The Council of Scientific and Industrial Research were pleased to approve the recommendation of the Committee in March 1943 and sanctioned a grant to meet the expenditure of the investigation.

The services of Mr. C. T. Ittyachan of the Agricultural Department of the Government of Madras were kindly lent to the Committee by that Government for conducting the survey under the special supervision of Rao Sahib A. K. Menon, a member of the Essential Oil Advisory Committee. Mr. Ittyachan started the work towards the end of October 1943 and the report was completed within 8 months.

Khus, *Vetiveria zizaniodes*, Stapf. is found throughout the plains and lower hills of India, Burma and Ceylon upto 4000'. It thrives well in warm damp climates and on rich loamy *cum* sandy soil. It grows wild in the Punjab, the United Provinces and parts of Assam, Baroda, Hyderabad and Mysore States. In South India, especially in the Malabar coast, it is mostly cultivated. The slips are planted 8 in. to 12 in. apart in ridges on loosely prepared plots. It is a densely tufted perennial grass which attains a height of 3 ft to 6 ft. with the root stock branching into spongy, aromatic, fine rootlets.

There are two varieties of grass met within India,—flowering and non-flowering. The roots vary in length from 4 in. to 14 in. according to the conditions of growth, soil, climate, etc. The yield of root from one acre is about half to one ton. Manuring and watering, where necessary, definitely improve the crop. The cost of cultivation per acre in Malabar before the war was about Rs. 112 but it has since gone up owing to the increased cost of labour, etc.

The *khus* root is put to a variety of uses. It is largely consumed for making 'tattis' (screens) specially favoured in North India in the hot season. Fancy articles such as fans, baskets, etc., are also made from the roots. The roots possess a fine aromatic essential oil which by virtue of its tenacity, intensity and remarkable persistency is highly valued and it enters into almost every kind of quality perfume, whether it be for soaps, toilet creams, face powders, etc. An infusion of the root forms a febrifuge and stimulant and a paste prepared from the root and applied to the head prevents heat stroke, prickly heat and such summer ailments.

From a morphological study of the roots, it was observed that the density of the glandular hairs on the roots indicates a high oil content.

The present total annual output of roots from all the producing centres in India is about 77,500 maunds (2,840 tons), the share of the United Provinces being 26,500 maunds, Punjab 16,000 maunds, Bharatpur 20,000 maunds, Madras Presidency and South Travancore 15,000 maunds. 38,000 maunds, (1,390 tons) are used for making 'tatties' 31,000 maunds (1,140 tons); for the distillation of the oil and 8,500 maunds (300 tons) for miscellaneous purposes.

The yield of oil from the root varies according to the soil, climate, maturity, time of lifting, etc. Some of the best varieties of Indian roots distilled in Germany in 1930-31 yielded 1.1 per cent. of oil. Similar yields

* Survey of Indian Vetiver (*Khus*) and its oil by Rao Sahib A. K. Menon and C. T. Ittyachan, C. S. I. R. Monograph, 1947.

were obtained at the Kerala Soap Institute, Calicut, in 1938-39 from the roots grown in Malabar. Of late there has been an appreciable drop in the yield, probably due to the bad quality of the roots, or defective methods of distillation employed. There is considerable diversity in the figures of the yield of oil furnished by perfumers in various parts of India and they vary between 0.152 and 0.495 per cent. According to published reports, the yield of oil in Java and Reunion was about 2 to 3 per cent., while in Europe 0.1 to 1 per cent. was obtained from the roots imported from Java, Reunion, West Indies, etc.

The time-honoured method of preparing the oil followed by perfumers throughout India is to distil the roots soaked in water in an alembic (copper pot) over open fire and allow the hot oil carried by the steam to cool in receivers containing sandalwood oil, white mineral oil, etc., which absorb the oil. The cost of such distilling units ranges from Rs. 250 to Rs. 600. The cost of distillation also varies in different localities depending upon the cost of the roots, fuel, labour, etc. The profit works out at Rs. 2-8 to Rs. 8-4 per maund of roots distilled according to the selling price of the pure oil which ranges from Rs. 3 to Rs. 6 per tola. The labour charges and cost of materials have increased considerably of late. Improved methods of distillation and extraction by solvent will give better yields of oil. Roots extracted with ether yield over 5 per cent. of a fine quality of resinoid of light brown colour and an agreeable aroma vastly superior to that of the distilled oil. Indian *khus* oil is of varying consistency, colour, density and fragrance. The pure oil unmixed with sandal oil or white mineral oil is known as 'Ruh' or 'Rooh' which has a light greenish to brown colour with a fairly strong and fine aroma. The oil distilled from the fresh roots in

North India is not viscid as that obtained from the dry roots in South India and the odour is less intense. The oil coming into the market is very commonly adulterated with cedarwood oil, terpineol, etc. The 'attar' or 'ittar' is an inferior quality of *khus* oil with a lighter colour and weaker aroma. This is made by mixing the pure oil with paraffin oil, til oil, etc; a better quality is that mixed with sandalwood oil.

European distilled oils from dry roots are invariably yellowish to dark brown in colour very viscid and have an intense and persistent odour. Oils distilled in Java and Reunion from the fresh roots have a pale colour, a thin consistency and a somewhat poor aroma.

The internal trade in *khus* roots is estimated at about Rs. 12 lakhs per annum, Rs. 5 lakhs being the value of the *khus* oil obtained from roots and Rs. 7 lakhs being the value of the roots used for other purposes. Before the war India imported about one ton of *khus* oil valued at about Rs. 50,000, the price of oil ranging between 12 sh. to 112 sh. per lb. according to quality.

Chemical analysis of the oil obtained from the roots collected in different parts of India during the investigation and of some samples of pure oil purchased was conducted by the Tata Oil Mills, Bombay.

A description of the plants allied to *khus* is given in the report; these being 'Khathran' grass, 'karuver' grass and 'javasa.'

The report concludes with a recommendation for the establishment of 4 research stations in suitable centres of production for undertaking research with a view to increasing the yield of roots, the oil content, aroma, etc., and for studying the best and most economical methods of extracting the oil, in short for improving the Indian *khus* industry in all its aspects.

Adhesives for Plywood

The Forest Research Institute, Dehra Dun, has taken out a patent for the manufacture of prolam adhesive from gluten, a by-product of starch factories. This adhesive is of special interest to the Indian Plywood Industry, and in spite of its low cost it approaches phenol-formaldehyde synthetic resin in efficiency.

The rights of ownership of the patent now vest in the Government of India. The Patents Advisory Committee in the Department of Industries and Supplies, Government of India,

have, however, decided to grant non-exclusive licences for commercial working of this patent to starch factories on condition that firms will be allowed to work this patent free of royalty for the first year and thereafter a royalty of 1 per cent. will be levied on the sale price subject to periodical reviews.

Any person or firm anxious to exploit this patent should correspond direct with the Secretary, Patents Advisory Committee, Department of Industries and Supplies, New Delhi.

Arundo Tourn *

Rayon has led to a great interest in materials rich in α -cellulose. The following article on "*Arundo donax* Linn." will be of interest to scientists working on raw materials for the production of rayon.

A. donax Linn. belongs to the genus *Arundo* Tourn., comprising 12 species of tall and stout reed grasses, distributed over the tropical and temperate regions of the world. Of these, 3 species occur in India.

A. donax Linn. (Great Reed, Spanish Cane), called *Bara-nal* in Hindi, *Bansi* in Punjabi, *Gahanal* in Bengali and *Alokyn* in Burmes, is a perennial reed grass, usually 6'-12' high, found in the lower Himalayas, from Kashmir to Nepal and Assam, ascending up to 8,000'. It is also met with in the Nilgiris, Coorg and Burma, and is distributed westwards to North Asia, Africa and Europe.

The reed is used in Southern Europe for the manufacture of baskets, mats, trays, fishing rods, etc., and for making musical pipes. When the reeds are rendered fireproof by treatment with water glass, they can be used for thatching.¹

Raitt² considers *A. donax* to be one of the most suitable raw materials in India for the manufacture of high grade writing paper. He has found it to contain: total cellulose, 42.8 and lignin, 9.4 per cent. and to yield 37 per cent. of unbleached pulp, and 34 per cent. of bleached pulp. Reed of Chinese origin has been found to contain, total cellulose, 50.3 (α -cellulose, 36.2) and lignin, 15.7 per cent. and to yield 44 per cent. of bleached pulp³.

The stalks and leaves of cultivated reeds yield a pulp of high (α -cellulose) content⁴. In Italy this pulp is used for rayon manufacture⁵. It may also be used for making explosives⁶.

Two alkaloids, gramine (donaxine) $C_{11}H_{14}N_2$, m.p. 138-139°C, donaxarine



Fig. 1.—*Arundo Donax*

$C_{13}H_{16}O_2N_2$, m.p. 217°C, have been isolated from *A. donax*. The former in small doses raises blood pressure in dogs, but in larger doses it causes a fall. Its action is similar to that of α - ψ ephedrine.

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* Contribution to the *Dictionary of Economic Products and Industrial Resources of India*. Suggestions are invited by the Chief Editor, 20, Pusa Road, New Delhi.

REVIEWS

Pearl Shell, Beche-de-Mer and Trochus Industry of Northern Australia

THE economic exploitation of the marine resources of the maritime countries of the world which had been interrupted since the outbreak of the Second World War seems to be receiving once again due attention at the hands of the administrators in charge of them. The publication of the Economic Report No. 1 on the Pearl Shell, Beche-de-Mer and Trochus Industry of Northern Australia (Sydney, 1946), prepared by the Northern Australia Development Committee at the instance of the Premier's Conference of June 1946, and published by the Commonwealth Department of Commerce and Agriculture, is an excellent example of this sense of awareness of the urgency of post-war rehabilitation measures. In terms of employment offered and value of production, pearling ranks third among the principal industries of Northern Australia yielding a revenue equal to a tenth of the overall amount for total Australian fisheries, and the Committee feel that, in spite of the unfavourable conditions of the industry such as the insecurity of the market position and the low profit level, action should be taken to re-establish the industry on the most efficient basis possible, if only (1) to help the communities dependent on this industry for their livelihood and (2) to tap a certain source of dollar credits needed by Australia.

The Committee have adopted a far-sighted and responsible view of the task allotted to them and recommended the following measures for the rehabilitation of the industry:

1. A comprehensive survey of the shell beds by the Council for Scientific and Industrial Research in one of their research ships to discover the general limits, composition and density of the stocks of pearl shell, Trochus and Beche-de-Mer, followed by the preparation of maps of the areas.

2. Institution of the appropriate fundamental biological studies of the species

concerned in the fisheries with special reference to their environment.

3. The evolution of a system of predicting the fluctuations in the abundance and composition of the stocks of each.

4. Investigation of the physical properties of the shells and of the possibilities of new utilisation of the material concerned.

5. Examination of the possibility of plastics developing into a serious threat to the pearl-shell industry and the assessment of the strength of this competition from plastics:

6. Investigation of possible uses of by-products of the industry such as oyster and trochus meat, clam and other shells and economic survey of possible markets.

The Committee have devoted one big chapter for the discussion of the many-sided aspects of the industry as a whole dealing with its history, the production factors such as manpower, boats, equipment, meteorology which conditions shell production in the different seasons, marketing, organisation of the industry and its financial structure, and finally, processing, which is calculated to cut down freight costs and to provide additional employment in secondary industries. This chapter is well documented by a series of tables, graphs and photographs.

The Committee have not considered the Governmental responsibilities in regard to administrative, developmental and research problems of the fisheries as beyond the scope of their enquiry; they have not failed, however, to focus attention on the international aspects of fishery management, labour and markets. They recommend therefore that (1) the Commonwealth should assume administrative responsibility in respect of extra-territorial fisheries and effect the fullest possible collaboration between the States and the Commonwealth on this

matter, (2) steps should be taken to bring into effect Commonwealth and State ordinances to enforce radio and other standardised improvements on fishing boats, (3) a standard method of collecting and keeping statistics in all the States be brought into force, (4) a machinery for the consultation of representative groups in the industry be set up, (5) the Division of Fisheries, Council for Scientific and Industrial Research, carry out the required biological and technological investigations, (6) the Fisheries Division of the Department of Commerce and Agriculture carry out economic investigations and institute training facilities for the industry in diving, tending, boat management, knowledge of topography of the coast, elementary seamanship and navigation, and (7) consideration be given to the possible need of rendering financial aid to the industry in the early post-war years until the industry is established on a firm basis.

The Report has at the end a number of appendices dealing with scales of wages of labour employed, the Australian State and Commonwealth legislation in force in regard to the pearling industry, the taxonomy of Australian pearl-shell oysters, the annual repair and renewal charges for the fishing boat, and lastly, with the most valuable information on the artificial culture of oyster pearls which has been prepared from information brought to Australia by the Australian Scientific and Technical Mission to Japan.

As the information contained in Appendix VI is rare and would be of value to our fishery scientists and industrialists the reviewer need offer no apology for reproducing it in full below for the benefit of Indian readers.

A fairly extensive bibliography on Pearl, Trochus and Beche-de-Mer industry follows the appendices.

Though the fishing industry for pearl-oyster, chank, trochus and turbo and beche-de-mer in India has been in existence for several decades, if not centuries, it has not received the attention of our administrators and industrialists to the extent it has in the Far Eastern Countries and Australia. The erratic fluctuations in pearl oyster fishing hitherto confined to the Gulf of Manaar have never been fully understood and properly related to the physical and biological factors influencing the fishery. The extensive trochus and turbo beds in the Andaman and Nicobar waters, the dis-

covery, development and final depletion of which we owe to the Japanese fishing companies of Singapore, are likely to have been rehabilitated since the closure of fishing for these shells at the outbreak of the last great war. The possibilities of developing the Beche-de-Mer industry on a commercial scale remain unexplored. The chank industry depends for its existence on the steady demand for these shells from Bengal. It is to be hoped that an enquiry of the kind which the Commonwealth of Australia has conducted in respect of its commercial shell and Beche-de-Mer fisheries will be instituted by the Indian Governments concerned, and prompt scientific steps will be taken to place the shell fish and Beche-de-Mer industry of India on a sound basis.

Appendix

Artificial Culture of Oyster Pearls.

The artificial culture of pearls requires in the first place the availability of an abundant supply of young oysters and the ability to handle and take care of the oysters after processing.

In Japan it was found that the supply of naturally spatting oysters was inadequate for the purposes of the industry and accordingly a technique was evolved for catching the spat of the pearl oyster. The cultch employed consisted of wire cages dipped in tar and then coated with sand and lime. These are more fully described as follows:—

Small cages of 3/4" galvanized wire mesh covering heavy gauge galvanized wire frames are used. The cages are approximately 2' 6" × 1' 6" and are divided into compartments 1' 6" × 6" × 6" by means of wire mesh shelves. Each compartment is further subdivided by another wire mesh shelf set diagonally along its length. Corrosion of the wire is reduced by dipping the cages in boiling tar. The cages are then dipped in a watery mixture of sand and lime, which, when dry, forms a friable coating of 1/16" to 1/8" thick over the wire and is an excellent substratum for the young spat.

The cages are suspended at a depth of 6 metres from large rafts which are fully decked and cast an intense shadow. This shadow attracts the negatively phototropic spat, which are thus induced to settle on the cages. The spat setting period is reported to extend from July to November, and the cages are set in place early in July.

The spat is allowed to remain on the cages until the shell reaches a diameter of about $1/2$ ", i.e., a period of 4 to 5 months. The young oysters are then removed from the catching cages and placed in culturing cages until they reach a diameter of about 1". By holding the young oysters at first in the spat cages and later in the culturing cages for about 1 year (diam. 1") they are protected from at least the larger free swimming and also the benthic predatory organisms.

The 3 year old oysters are collected by women divers and brought up to sorting stations. The shells are cleaned and the best are placed in trays for treatment. Below standard shells are returned to the sea-bed.

In Japan some naturally grown oysters were collected and also naturally grown oysters from Australian beds in the Arafura Sea were taken by well-boat to Palau for cultural operations: An Australian industry could possibly find sufficient naturally grown oysters on the beds; certainly the initial operations could be based on such stock.

The actual cultural operation consists of developing a pocket of epithelial tissue parasitically in the gonad of the oyster and enclosing an artificial nucleus.

The operation is fundamentally simple but requires a fairly high degree of manipulative skill. It is performed by women and girls who are required to undergo a preliminary training for a period of about 3 months. Full proficiency may be acquired after 12 months' experience.

The selected shells recovered by the women divers are cleaned of wood and animal growths and placed in shallow open vessels. After a short period, the shells gape open and a small wooden plug, $2\ 1/2$ " long by $5/8$ " by $1/4$ ", oval in cross section, is inserted. The shells are held apart during the insertion of the plug by stainless steel opening tongs.

The gaping oyster is then placed in a special mounting clamp, with the left valve uppermost.

One oyster is dissected and slender strips of tissue are cut from the whitest part of the mantle. These strips are about $1\ 1/2$ " long by $1/8$ " wide. Each strip is then cut into $1/8$ " squares, the grafts.

A small incision is made in the gonad of the oyster held in the clamp and the cut is held open while one graft is inserted. Immediately above the grafts, a nucleus is

inserted and the edges of the incision are pressed together. In some cases, two grafts and nuclei may be inserted in one oyster, one on each side of the midline. Some reports refer to sterilisation and ligaturing of the incision after the insertion of the graft and nucleus but no technical account of this has been received.

The nuclei are small spheres, about $1/16$ " diameter of calcareous semi-nacrous material, prepared from the shells of the fresh-water mussel *Margaritana margaritifera*. Although this species is practically worldwide in distribution, the largest and heaviest shells are formed in the Mississippi River. Shells from this region were imported into Japan by the Mikimoto organisation, and from them the nuclei are prepared.

Following the insertion of the nucleus, the oyster is replaced in the culturing cages. From 60 to 100 oysters are placed in each cage and the cages are returned to the sea. They are suspended at a depth of about 10 metres, from open bamboo rafts which are moored in groups in sheltered areas.

For a period of about 2 months, the cages are lifted every week for examination to determine whether the oyster has survived the operation, whether the incision has healed, and whether or not the nucleus has been extruded.

After this period of "convalescence" and observation, the cages are transferred to the culturing zones and, except for the quarterly cleaning, are not disturbed for a period ranging from 3 to 6 years.

It was stated that the most rapid growth occurs during the first two years, but that the best nacre is deposited during the later years.

In cross section, the nature cultured pearl shows three distinct layers. The innermost is the circular nucleus, second is a relatively thick layer of semicrystalline calcareous material (Conchiolin) and finally the out-coats of pure crystalline nacre (Aragonite). The conchiolin layers are laid down within 3 to 6 months of the insertion of the nucleus, and thereafter the nacreous layers are deposited.

Remarkably accurate records are kept of all nuclear insertions. Each technician engaged in inserting the nuclei has a number of terra-cotta blocks, upon which are engraved an identifying character and a serial number. As each culturing cage received its quota of oysters, one of these

blocks is inserted, and remains in the cage until the pearls are harvested. At each inspection, a record is kept of the number of oysters which died and which extruded the nuclei. The figures are then entered in the office record books which are always kept up to date. From these records, not only is a check maintained upon the individual operators, but complete production analyses may be extracted.

After the elapse of the required period, the cages are brought ashore and the oyster opened. Skilled operators remove the culture pearl and any large adventitious pearls which may be visible. Shells carrying well formed "blister" pearls are treated to remove the pearls. The recovered pearls are then taken to the factory where they are sorted, graded for size and quality for final preparation for stringing and mounting.

Certain by-products are obtained in this industry in Japan. This consists mainly of grinding the shell to a powder to be used as a source of calcium for patent medicines. The shells used by the Japanese were not suitable for the usual mother-of-pearl products but Australian oysters would be quite suitable for this purpose and in fact this industry would serve to increase and improve the mother-of-pearl output.

(The above report has been prepared from information brought to Australia by the Australian Scientific and Technical Mission to Japan.)"

H. SRINIVASA RAO.

Chemistry of Vitamins and Harmones.

S. Rangaswami and T. R. Sheshadri (Andhra University, Waltair) 1946, pp. 329, price Rs. 7/8/-.

In this comparatively small book, the authors have given a clear and concise account of the very extensive subjects of vitamins and hormones. In spite of its brevity, the book is readable, and it includes most of the important facts on the chemistry of these biologically important substances. The book comprises of 25 chapters each dealing with an individual vitamin or hormone, and each chapter contains a systematic treatment of the occurrence, isolation, structure, synthesis, methods of assay, properties, functions of the compound and its requirement by the organism. This systematic treatment makes it particularly useful for advanced students of chemistry. The

accounts on the structure and synthesis are well presented.

The book is up-to date and is singularly free from errors of fact. Its printing and general get-up are not as good as one might desire. Little attempt has been made to interest the Indian readers by making particular reference to Indian conditions. Shark liver oil, for example, is only considered as a substitute for cod liver oil and the whole subject is dismissed in one sentence, in spite of the fact that shark liver oil is far superior to cod liver oil as a source of vitamin A, and now represents a flourishing industry in this country. As much as 30,000 gallons are being produced in India and it is beginning to be exported to countries from which cod liver oil used to be imported into India. This product is also eminently suited for production of vitamin A concentrates. Similarly no or only a passing reference is made to various other exceedingly vitamin-rich Indian products: nor has any notice been taken of the volume of work done in India on these substances.

The publication of this book is, however, welcome, since it provides an excellent summary of our knowledge on vitamins and hormones, and the book is particularly useful for students preparing for examinations in advanced chemistry.

B. A.

Hydraulic Measurements. A Manual for Engineers. By Herbert Addison (Messrs. Chapman & Hall, Ltd, London, W. C. 2), Second Edition, 1946, pp. xii + 327, price 21 sh net.

This is an exceedingly useful book for those engaged in hydraulic measurements. In view of the recent advances in fluid mechanics, such a practical book as has been written by Professor Herbert Addison has been a long-felt necessity. The first 5 chapters deal with pressure head, velocity of flow, weight and volume, in a simple and concise manner. Chapters 7 to 9 will interest those engaged in measurements of flow through pipes, and irrigation engineers will find chapters 10 to 13 containing useful information on measurement of discharges in practical cases, particularly valuable. The book is limited in its scope to measurements of flow of liquids only, but it deals with the various instruments with an open mind. Many engineers have hard convictions about certain instruments for measurements of discharge, and conflicting

views are often expressed about the performance of one instrument or the other. They will find in this book scientific, brief and unprejudiced accounts of the various instruments for measurement of flow of liquids, their maintenance and operation. The illustrations are simple and clear. It is a concise and practical book for laboratory and field engineers.

V. I. VAIDHIANATHAN.

Principles of Fruit Preservation. By T. N. Morris. Monographs on Applied Chemistry Series, edited by Howard Trip (Chapman and Hall, London) 1946, Second edition, pp xiii + 198, Price 18 Sh.

The book needs no introduction nor *de novo* criticism as it has already been before the public for these fourteen years and its usefulness has been adjudged. The present edition produced in strict conformity with authorised economy standard, is a very compact volume compared with its bulky predecessor. Several sections, notably those on pectins and pectin jellies and on the corrosion of tin plate cans, have largely been re-written and two new chapters added, one on candied fruits and the other on fruit juices.

The printing is excellent and singularly free from blemish, perhaps with one exception on page 5, where "Subject has" is to be read "Subject has".

M. S.

The Reclamation of Ravine Lands of Jumna in the United Provinces. By H. L. Chhibber. (Bulletin No 2, *National Geographical Society of India, Benares*, 1947, pp 11, Price Re. 1/-).

In this bulletin Dr. Chhibber presents the problem of soil erosion as it exists in India today. Soil erosion has been an alarming problem in many countries of the world and particularly in the U.S.A., where the Government have been able to combat it successfully. In India also, the problem is taking dangerous proportions, but unfortunately there is only a halting realization of the menace. "When the soil is gone", said Theodore Roosevelt, "men must go and the process does not take long."

The bulletin deals with this problem in a part of the United Provinces. Any visitor to that area must have noticed the enormous extent of land in the trans-Jumna tract lying barren and waste, and these lands are all lost to agriculture. The river Jumna is bounded by cliffs and due to the action of

running water, ravines have been formed. There is no end to this natural action unless an artificial check is imposed.

Nevertheless, the alluvial soils in the region are fertile and being semi-arid, they are little leached. The author, while suggesting some means of reclaiming these lands for agriculture, recommends the tapping of underground water supplies in addition to improving surface irrigation. Building of reservoirs for storing water at suitable sites and growing of drought resisting crops are also suggested.

For large-scale reclamation work the use of machinery is recommended. By artificial terracing some of the ravine lands can be reclaimed, but in this case a huge amount of manual labour must be subsidised. Afforestation checks soil erosion and it also provides the farmer with fire-wood, timber and grass.

Dr Chhibber has proposed a number of remedies suitable for different parts of the ravine lands. A geographer's co-ordinated study, such as this, is always helpful to the planning and development authorities of Government engaged in the "Grow More Food" programme. We hope the author of this bulletin would prepare a more elaborate scheme of land-reclamation for the whole of India.

SITANSHU MOOKERJEE.

Tata Quarterly, A Review of economic and financial conditions in India.

Public opinion on the vital economic problems facing the country has never been more alert than it is today, and an educated and instructed public opinion can obviously play a decisive part in the formulation and execution of sound economic policies designed to secure for India's starving millions a rising standard of living. In the creation of such an educated public opinion, financial journals which regularly collect and analyse the data relating to production, prices, trade, currency and taxation have a very useful part to play. We have, therefore, no hesitation in welcoming into the field of financial journalism, the *Tata Quarterly*, a quarterly review of economic and financial conditions in India, inaugurated by India's industrial pioneers, *Tata & Sons, Ltd.*

Much of the review, of course, covers ground which has already been made familiar in official publications, and the Statistical Tables relating to Wholesale

Prices, Cost of Living Indices, Inland Trade, Foreign Trade, Money Supply and Rates, Treasury Bills, Scheduled Banks and Government Finances follow the orthodox pattern which has been evolved by the *Monthly Survey of Business Conditions in India* issued by the Government of India. But as the January 1946 issue of the *Tata Quarterly* emphasised, "There is an obvious distinction between an economic survey undertaken by a business concern and one carried out under Government auspices". The standpoint from which business interests view current events is not merely different from, but is often opposed to, that of Government, and the *Tata Quarterly* frankly seeks to place before the public the businessman's analysis of current developments and estimate of the efficiency of the current Governmental policies. Obviously, there can be no question as to the need for such a journal in India.

Among the more important topics which have been discussed in the *Quarterly* till now are India's Sterling Balances (April 1946), Objectives of Foreign Trade (July 1946), Cheap Money Policy (October 1946), the Banking Bill (January 1947) and the State of Indian Economy (April 1947). In its criticism of Government, when it feels that such criticism is called for, the *Quarterly* does not mince words. Thus in the latest issue, the responsibility for the present economic distress in the country is squarely placed on the shoulders of Government for its lack of a well thought out policy to bring the Indian economy back to normal, its indecision and vacillation in the sphere of controls, its failure to follow up the repeal of the Excess Profits Tax in 1946 by adequate arrangements to import capital goods from abroad and the precedence given by the Provincial Governments to such relatively secondary measures of social reform as prohibition, bigamy and divorce, over measures to tackle the urgent problems of food, clothing and housing. It can, of course, be argued that part of these troubles at least could have been overcome if India's business classes had shown greater vision and sympathy in their relations with the wage earners, and in co-operating fully with Government in enforcing price control. But frankly the *Quarterly* seeks no more than to place before the public the case of the business interests.

The statistical data at present given in

the journal are extremely meagre and are already available in the official publications. It will, therefore, add greatly to the utility of the journal if it can give more detailed information on a month-to-month basis on the actual trends in production, prices, wages and markets in India's main industries such as steel, jute, cotton, sugar, paper, cement, chemicals, etc.

P. S. N.

Indian Minerals (Mineral Information Bureau, Geological Survey of India), 1947, Vol. I, No. 1.

The attractive publication "Indian Minerals" issued as a quarterly by the Mineral Information Bureau, Geological Survey of India, is a newcomer into the field of scientific journals. It has been a long-standing complaint by the public that the publication of statistics of mineral production in India is inordinately delayed.

The Geological Survey of India, in collaboration with the Department of Mines, intend to remedy this delay, and speed up collection of such statistics, at least for important minerals, and publish the data promptly through the columns of their new organ.

The first number has a wealth of technical information supported by factual data, and a high standard is maintained throughout. Under the title, the "Mineral Wealth of India", the first article in the journal presents a survey of 38 minerals, showing the present position and prospects industrially and strategically. A summary of the Coal Fields Committee Report, and four other articles dealing with petroleum resources, Zawar silver-lead-zinc mines, emeralds in Mewar and mineral springs of India, come next. The last article in the first section is a review of the mineral production in India during 1944 by the Director, Geological Survey of India. The rest of the journal is divided into four sections; the first three devoted to topical news, mineral digest, scientific news and notes and the fourth a novel feature for a scientific journal, "Trade and Commercial Intelligence".

The treatment of the matter is lucid and written with the obvious object of catering to the layman. The periodical should be of interest and value to a large section of the public engaged in industry and commerce.

NON-TECHNICAL NOTES

35. Manufacture of Loudspeakers.

Loudspeakers form one of the essential component parts of sound reproducing and intensifying instruments such as radio receivers, gramophone records, talkie amplifiers and the amplifiers used in public gatherings. Prior to World War II all the loudspeakers in use in India were imported from abroad, mainly from the U.K. and U.S.A., most of them as component parts of radio receiving sets. As a result of the efforts of the Council of Scientific and Industrial Research, investigations leading to the determination of the conditions for the manufacture of loudspeakers have now been completed and the process is ready for commercial exploitation. The process, as at present perfected, relates to the manufacture of the energised type of loudspeakers, but an important merit it possesses, from the businessman's point of view, is that a concern taking it up can without much difficulty switch over to the production of the permanent magnet type of loudspeakers also, if the market conditions so demand, as the only additional item needed will be the permanent magnets of the required shape and size, made of modern magnetic alloys.

Probable Market

Loudspeakers would seem to have an assured and expanding market in India. The demand for loudspeakers in India comes mainly from radio set repairers, radio manufacturers and dealers in talkie and public address equipment. There are today in India about 230,000 wireless receiving sets which need regular servicing. In addition, the annual increment in the number of radio receiving sets in India is estimated at about 50,000 and with the steady increase in the popularity of the radio, this rate of increase may well be exceeded, and as an indigenous radio manufacturing industry springs up in India, the market for loudspeakers is likely to expand considerably. The same upward trend may also be expected with regard to the demand for loudspeakers from dealers in talkie and public address equipment.

Cost Position

As regards the actual production, not much difficulty is expected either with regard to the

raw materials or the equipment needed. The main raw materials required are mild steel (or preferably soft iron) in the form of rods and plates, enamelled copper wire, paper pulp, a few chemicals and small quantities of adhesives, fibre sheets, empire cloth, etc. Almost all of these are easily available. The machinery needed for manufacture consists mainly of lathes, power presses and drilling machines. The initial equipment for a plant with a capacity of 10,000 loudspeakers per annum, on the basis of the present prices, may cost about Rs. 50,000/-. The running expenses inclusive of the cost of materials, labour and supervision charges, power, salaries of experts and office expenses, may amount to Rs. 100,000 per year for a plant of the above size. The factory cost of a 6.5" size loudspeaker would thus be near about Rs. 11/-. This compares favourably with the present (March 1947) retail price of loudspeakers which varies from Rs. 26/- for English speakers of the R. A. field type of 6" size to Rs. 34/- for the 8" size (not allowing for the customary discount.)

Cost of Production

Basis, 10,000 loudspeakers per annum of 6.5" size.

Capital Expenditure.

Block capital in the form of machinery and apparatus.	Rs. 50,000
Working capital (equivalent to one year's requirements of materials and pay of employees, cost of power, etc.)	100,000
	Rs. 150,000

Annual Charges.

	Rs.
Raw materials	57,000
Labour charges	20,000
Technical labour and supervision	10,000
Power consumption	1,500
Office expenses and house rent	10,500
Depreciation on Rs. 50,000 at 10%	5,000
Interest on working capital at 5%	5,000
Total factory cost	Rs. 109,000

∴ Approximate factory cost, per loud speaker : Rs. 10.9 or Rs. 11/-

36. Manufacture of Enterovioform

"Enterovioform" is the trade name of iodochlor hydroxyquinoline manufactured and marketed by C I B A. This synthetic drug is used as an internal antiseptic in the treatment of amoebic dysentery. Experiments carried out under the auspices of the Council of Scientific and Industrial Research have resulted in a simple and economical process for the synthesis of this drug starting from phenol.

The method comprises of 4 simple steps and does not involve the use of any complicated equipment. The first two steps are chlorination and nitration. The third step makes use of Skraup's reaction for the synthesis of quinoline derivatives from aromatic amines. This reaction has been modified by various workers previously. The modification adopted here enables the preparation of the quinoline compound directly from the nitrocompound. The next step, namely iodination of the quinoline to iodochlorhydroxyquinoline, is carried out by an improved and simple process.

The chemicals required in the manufacture are simple compounds easily available within the country.

The equipment needed both in capacity and type will vary according to the production aimed at. If it is desired to make only small quantities, say 1 lb. to 5 lbs., a part or the whole equipment may be in glass. For larger quantities porcelain vessels of cylindrical shape, or vessels of acid resisting alloy steels may be used. It is felt that a batch yielding 5 to 10 lbs. of the end product will be economical. Funnels for filtration, condensers, mechanical stirrers and a small steam distillation arrangement are the other requirements.

The cost of the product by this process will largely depend upon the ruling prices of the chemicals which are at present high. At the prevailing rates the cost of chemicals for making 1 lb. of the product is about Rs. 30.

Full details of the experiments which were conducted mainly to simplify the reactions and to determine the proper conditions governing them, can be had from the Council of Scientific and Industrial Research. As the process does not contain patentable features, it has been decided to release the process as "Technical advice" to Indian manufacturers.

37. Manufacture of Concentrated Extracts of Pyrethrum

It is well known that solvent extracts of the flowers of *Chrysanthemum cinerariaefolium*, popularly known as pyrethrum flowers, possess insecticidal properties. The cultivation of pyrethrum flowers in India was introduced a few years before the war, and has made good progress in Assam, Kashmir, Nilgiris and other localities. Before the war only small quantities of pyrethrum extracts used to be imported into India. The manufacture of pyrethrum extracts was undertaken in the country on a fairly large scale from imported as well as Indian flowers during the war for the preparation of mosquito-cidal sprays and mosquito-repellant creams, to combat the menace of malaria in the Burma and South East Asia fronts.

Thus in the last few years, pyrethrum cultivation, and manufacture and application of pyrethrum products have established a foothold in the country, and in view of the progressive health and agricultural plans awaiting implementation, further development of the pyrethrum industry may be considered as fully assured.

Exhaustive extraction with kerosene oil gives extracts of 1 to 1.5 per cent. concentra-

tion of the active principles, viz., pyrethrin I and pyrethrin II.

The low concentration of the insecticidal principles in the extracts is in many ways a disadvantage in the preparation of biologically stable aqueous emulsion sprays and anti-mosquito creams. It also entails loss of a fairly large amount of kerosene or other hydrocarbon solvents besides involving a huge expenditure in transportation in its triple aspects of volume, containers and freight. In order to overcome these drawbacks, high concentrates of pyrethrum are prepared in foreign countries. e. g. U.S.A., by extracting the flowers with low-boiling solvents, e. g. petroleum ether and ethylene dichloride, and dissolving the oleo-resin obtained on removal of the solvent, in suitable mineral oil after purification. These solvents, however, are not available in India on a commercial scale.

As a result of investigations carried out under the auspices of the Council of Scientific and Industrial Research, a process has been evolved for the preparation of biologically stable extracts of high concentration using only those solvents which are easily available in the country.

Process

The process, which has been patented, consists in the exhaustive extraction of pyrethrum flowers with a suitable solvent mixture chiefly consisting of alcohol, and recovering the lower boiling components of the solvent mixture from the total extract below 60°C. under reduced pressure. The oleo-resin is thereby obtained in the form of a solution in the higher boiling component containing 10 to 15 per cent. of total pyrethrins, the actual strength depending upon the pyrethrin content of the flowers which varies from 1 to 1.5 per cent. The estimation of pyrethrins in the concentrates carried out by chemical methods has been subsequently corroborated by biological assays carried out at the Malaria Institute of India and the Biological Standardisation Laboratory, Calcutta.

Stabilization

Pyrethrum extracts generally deteriorate on storage, particularly when they are of high concentration, and various anti-oxidants are used to stabilize them. It has been established that derivatives of bhilawanol, obtained from the juice of bhilawan, popularly known as 'marking nut,' can be employed to stabilize concentrated pyrethrum extracts. The use of these products for the stabilization of pyrethrins has been covered by a patent.

Advantages of the process

The process as described above has several advantages which are enumerated below:

- (1) The solvents used for extraction are non-toxic.
- (2) They are not highly volatile like petroleum ether, and so the loss of solvents during extraction and recovery is comparatively low.
- (3) The amount of non-toxic inert matter in the concentrate is considerably less than that contained in alcoholic extracts.
- (4) These concentrates can be used in the preparation of biologically stable aqueous emulsion sprays with the help of the pyrethrum emulsifier evolved in the laboratories of the Council of Scientific and Industrial Research. The use of aqueous sprays would effect a huge saving in mineral oil, like kerosene, generally employed in the manufacture of insect sprays.
- (5) Fine quality, semi-vanishing, mosquito-repellant creams, which will be more stable on storage or transport during hot seasons, can be prepared by employing these concentrates, since the more the concentration of the pyrethrins, the less will be the amount of

mineral oil extract required to give the desired protection against mosquitoes.

Raw materials

In the manufacture of the concentrates the quality of flowers is an important factor. Pyrethrum flowers grown in India are quite rich in pyrethrins, ranging from 0.9 per cent. to 1.4 per cent. and compare favourably with flowers imported from Kenya. All the solvents required for the extraction process are commercially available in India.

Equipment

The equipment required for handling 4,000 lbs. of flowers at a time are:—

- (1) *Powdering mill*: A suitable crusher or pulverizer to give powder of about 200 mesh.
- (2) *Percolators or extractors*: 5 batteries of 10 percolators of 200 gallons capacity each, made of iron with enamel lining, fitted with 2" rotary pumps for continuous extraction.
- (3) *Expeller*: To press out the solvent from the "marc" (extracted flowers).
- (4) *Vacuum stills*: 3 batteries of 10 stills made of iron and electroplated, having a capacity of 200 gallons.
- (5) *Vacuum pumps*.
- (6) *Boiler* for steam generation.
- (7) *Laboratory equipment* for standardization of the extract.

Cost

The prime cost of production (excluding overheads and depreciation and containers) to make 450 to 460 lbs. of 10 per cent. concentrate from 4,000 lbs. of flowers, is as follows:

	Rs.
1. <i>Raw materials</i> :	
(i) Cost of dry pyrethrum flowers (1.2 per cent. pyrethrin content) at Rs. 1/14 per lb.	5,000
(ii) Solvents:	
Loss due to evaporation, etc. (taken approximately as 15 per cent.)	190
Solvent left in the concentrate	34
(iii) Cost of stabiliser	9
2. <i>Labour</i> :	
30 men at 1/2 per day	45
4 mistries at 2/8 per day	10
3. Power at 100 units per day at -/1/- per unit	6-4-0
	5,294-4-0
Approximate cost per lb. of 10 per cent. extract	Rs. 11-8 0 to 11-12-0.

Electronic Reverberation Recorder

THE January 1947 number of the *Proceedings of the Indian Academy of Sciences* (1947, 25, 70) contains a paper by N.B. Bhatt and D.L. Subrahmanyam on "an Electronic Reverberation Recorder",—an instrument which has been designed and developed in the Electroacoustics Laboratory of the Indian Institute of Science, Bangalore. This instrument helps to record and study the reverberation characteristics of rooms ranging in size from a small studio to a large auditorium by delineating the decay of sound energy density in db. per second on the screen of a cathode ray oscillograph, thus performing essentially the same function or functions hitherto recorded on high speed mechanical level recorders. The difference between these recorders and the instrument described is that unlike the former, it involves no moving mechanical members either for the sound energy scale or for the time scale of the decay curve as both these functions are performed electronically.

The enormous range of the sound density of nearly a million times, 60 db., present in a room is picked up by a high quality microphone and after suitable amplification by a low noise, high gain, negative feedback stabilized amplifier, is rectified and impressed on a logarithmic stage, the output of which, after further amplification, is impressed on the vertical plates of a cathode ray oscillograph. Sweep voltage from a linear time base circuit containing a thyatron-pentode combination with suitable modifications and negative feedback for linearisation of the trace is applied to the horizontal plates. Provision is made to have sweep times of 1 sec., 3 secs., 5 secs. and 7 secs., the values being chosen to accommodate reverberation times of rooms from small studios to large auditoria.

The calibrations of the instrument are accurate within 2 per cent. with proper voltages and currents in various circuits; a meter is mounted on the panel of the instrument which by mere flick of the switch under it, measures the voltages and currents

at crucial points and enables them to be adjusted. The speed of recording is nearly 550 db. per second. Its portability and facility to work from a 220 volt 50-60 c.p.s. mains supply with a power consumption of about 60 watts, will provide a handy and useful tool to the practical constructor in regard to the placement of acoustical materials to obtain predetermined reverberation characteristics by visual observations, on the spot, of the sound decay curves. The instrument can also be employed in making articulation tests of speech sounds under various conditions.

Production of 2,3-Butanediol

The production of 2,3-butanediol by dissimilation of glucose by several strains of *Bacillus subtilis* and *Serratia marcescens* has been recently described (Neish, *et. al.*, *Can. J. Res.*, 1947, 25, 56, 65).

Both the Ford and Marburg types of *Bacillus subtilis* dissimilate glucose under aerobic conditions giving carbon dioxide, acetoin and 2,3-butanediol as main products. Under anaerobic conditions, Marburg type cultures do not ferment glucose, while Ford type cultures dissimilate it as rapidly as they do under aerobic conditions. In preparing the medium, 5 per cent. glucose (C P) and 0.5 per cent. yeast extract (Difco) were sterilised together and, after cooling, sterile salts solution (potassium monohydrogen phosphate, 0.05 per cent.; potassium dihydrogen phosphate, 0.05 per cent.; magnesium sulphate metaphosphate, 0.02 per cent.) was added. A weighed amount of sterile calcium carbonate (1 per cent.) was added at the time of inoculation with a 24-hour inoculum grown at 37°C.

Under aerobic conditions, (carbon dioxide-free air being bubbled into the fermenting vessel) Marburg type strains *B 42* and *B 43* produced 30.41 and 30.65 millimoles of 2,3-butanediol respectively, for every 100 millimoles of glucose dissimilated. The fermentation period was 7 days at 30°C. One Ford type culture *B 2*, under the same conditions, gave a yield of 33.65 millimoles

of 2, 3-butanediol. Under anaerobic conditions (using oxygen-free nitrogen atmosphere), Ford type culture No. 350 gave an yield of 56.16 millimoles of 2, 3-butanediol for every 100 millimoles of glucose dissimilated. The fermentation was conducted at 37°C. for 11 days. The 2,3-butanediol obtained in all the cases is a mixture of 65 per cent. *meso*- and 35 per cent. *laevo*-isomers.

The fermentation of glucose by four strains of *Serratia marcescens* under anaerobic conditions showed that the maximum yield of 2, 3 butanediol was obtained in the case strain 51, 62.48 millimoles of the product being obtained from 100 millimoles of glucose dissimilated. The medium was the same as before except that 2 per cent. calcium carbonate was sterilised separately and added just before use. Using a synthetic medium in which the yeast extract was replaced by 0.25 per cent. ammonium chloride, strain S2 produced 59.60 millimoles of 2,3-butanediol. The fermentation period was 5 days at 35°C., a current of carbon-dioxide-free air being bubbled through the fermenting material. The 2,3-butanediol is a *meso-dextro* mixture containing about 2 per cent. of the *dextro*-isomer.

Dehydration of 2,3-Butanediol and Butanone

One of the possible methods for the production of butadiene is the dehydration of 2,3-butanediol to butanone—2 and its subsequent dehydration. The method for the dehydration of butanone-2 to butadiene using activated bentonite has been reported for the first time (*Can. J. Res.*, 1947, 25, 80).

Bentonite is a clay which can be had in large quantities at a relatively low cost. The material is activated by treatment with 20 per cent. aqueous sulphuric acid (weight of acid used, 50 per cent. of the weight of clay). The mixture is boiled gently with stirring for 3 hours. The slurry is diluted to three times its volume and filtered. The clay is washed thoroughly, dried at 110°C. for 12 hours and then broken up and screened (4-8 mesh). Used bentonite can be reactivated by passing air over it at 550°C. to 600°C. for 5 to 8 hours.

Crude *laevo*-2,3-butanediol is diluted with an equal volume of water and heated over a steam bath for several hours with 200 gm. of calcium oxide per litre of solution to remove any acetic acid, filtered and fractionated under reduced pressure. The purified material is passed through a reactor

consisting of a 1" iron pipe contained in a vertical furnace. The upper portion of the reactor is packed with coarse steel wool serving as a preheater, while the lower portion is packed with activated bentonite catalyst. 2,3-butanediol, diluted with the desired amount of water, is run in. In the absence of water vapour a yield of 86 per cent. butanone-2 is obtained at 225°C. Dehydration of butanone-2 is conducted in the same reactor, water and ketone being run in from separate feeders. A maximum yield of 44.8 per cent. butadiene based on the charged ketone is obtained when the reaction is conducted at 700°C. with a ketone-water molar ratio of 1 to 40.

Uses for Glycols

War-time researches in U.K. and U.S.A. have shown that glycols possess valuable sterilization properties (*C. T. J.*, 1947, 120, 238). In general, the glycols work with increasing efficiency in increasing humidity. Ideal conditions for the bactericidal activity of glycol are, 50°-80° F., and 20-60 per cent. relative humidity. One method of dispersing the material is to pass heated air over discs rotating through a bath of glycol; another is to boil mixtures of glycol and water. In a small unit, glycol is evaporated from wicks by means of a heat lamp.

Propylene glycol is said to be bactericidal in a concentration of one part in eight million parts of air, which is well below the fog point. Triethylene glycol, effective in even smaller concentrations of one part in 400 million, is considerably cheaper, but the margin between the bactericidal concentration and the point where it condenses on cool surfaces is narrower than for propylene glycol. Thus, greater care must be exercised in maintaining satisfactory operating conditions.

One installation in a 15-bed hospital ward used \$3.00 worth of propylene glycol in a month, while a four-floor bank building used \$150.00 worth of triethylene glycol for sterilization purposes.

Printing inks manufactured with glycols in place of the conventional petroleum solvents are likely to find wide acceptance in the printing industry. Four types of materials, methylpentanediol, propylene glycol, polyethylene glycol and di-ethylene glycol, are being used in experimental printing inks of the magazine type and are reported to print better, give greater fidelity and dry more rapidly than normal inks, while presenting a hard, brilliant finish.

Glycols are being used in increasing quantities in cosmetics and ointments, adhesives, water-soluble lubricants, emulsifying agents and insect repellents. Considerable expansion of glycol production is under way in the United States of America and according to present plans, the annual capacity will reach 415 million lbs. in 1948.

Zircon Porcelain

Zircon porcelain, a war-born product which is becoming of permanent value, contains at least 50 per cent. by weight of zircon. Fluxes are present in amounts under 30 per cent. and are usually added as double zirconium silicates of alkaline earthoxides. Clay is added in amounts not exceeding 30 per cent. by weight and small additions of bentonite are often made to increase plasticity and strength (Russell and Mohr, *J. Amer. Cer. Soc.*, 1947, 30, 32).

The body constituents are mixed either by the wet or dry mixing process. The body may be formed by extrusion, turning, dry or semi-wet pressing, or casting. The hardness of zircon causes tools and dies to be abraded more than with the conventional whiteware bodies and glazing also presents difficulties. Ordinary white-ware glazes are absorbed by the body during firing unless an extremely heavy coat is applied. Because of the low thermal expansion of zircon porcelain, ordinary glazes also tend to craze and decrease the strength of the product. Special glaze compositions have been developed and zircon porcelain is now manufactured with compression type glazes which even improve the strength of the already stony material.

Zircon porcelain is an extremely hard, dense, white mass, heavier than the conventional types of porcelain due to high specific gravity of zircon. It is 50 to 100 per cent. stronger than mullite and high-voltage porcelains and 10 to 50 per cent. stronger than steatite, heretofore the strongest of porcelain-type materials. Thermally zircon porcelain is superior to all other porcelains. It has the highest thermal conductivity of any porcelain and approaches the low thermal expansion of mullite porcelain. It falls within the best three classes of ceramic high-frequency insulators, namely, L-4, L-5 and L-6 which have loss factors at 1. m.c. of 0.016, 0.008 and 0.004 respectively. Zircon porcelain lends itself admirably to the development of all types of vacuum or hermetic metal-to-porcelain seals. The stability of mechanical properties at temperatures

up to 1000°C or higher, merits consideration for special applications. It has good electrical characteristics at normal and elevated temperatures, low electrical losses at high frequencies and very good thermal-shock resistance. This excellent combination of properties affords zircon porcelain wide application in the low frequency power-field, in high-frequency and ultra-frequency communications and signalling equipment. Among the impending or current uses for zircon porcelain are components for radio, radar and miscellaneous high-frequency equipment such as sockets, tube bases, coil forms and terminals. Some of the other uses are capacitor dielectrics, spark-plug insulators, resistor tubes of all types, bus supports, bushings for transformers and capacitor cases, and supports for application at elevated temperatures.

Pox Vaccine purified by Penicillin

Of all the biological products, small pox vaccine demands the greatest attention in its preparation. The vaccine pulp produced by the calf *in vivo* is susceptible to infection, and has to be sterilized without inactivating the virus.

A new method for purifying the vaccine has been developed in the Department of Bacteriology, Laval University, Quebec. (*Can. J. Res.*, 1946, 24 E, 149). By adding penicillin to the vaccine and maintaining a threshold concentration of 56 units per cc., most of the gram-positive cocci and certain anaerobic bacteria, e.g. *Clostridium perfringens* and *C. fallax* are rendered non-pathogenic.

The glycerinated solution of the vaccine together with phosphate buffer is mixed with the requisite quantity of penicillin in a Waring blender and placed in a refrigerator at 5°C. for 3 days. The cultures remain sterile when inoculated with vaccine titrated with 56 units per cc. of penicillin which is the minimal quantity. It has also been established from biological data that penicillin has no effect on vaccine virus and all vaccinated children showed a much straighter reaction than when vaccinated with ordinary vaccine. The titre of penicillin must be periodically checked as also the virulence of the vaccine virus.

Vaccine emulsions containing hemolytic streptococci and anaerobic bacteria, which upto now had to be discarded, can now be used, as it can be freed in a few days from the principal microbes except the gram-negative bacilli by treatment with penicillin. By

maintaining the required threshold of penicillin, all danger of infection at the time of vaccination can be totally avoided.

Manufacture of Vitamin C

The manufacture of ascorbic acid was begun in 1938 at Roche Products Factory at Welwyn. The process now employed by the firm has been recently described (*Ind. Chem.*, 1947, 23, 169).

The starting point for the manufacture of ascorbic acid is *l*-sorbse obtained from *d*-glucose. *l*-Sorbse is condensed with acetone in presence of sulphuric acid to give diacetone sorbse which is then oxidised with potassium permanganate to yield diacetone keto *l*-gluconic acid, which on treatment with gaseous hydrochloric acid gives ascorbic acid. The crude product thus obtained is purified by treatment with activated carbon and recrystallisation.

The production of diacetone-sorbse is carried out in a lead-lined, jacketed pan of 3,000 litre capacity. The pan is totally enclosed, fitted with an agitator and cooled by brine. At the end of the reaction, the excess acid is neutralised by sodium carbonate, and the sodium sulphate removed by settling and washing. The excess acetone from the mixture is recovered by distillation but is unsuitable for reuse until dehydrated to 99.8 per cent. purity or better. A bubble type column operating backward is utilised for the removal of water from acetone.

The concentrated diacetone-sorbse solution still contains some acetone together with undesirable condensation products which must be removed before proceeding further. This is accomplished by dropping the concentrate from the primary still into a small stainless steel still where the unwanted substances are removed under vacuum leaving a thick syrup. As both mono and diacetone-sorbse are formed during the original condensation, and only the latter is required, the mono-derivative has to be removed. The syrup is diluted with water, and the diacetone-sorbse extracted with a solvent. The solvent is recovered by distillation under vacuum yielding crude diacetone-sorbse in the form of a syrup which crystallizes slowly.

The distillation is carried out in two stages, the first at atmospheric pressure and later under vacuum. The mono-acetone-sorbse is recovered from the solution by distilling off the water under vacuum, and recycled to the condensation vessel. The oxidation of dia-

acetone sorbse to keto-gluconic acid is carried out with potassium permanganate (or hypochlorite) in a 3,000-litre vessel, the temperature being controlled by circulation of water in an external jacket. The reaction is carried out under alkaline conditions in the presence of caustic soda, solid permanganate being added gradually until a slight pink colouration indicates that the reaction is complete. The excess of alkali is neutralised by passing carbon dioxide into the solution. The manganese dioxide formed is removed in a wooden plate-and-frame press. The cake of precipitated manganese dioxide is carefully washed to recover last traces of ketogluconic acid and these washes are combined with the filtrate and concentrated under vacuum. As the gluconate is heat sensitive, the concentration is carried out under vacuum at as low a temperature and for as short a time as possible. A stainless steel evaporator of a special design has been developed, which utilises natural convection and employs a steam jet to provide the necessary vacuum.

The next step is the release of free gluconic acid from the sodium salt after removing the oxalates formed during oxidation by precipitation with calcium chloride. The precipitate is allowed to settle, and the clear liquor decanted into a glass-lined vessel maintained at a low temperature by a brine jacket. Sulphuric acid is then added to precipitate the free gluconic acid. This is recovered by spinning in a rubber lined centrifuge and washing with ice cold water. The free acid is dried in an aluminium rotary drier by warm air.

The final conversion of the keto-gluconic acid to crude ascorbic acid is brought about by hydrochloric acid gas. The keto-acid is dissolved in a mixed solvent consisting mainly of chloroform. Hydrochloric acid gas is then passed into the solution. The ascorbic acid gradually separates out when the reaction has been completed, and is spun in a specially designed centrifuge in which all surfaces coming into contact with the liquor are of solid silver. The filtering medium is glass cloth and this is protected by means of a solid silver gauze. The centrifuge is designed to be as fume-tight as possible to prevent the escape of chloroform.

The product thus obtained is 96 per cent. pure ascorbic acid. It is purified by treating a concentrated solution in water with decolorising carbon and forcing the solution through ceramic filter candles by carbon

dioxide. The clarified solution is collected in a vessel cooled by brine and ascorbic acid re-crystallised.

The mother liquor still containing 20 per cent. of ascorbic acid is concentrated under vacuum, cooled and a second crop of crystals obtained. The cycle of operations is repeated until the liquors become unworkable.

A new Camera

Mr. Edwin H. Land, President and Director of Research of the Polaroid Corporation, demonstrated recently before the *Optical Society of America*, a camera which produces a dry positive on paper 60 secs. after releasing the camera shutter. The camera contains a roll of film of the conventional type except that the support is opaque, and the exposure is made in the usual way. The camera also contains a roll of specially prepared paper which is not sensitive to light. The paper support is also opaque, and has attached at intervals equal to the length of the picture, capsules containing a viscous solution of the processing materials. This solution includes hydroquinone and 'hypo' and is released when the capsule is burst on passage of the film and paper between pressure rollers. This takes place after exposure, and the solution is spread as a thin layer between the film and paper, where the following action is said to take place: The hydroquinone rapidly reduces the silver halide in the film in those regions where light action has taken place, thus immobilizing the silver in these regions. In the unexposed regions the 'hypo' takes the silver halide into solution, and diffusion and reduction take place with the result that silver is deposited in the prepared surface of the paper, producing an image in silver. Since most silver is deposited in the paper in those regions where the least exposure occurs in the camera, the paper image is a positive. The film and paper are pulled apart when the action is complete, yielding a paper 'print' which has a slightly damp surface. The film-paper sandwich passes out of the camera immediately after passing the pressure rollers. The purpose of the opaque supports is to protect the film from further light action while the 'processing' is taking place. In some variants of the system further prints can be obtained from the 'negative', but in general it appears necessary to rephotograph the original to obtain further copies. (*Nature*, 1947, 159, 497.)

Mineral Deficiencies in Trees

A South African practice (*Soils and Fertilizers*, 1946, 9, 235) for the treatment of mineral deficiencies in plants is by spraying the foliage with the mineral salt in which it is deficient. Applications to the soil are usually uneconomical and may cause severe injury to the plant. Citrus plants deficient in zinc are treated by a spray mixture containing 4 lbs. of zinc sulphate and 2 lbs. of lime in 100 gallons of water. Sprays may be applied at any time of the year but quicker results are obtained just before the growth flush, or trees may be sprayed after harvesting the fruit. Foliage sprays are reported to give quicker results than soil applications.

Continuous Soap Making Process

A continuous soap making process, in which the finished products are made from raw fats in a few hours has been developed by Messrs. *Procter and Gamble in America*.

The process (*C. T. J.*, 1947., 120, 521) is continuous counter-current hydrolysis under pressure and at high temperature with a catalyst, followed by continuous distillation, neutralisation and finishing. The mixture of fats, in the proper proportion for whatever soap is being made, reacts with water under pressure in a vertical column and split into fatty acids and glycerine.

The crude fatty acids coming from the hydrolyser are purified by dry vacuum distillation and the distillate is neutralised to yield "neat soap". The soap is comparable to that produced in the kettle and may be handled in a variety of ways. By-product glycerine recovered from the hydrolyser gives a better product than that recovered from the soap kettle. It is concentrated in a multiple-effect evaporator which is synchronised with fatty acid production.

From raw materials consisting of 1,000 lb. fat, 135 lb. NaOH and 5 lb. salt were obtained 1,350 lb. soap (30 per cent. moisture) 125 lb. glycerine (80 per cent. crude), and 100 lb. still bottoms (for recovery).

Greater flexibility, more accurate control, improved glycerine recovery and better soap colour are claimed for this process.

The Dynamo Pocket Torch

A handy pocket torch perfected by the Philips Research Laboratories is described in the *Philips Technical Review* (1946, 8, 255). A lever with gear rack is periodically pressed in by the thumb against the pressure of a spring.

The gear rack drives the rotor of a dynamo via a transmission with freewheel. With normal thumb pressure the dynamo supplies the lamp with 0.3 watt. (eff. voltage 2.5 V), the mechanical energy required on the part of the user being 0.9 W. The light flux obtained is 2.4 lumens, half of which is radiated as useful light which is concentrated by a small lens and a simple reflector. Notwithstanding the intermittent drive there is very little variation in the luminosity while the torch is worked. The dimensions of the torch are 8.5 cm. x 5 cm. x 3 cm. and it weighs only 215 grms.

"Riblock" Radio Valves

The demand for small, inexpensive radio sets and the increasing importance of short and ultrashort wave bands have led to the development of a new series of radio valves. The "Riblock" valves, now produced by the Phillips Research Laboratories, (*Phillips Technical Review*, 1946, 8, 289) embodies an entirely new technique. Thanks to the development of radio valves with flat bases either with all-glass or with metal bulb, it is possible to reduce the dimensions of the valve, particularly the length, while at the same time improving their qualities for very high frequencies. There was little prospect of being able to reduce the dimensions of the metal-built type because the metal capacities and dielectric losses between the leads may become too great. With the all-glass type, there was the difficulty in the way of further reduction in size in that the cathode gets too hot when the bulb is seated on the base plate. In the new series of valves this difficulty has been overcome by joining the bulb and the base plate together with an adhesive consisting of an enamel with low softening point. The diameter is limited to 22 mm. This allows eight contact pins in the base and obviates over-heating of the bulb by permitting the maximum dissipation to occur.

Applications of Infra-red Radiation Heating

The methods devised for utilizing radiations in the infra-red range have been recently described (*Ind. Chem.*, 1947, 23, 83). During the war-years, drying tunnels equipped with infra-red radiation were developed for the quick drying of sheet metal articles coated with paint or varnish, the source of radiation being either gas or electricity. Such tunnels show marked

advantages over the convection driers when large quantities of exactly the same article are to be dried. The convection drier handles a large assortment of goods of different sizes and shapes and the dried articles may remain inside the plant without spoilage. Articles to be irradiated by infra-red radiations, however, must generally be of the same quality, size, shape and colour and they have to be passed in single file through the tunnel.

Infra-red drying tunnels are of two types; gas fired and electric. Gas fired tunnels are usually horizontal cylinders through which the articles to be dried are carried by a conveyor at a predetermined speed. In a typical tunnel, 3' diameter by 3' long, the panel temperatures are of the order of 600° F. which produce flux densities of from 3,000 to 4,000 B. Th. U. per sq. ft. per hour. In a new design, the sides and top of the tunnel are corrugated to increase the radiating effect, to render radiation less directional and thereby increase the rate of drying. The temperature attained by the articles was about 300° F. in one minute.

In recent years much use has been made of tunnels and ovens comprising of banks of Mazda infra-red industrial lamps. The electric tunnels in general outline are unlike those which are gas fired. The main factors controlling the general form of an installation are the shape of the product, flux densities required and the method of operation. Each lamp carries a reflector designed specifically for a particular type of material. Flux densities of 1 to 10 watts per sq. inch are obtainable in tunnels using the Mazda 250-watt infra-red industrial lamp. The length of a specific tunnel is determined by the time required to attain the necessary temperature and by the conveyor speed.

For the efficient reflection of visible and infra-red wave lengths four metals are available: gold, copper, silver and aluminium. Glass has extreme transparency at near infra-red and visible wavelengths and is suitable for the protective enclosure of practical sources radiating energy in these regions. Gold, copper and silver could be treated effectively at visible and ultra-violet wavelengths using aluminium reflectors. Anodised aluminium shows a sudden dip round 8,000 Å. Reflectivities of paint pigments suggest their use in far infra-red

wavelengths. Mazda infra-red lamps have proved useful in the softening of plastics prior to moulding. Pigmented plastics, ranging from black to all the known colours, usually absorb the energy quite readily and can be softened sufficiently for easy moulding, in a period of five to ten minutes. Clear plastics, however, transmit a large portion of incident energy and take a longer time to soften unless specially treated.

Mazda infra-red lamps are also extensively applied to the drying of latex on fabric. The lamp installation used can be very easily adopted to dry certain plastics on a continuous belt. The plastic is applied to the belt in a thin film which is then dried. Then a second film is applied and dried and the process repeated until the requisite thickness of plastic is built up on the belt. At this point the plastic is cut from the belt. This type of processing can be applied to the curing of synthetic glue; thus glue used for joining plywood to an underframe can be dried in 10 minutes as against anything up to eight hours in free air.

Ceramic articles are usually dried in 5 hours by electrically heated air, blown counter current through a conveyor type stove, thus producing a high humidity condition at the initial drying stage. Controlled humidity of this type has been accepted hitherto as the "correct" method of drying clays, timber, etc. thus avoiding "case-hardening". It has been found possible to dry the articles mentioned above satisfactorily in less than half an hour in the infra-red tunnel.

One of the main uses for infra red heating is the rapid drying of coatings of paint, lacquers and varnishes on articles. With the entry of synthetic resins into industry there is a vast range and assortment of coatings which can be classified under three heads. The first comprising of paints containing a solvent which, when evaporated, leaves a pigment and an oleoresin, lend themselves admirably to drying by infra-red rays. Lacquers and varnishes constitute the second class and are the easiest to handle as only the solvent has to be eliminated. The third class includes the so-called "heat-transformable" paints wherein the paint vehicle must be polymerised and the solvent evaporated. Different coatings of this type have different optimum temperatures and

periods of exposure for rapid polymerisation, but with the infra-red tunnel any of the desired temperatures and period of exposure are easily obtained.

Paints and Paint Materials

A symposium on Paints and Paint Materials was organized by the *American Society for Testing Materials*, during its 1947 Spring Meeting. Discussions were held under 3 heads: (1) Methods of evaluation of paints; (2) Evaluation of Paint materials; (3) Statistical analysis of paint test data.

The paper on "Evaluation of industrial finishes" gives an account of laboratory tests used by the *General Electric Company*. The tests include effect of salt spray and humidity, alkali resistance, colour retention, abrasion resistance, flexibility, impact resistance, stains and adhesion. The testing of marine finishes under laboratory conditions does not provide reliable data. Because of great variations in sea water, location, season, etc., care must be taken in the selection of sites for testing. Certain locations in Porto Rico, Florida and Cuba are found suitable for exposure tests. Among the most promising laboratory tests is the determination of leaching rates for copper containing paints.

A method involving the use of an inclined tube viscometer, based on the observation that the time of flow of a bubble through a liquid when the tube is in the vertical position is approximately twice the time when the tube is at 45°, has been developed. This method promises to be more accurate and rapid than the methods now in use for the determination of viscosity. The equipment is simple and sturdy and the results can be recorded on a continuous scale in terms of fundamental units. Improvements in auxiliary equipment for the Stormer viscometer, the stroboscopic timer permitting determinations to be made at specific rates of revolution with closer agreement between different operators, have been described in a paper read at the symposium.

In a paper entitled, "How paint technologists can use statistical methods," a number of practical suggestions are given. Six hypothetical cases are presented and the methods of approach suggested. For example, the author shows how a list of viscosities expressed as times (seconds) of flow of the material in a certain instrument, is not nearly so significant as three specific figures would

be, viz., number of tests, average value, and the standard deviation. Another case dealt with, relates to sampling of material from a revolving drum and the number of samples to be taken to give reliable results.

Jute Substitutes

The first step towards production of jute bags in South Africa has been decided upon by the Government which has asked farmers to collect the seed of wild hollyhock, a noxious weed indigenous in Northern Transvaal on a large scale. It is believed that wild hollyhock has qualities superior to jute. If the seed can be produced in sufficient quantities, it may be possible to start production on a full scale in three or four years. As the wild hollyhock grows naturally in many parts of South Africa, producing a heavy yield of good quality fibre, it offers great possibilities for a fibre industry in the Union.

An Improved Variety of American Flax

The U. S. Department of Agriculture has evolved a new variety of flax called cascade which yields, more than any other kind, grows tall and resists disease. It is officially announced to be the result of a cross achieved by Dr. B. B. Robinson of the Agricultural Department. The fibre flax is grown in the Groveland district of Oregon, which is practically the only State in the United States which grows flax. The new kind has been grown commercially for the first time this year, giving an yield of more than 4 tons per acre.

Ramie Fibre produced in Australia

Australia may establish a new agricultural and secondary industry as a result of successful trials with the growing of ramie (*Bohmeria nivea*). Ramie fibre is recognised as the toughest and most versatile of the vegetable fibres. It has been grown in Egypt, India and China for centuries, but upto the present no commercial method has been developed for extracting the fibre from the stem of the plant. Following the invention by a Sydney businessman of an efficient and cheap method of extraction, the Commonwealth Government backed further experiments with a grant of £A. 5,000. The first crop which has now been harvested at Lismore (New South Wales) has exceeded expectations. In certain places the ramie grew higher than 6' and was cut mechanically with a reaper and binder.

In the process of extraction, the ramie is first degummed. After removing the bark, a clean, decorticated fibre remains. While processes used in other parts of the world yield about 1 per cent. fibre, the new Australian process is expected to yield upto 10 per cent. The process has been patented throughout the world but may be used under license in other countries, particularly U. S. A., where large-scale experiments have failed to produce a process approaching the efficiency of the Australian invention.

Chromium Smelting and Refining

A new process, known as Udy Process, has been developed by the *Chromium Smelting and Refining Company*, Sault Ste. Marie, Ontario, Canada, for manufacturing chromium from low grade domestic ores, according to a report from the British Commonwealth Scientific Office. The ore is roasted at 1,000° C. with lime to remove volatile matter and to form a sinter. The sinter is mixed with finely ground coal or coke and fed into a furnace heated to 3,400° F. The product obtained is a chromium-iron alloy admixed with 8 to 10 per cent. carbon and about 5 per cent. silicon.

For preparing ferrochrome, the product so obtained is ground to 200 mesh and mixed with sufficient quantity of sodium nitrate to oxidize all the silicon and carbon. 'Chrom-x', thus obtained is briquetted for direct addition to the steel bath. Each briquette is analysed for its chromium content.

Chemical Projects in Ceylon

The Ceylon Government has sought the advice of technical experts on several post-war industrial projects (*Chem. Age*, 1947, 56, 439). Dr. A. J. V. Under wood, the well known British Chemical Engineer, is advising the Government on acetic acid manufacture from coconut shells. The acid is an essential requirement of the rubber industry, and coconut shells are a waste material in Ceylon. It is proposed to develop the coconut shell carbonization industry to obtain wood naphtha, creosote and pitch.

Ceylon's rubber is to be chemically treated and softened for export as softened rubber which is in heavy demand. Machinery worth Rs. 550,000 is being imported for this purpose. The State Council sanctioned a sum of Rs. 286,000 for a Rubber Service Laboratory in Colombo which will render technical aid to the rubber industry.

A modern mill for processing copra and coconut oil is to be shortly established in Ceylon. On the advice of a London firm of consultants, a scheme costing Rs 6,500,000 has been prepared (*C.T.J.*, 1947 **120**, 233). In addition to refined coconut oil, glycerine, fatty acids and margarine will be produced.

The programme of industrial development of Ceylon contemplated in the five-year plan of the Ministry of Labour includes the large scale production of caustic soda (present consumption, 2,000 tons a year), synthetic ammonia, (28,000 tons a year, used largely in fertilisers), and drugs and fine chemicals, for which there are many indigenous supplies and a big potential market. Approval has been given for the erection of a plant for the manufacture of 2,000 tons of sulphuric acid annually, the overall cost of building and equipment being approximately Rs 2,500,000. The government strychnine pilot factory will be enlarged to give an output 1,000 lb. of strychnine per year.

Sindri Fertilizer factory

Discussions following the decision that the fertilizer factory at Sindri (Bihar) should be State-owned, have revealed that Provincial and State Governments are, in general, prepared to make substantial contributions towards the capital expenditure of the project and also guarantee the purchase of their requirements of ammonium sulphate from the factory. The consensus of opinion was in favour of the formation of a statutory corporation to own and manage the factory on behalf of the several governments that participate in the enterprise.

A scheme for the constitution of the corporation has been drawn up and circulated to Provincial and State governments for comment. According to the scheme the Central government will meet all expenditure on the planning and construction of the factory in the first instance. The factory will be transferred with all the Central Government's assets and liabilities to the corporation on a suitable date. Only Central, Provincial and State governments shall be entitled to become members of the corporation, and each member will be required to invest not less than Rs. 25,000,000 or alternatively, to guarantee to buy not less than 25,000 tons of ammonium sulphate annually for a minimum period of 10 years.

The management of the corporation will be vested in a Governing Body to which 3 members will be nominated by the Central

Government and 1 member by each participating government. This body will be responsible for the general policy, the executive control being vested in a General Manager, who will be assisted in his work by 2 Deputy Managers and a Financial Adviser.

Telecommunication Projects for India

A start is being made by the Government of India in their Rs. 32 crore, five-year tele-communications project which aims at linking by direct channels of telephones and telegraphs, all principal cities including Bombay, Karachi, Lahore, Delhi, Calcutta and Madras. An additional three-channel telephone system will be installed between Karachi and Bombay. The advantage in the three-channel system is that it enables three conversations to proceed simultaneously without interfering with one another on one trunk which ordinarily permits of one conversation only. Karachi is also to be linked with an additional three-channel system with Sukkur, which connects directly telephone channels to Quetta as well. Karachi is already connected with Delhi and Lahore by the channel telephone system.

In order to eliminate the existing telegraphic congestion and undue delay in the disposal of telegrams, it is proposed to instal at Karachi an 18 channel system linking Lahore and a six-channel system for Quetta. At present Karachi has four telegraph channels for Bombay and three for Lahore. Some of these will be used for providing direct links to all big cities in India such as Madras, Calcutta, New Delhi and Rawalpindi.

Telecommunications in Sind are being considerably expanded under the Rs. 16/-crore scheme for this circle. As a result telephone and telegraph facilities will be more readily available in the principal towns of Sind like Hyderabad, Sukkur, Shikarpur, Nawabshah and Mirpurkhas, while the Karachi links with Quetta will connect the frontier outposts of India more expeditiously.

Agricultural Development

The Department of Agriculture proposes to spend over 5 crores during the current year over several development schemes. This includes six building schemes estimated to cost over a crore of rupees. Rs. 16,70,000 are provided for the Zoological Survey of India buildings and offices, Rs. 54,00,000 for cattle breeding farms, Rs. 10,85,000 for construction of a laboratory for plant protection in Delhi.

The other development programmes of the Department include the following:

	Rs.
Soil conservation schemes ..	7,22,000
Agricultural College at Delhi ..	23,62,000
Rice Institute ..	14,60,000
Scheme for the manufacture of milk powder ..	1,03,000
Indian Institute of Fruit Technology ..	13,21,000
Central Potato Research Institute ..	24,75,000
Central Fisheries Research Institute ..	56,50,000
Re-organisation of the Forest Research Institute ..	36,34,000
Central Horticultural Research Institute ..	11,00,000
Animal Husbandry College ..	32,82,000
Central Groundwater Section ..	11,00,000
2 Cattle Breeding Farms ..	22,38,000
Re-organisation of the Zoological Survey of India ..	3,24,000
Expansion and re-organisation of the Botanical Survey of India ..	5,00,000
Grant for the Improvement of Areca nut Cultivation ..	5,00,000
Contribution to Food and Agriculture Organisation for the second financial year ..	4,35,000

Mineral Production during 1944

Indian Minerals, 1947, 1, 33, lists the minerals produced in India during 1944, giving their tonnage.

Mineral	Quantity tons	Value Rs.
Antimony	962	1,53,920
Apatite	228	2,280
Asbestos	583	1,21,805
Barytes	15,299	1,79,358
Bauxite	12,135	57,112
Bentonite	10	23
Beryl	500	44,135
Granite	1,633,563	30,69,967
Laterite	795,258	1,31,383
Limestone and Kankar	5,218,100	1,19,01,146
Marble	18,604	3,14,396
Sandstone	395,502	12,21,651
Slate	6,346	1,64,954
Trap	6,575	11,891
Miscellaneous building stone and road metals	5,704,820	57,04,483
Calcite	1,411	7,858
Chromite	39,555	7,06,480
China clay	89,220	10,28,227
Coal	26,126,676	27,23,92,131
Copper	326,917	67,27,790
Corundum	343	78,015
Diamonds	1,837	2,18,061
Felspar	338	3,814
Fluorite (Fluorspar)	1,229	12,142
Fuller's Earth	11,075	2,15,476
Galena	18.5	2,970
Garnet	23	588
Gold	188,205.872	3,55,01,636
Graphite	927	1,30,816
Gypsum	83,706	3,25,184
Ilmenite	100,794	7,39,308
Iron-ore	2,363,640	56,05,787
Kyanite, sillimanite, quartzite and quartz mica-schist	29,186	4,46,352

Mineral	Quantity tons	Value Rs.
Magnesite	41,936	5,24,770
Manganese ore	370,980	6,45,245
Mica Block:	25,423	1,09,07,000
Splittings:	46,814	1,63,94,458
Monazite	2,016	92,863
Ochre	12,183	1,55,525
Petroleum	97,453,077	1,78,42,044
Rutile	1,646	2,07,256
Salt	1,864,725	2,46,19,710
Salt petre	42,367	9,57,830
Silver	14,239	47,902
Steatite	21,392	4,61,489
Wolfram	30	90,000
Zircon	755	27,928

Development of Fisheries

A five-year programme, ending 31st March, 1952 and costing Rs. 80,75,000 in capital and Rs. 83,54,000 towards recurring expenditure, has been sanctioned by the Government of India for the development of fisheries in India. The plan envisages the establishment of a Central Fisheries Institute working through four stations. The stations will be located at Calcutta, Bombay, Karachi and Mandapam on the east coast of India. The Calcutta station will undertake the study of inland fisheries and the Bombay station of fish technology, namely, methods of treatment, preservation and utilization of by-products. The Government of India have already set up a Deep-Sea Experimental Fishery Pilot Unit at Bombay, where conversion work of the Basset trawler "Berar" is in progress. A skipper, a mate and an engineer for the trawler "Bangadh" and two Reekie boats for this Unit with necessary fishing gear have also been purchased in London.

The whole subject of fisheries in India was examined by Colonel R. B. Seymour-Sewell. According to him, fishery research should be regarded as a social service and not as a business enterprise. Colonel Sewell has formulated an elaborate plan under which there will be a Central Fishery Council and an Advisory Board working through four Committees.

Sand Stowing for Coal Conservation

A ten-year programme of sand stowing for the conservation of coal in India has been recently drawn up. The Works, Mines and Power Department of the Government of India have decided to set up a Committee with the Coal Commissioner as *Chairman* and convener. The Chief Inspector of Mines in India, the Chairman of the Coal Mines Stowing Board and a representative of the Railway Board will serve as members.

The programme will take into account the recommendations of the Indian Coalfields Committee, 1946.

India's Cattle Wealth

The Report on the Marketing of Cattle in India published by the Agricultural Marketing Department contains useful statistical information regarding international trade in cattle, density of cattle population in different areas, cattle mortality, seasonal prices and price trends, etc. It is estimated that the contribution of cattle towards the country's economy is of the order of Rs. 1,900 crores a year. According to the report Indian cattle are of inferior quality as a result of indiscriminate breeding.

The Department has put forward many valuable suggestions for improving the cattle wealth of the country. They include: Organisation of Co-operative Cattle Breeding Societies on a more extensive scale; the levying of cession sales and exports to finance cattle breeding schemes; the setting up of Co-operative Cattle Marketing Societies; better dissemination of market intelligence relating to price, demand and supply; legislation to prevent indiscriminate slaughter and to control contagious bovine diseases; and organisation of Co-operative Cattle Insurance Societies on a sound basis.

Guide to Commercial Timbers

A Guide Book to help in indentifying timbers used for different military purposes was compiled by the Forest Research Institute, Dehra Dun, at the request of the Army Authorities during the war years. This book has now been made available to the public. It includes five zonal keys with brief descriptions of timbers of commercial value in India, and phytomicrographs in the order non-porous, ring-porous, and diffuse-porous varieties.

Indian Central Cotton Committee

The 25th Annual Report of the Indian Central Cotton Committee for the year 1946 shows that increased attention is being given to research schemes on improvements in the race of the plant to enable the grower to secure more profitable yields.

Technological investigations, some of which are of a fundamental nature and others of direct practical value to trade and industry, have made good progress in the Committee's Laboratories. Plain cloth manufactured in a mill from the combed yarns of *Cambodia Co. 3* and carded *Kampala*

spun in the Technological Laboratory, showed that the quality of the former was even better than *Kampala* showing thereby that Indian cotton after combing to the extent of 16/18" can be used with advantage to replace East African cottons now used by the Indian mills. A new apparatus for measuring clinging power of small bunches of fibres was fabricated, and formulae have been evolved which give a better prediction of spinning value of Indian cottons from their fibre properties. Causes of abnormal spinning performance of certain Indian cottons having longer lengths are being investigated. Cullulose sheets of varying degree of transparency and gloss have been prepared from Indian linters by the viscose method. A self-recording dynamometer is being constructed in connection with the investigation of problems on modification in the physical properties of the cotton fibre.

Two bulletins, one on the influence of different concentrations of caustic soda on the quality of kier boiled and bleached yarns spun from Indian cottons, and another on the use of cotton bags for storing sugar, were published. In addition to the above, work on the spinning quality of mixed Indian cottons with special reference to their fibre-properties, influence of different fibre length groups on yarn-strength, comparison of different methods of measuring halo-strength, prediction of strength of yarn spun with different twist-multipliers, effect of storage on several varieties of cotton, etc., are in progress. The total number of samples received at the Committee's Laboratory for testing was 1,249, on which 269 reports were issued.

Problems relating to the improvement of cotton yields in India have been engaging the attention of the Committee since its inception. Some success in this direction has been achieved. The yield per acre rose from 96 lbs. in the quinquennium 1922-27 to 109 lbs. in the quinquennium 1937-42. The average yield per acre during 1942-45 was 112 lbs; the figure per acre of cotton in 1944-45 being probably a record at 122 lbs. In this connection the Committee recommended that two or more suitable officers possessing basic knowledge of agricultural conditions in India should be deputed to America to study cotton cultivation and the economics of cotton production.

Realising the need for an up-to-date publication explaining the procedure followed

in the preparation of cotton forecasts in India, the Committee issued in 1944 a publication entitled, "A manual on the preparation of all-India Cotton Crop Forecasts". It has now been decided to issue translations of this manual in five main Indian languages, *viz.*, Gujerati, Hindi, Urdu, Tamil and Telugu.

Rice Conference

The Conference of the Rice Study Group of the Food and Agriculture Organization which began its session at Trivandrum on May 16 last, concluded its deliberations on June 16 after discussing the Report prepared by its three Committees. Eight major rice-producing and consuming countries were represented at the Conference the purpose of which was to prepare an agenda for an International Rice Conference to be held shortly in South East Asia and to bring together facts and figures relating to production, trade prices, marketing methods, reserve stocks, and milling and storage practices. The countries which participated in the Conference were: India, the United Kingdom, the United States of America, France, China, Siam, the Netherlands and the Philippines.

Survey of production trends.—As the result of a detailed survey of rice production and of the possibilities of increased output, the Study Group has estimated that in 1950-51, Burma will have a surplus of 2.5 million metric tons of rice and Siam 1 million tons; India is expected to have a shortage of 2.5 million tons in that year. World demand in 1952 is placed at 10 million tons against an exportable surplus of 6.7 million tons. In seven years from now, the gap between supply and demand will exceed 3 million tons.

The Study Group recommends that attention should be given to minimising storage, depreciation and losses due to rodents and insect infestation. Paddy should be well dried before storage and parboiling should be adopted as far as possible. Consumption of parboiled rice should be encouraged.

Each member country should be called upon submit information regarding nutritional studies on rice to the F.A.O. and the latter should call an urgent meeting of experts to values studies to determine the comparative ini iate of different types of rice and to recommend the most suitable method of conserving and enhancing the nutritional values of rice.

As regards improvements in and expansion of production, the Study Group has recom-

mended that credit with low interest rates, both short and long term, should be provided to cultivators in all rice producing countries. Suggestions made for improvement in domestic marketing include standardization of different kinds of rice, standard weights and measures, crop forecasting and estimating and market intelligence.

National Price Policies and Research.

The Study Group urges that early steps should be taken to organise and conduct further studies on the changing pattern of supply and demand, price structure of rice, ways and means of coordinating price policies of surplus and deficit countries and economic problems relating to stabilization through a system of maximum and minimum prices.

Studies on rice should include problems of irrigation, drainage, rotations, manuring and breeding. These studies should be coordinated, and the F.A.O. should facilitate exchange of scientific information. An international body responsible for work on rice production problems should be set up, and this body should collect, maintain and exchange new varieties of seed for facilitating further research on breeding.

Regional Technical Institutions for India

The Co-ordinating Committee of the All-India Council for Technical Education met in Bangalore on 27—28 May, under the Chairmanship of Mr. N. R. Sarker.

The Committee stressed the necessity of establishing a minimum standard of efficiency for higher technical education, and of ensuring an adequate supply of trained personnel. If these objects were to be attained, technical education should be under the direction of the All-India Council for Technical Education.

In view of the urgent need for turning out technical personnel for the economic and industrial development of the country, it was suggested that suitable financial grants may be made from the Centre to existing institutions on the recommendation of the Council. It was felt that immediate steps should be taken to implement the recommendations made by the Council a year ago for the establishment of higher technical institutions in Calcutta and Bombay and for taking preliminary steps for the establishment of similar institutions in the northern and southern zones.

The Committee discussed the position of All-India Diplomas in Engineering and

Technology *vis-a-vis* the corresponding university degrees. For the co-ordinated development of higher technical education, it was felt that universities should have full particulars of the diploma courses as also of the higher diplomas of the projected higher technical institutions so as to facilitate flow of students between universities and higher technical institutions for advanced studies. On the question of post-collegiate practical training, the Committee requested the Government of India to compile a list of suitable factories where students may find reasonable facilities for training.

War Reparations

India has claimed 18 per cent. of the total number of items which may become available by way of reparations from within Japan, that is, excluding assets in former occupied territory on the Asian mainland and elsewhere. In regard to reparations from Germany, 11 industrial plants and machine tools have been allocated to India.

The Inter-Allied Reparations Agency at Brussels has so far allotted the following plants to India under the German Reparations Scheme:

Wagner and Co., Dortmund,—Machine Tools manufacturing plant; *Norddeutsche Dornier Werke No. 2 Factory, Luebeck*,—Household utensils and economy stoves manufacturing plant; *Norddeutsche Dornier Werke, No. 2 Factory, Luebeck*,—Household utensils and economy stoves manufacturing plant; *Norddeutsche Dornier Werke, & Household utensils and economy stoves manufacturing plant*; *H. Stoll & Co.*,—Sewing and knitting needles manufacturing plant; *Gustav Genschow & Co. A.G., Deutsche Waffen & Munition Factory A.G., Oskar Schneider & Co., Englehardt Foerster, Friedr Meyer und Sohne, Messerschmidt-GMBH.*,—General purpose Machine Tools of all types; *Norddeutsche Mutte A.G.*,—Machinery of blast furnace, coke oven, cement, vanadium, etc.

In addition, certain special machines (vehicle engine assembly units) from A.C.A. plant No. 5, *Kloekner-Humboldt Deutsche A.G.*, and 4 general purposes machine tools from plant No. 19, *Index Werke Hahn Tesseke*, have been allocated to India.

It is understood that the plant and machinery will be disposed of to private industries which are most suited to use them, unless they are required for the industrial schemes sponsored by Government.

Manufacture of Spindles

About 40,000 spindles per month are expected to be manufactured by a company which will be formed as a result of the agreement between the Indian Textile Delegation and the Textile Machinery Makers, Ltd., U. K.

The agreement provides that while 74 per cent. of the shares and the controlling interest would be held by Indians, the British concern would have a 26 per cent. financial interest and would be represented on the company's board up to a fourth of the total strength. Of the total capital of Rs. 1½ crores, the Textile Makers Ltd. would have shares of Rs. 39 lakhs which will consist of Rs. 13 lakhs worth of shares to be subscribed for in cash and fully paid-up shares of Rs. 26 lakhs *free of payment* in return for goodwill, patent rights, technical assistance and benefits of past and future research.

Pharmacognosy laboratory

The Health Department of the Government of India are establishing a Pharmacognosy Laboratory in the Indian Museum at Calcutta. The work of the laboratory includes identification and evaluation of drugs either in crude or prepared form, research on substitutes, methods of collection, curing and storage of drugs, influence of age, season and locality on the yield of active principles, adulteration of drugs, etc. Cultivation of medicinal plants in India, introduction of foreign drug plants for acclimatization in this country and zonal plantation of medicinal plants are included in the programme of work of this laboratory. Mr. S. N. Bal, Officer-in-Charge and Curator, Industrial Section of the Indian Museum, has been appointed Director of the laboratory.

Institute of Fruit Technology

The Indian Institute of Fruit Technology now functioning at Lyallpur on a small scale, will be greatly expanded and transferred to New Delhi in the current year. Besides carrying out researches on fruit, the *Institute* will provide training in fruit technology and tender advice to the fruit industry.

Department of Power Engineering, Indian Institute of Science.

—Plans have been completed for the expansion of the Department of Electrical Technology which has been the principal centre in India for post-graduate training and research in electrical engineering. The Government of India have sanctioned a sum of Rs. 60 lakhs for the

expansion, and the new department will provide advanced training to enable persons to undertake not only planning of power projects but also to operate power plants for the projected large scale electrical developments in this country. A 2 year post-graduate course has been drawn up for all-round training in power and high voltage engineering.

The new Department of Electrical Technology and Power Engineering will be in charge of Prof. M. S. Thacker, well known electrical engineer, who was associated with *Calcutta Electric Supplies* for over 16 years. Prof. Thacker's record as an electrical engineer is distinguished. He had extensive training in power engineering in the United Kingdom, and was connected with the *Bristol Electrical Corporation, South-West of England Grid Station*, before joining the *Calcutta Electric Supplies*.

Announcement

Board of Research in Atomic Energy.—A Board of Research in Atomic Energy with Professor Bhaba as *Chairman* has been set up under the auspices of the Council of Scientific and Industrial Research. A Joint Committee, consisting of six members appointed by the Council of Scientific and Industrial Research and three representatives of the Travancore Government, has been formed to advise on all matters connected with research, development, disposal and utilization of raw material available in the monazite sands of Travancore.

DR. B. D. NAG CHAUDHRY, Reader in Nuclear Physics, Calcutta University, has been deputed by the Government of India to U. S. A. and U. K. for advanced studies in atomic energy. The Atomic Energy Committee of the Council of Scientific and Industrial Research recommended his name to the Government for selection.

Indian Institute of Metals.—The principal object of the Indian Institute of Metals, recently established in Delhi, is to promote the art and science of making, shaping and treating of metals and alloys. India is a big consuming country for metals, both ferrous and non-ferrous, and those connected with the metal industry in India have been obliged to rely on foreign publications for all information relating to metals. The newly

started Institute will serve as a centre for the dissemination of scientific and technical information on metals.

Further information relating to the Institute can be had from Dr. D.P. Antia, Kota House, Shajahan Road, New Delhi.

All-India Commerce Association.—At a meeting of industrialists and university professors recently held in Cawnpore, it was decided to form an *All India Commerce Association* with a view to organize and encourage theoretically sound and practically useful studies, researches and discussions on problems of commercial and industrial importance. Sir Padampat Singhanian has been elected President of the *Association*. The first annual conference of the *Association* will be held in Cawnpore in December 1947. The subjects selected for discussion are: (i) the Indian Taxation Policy; (ii) Planning of India's Foreign Trade; (iii) Railway Transport in India; and (iv) Abolition of Zamindari and Private Capitalism.

The *Association* proposes to issue a journal. Inquiries relating to the *Association* may be addressed to Mr. A.N. Agarwala (*Secretary*), the University, Allahabad.

Survey of Industries recently Started in India.—The *Ali-India Manufacturers' Organization* (A. I. M. O) has been studying the subject of industrialization of the country for the last six years. The problems of newly started industries, their development and expansion, deserve more attention from the public and Government. Some of these indigenous industries face problems which affect their very existence and they need facilities and timely assistance. The *A. I. M. O.* believes that our industrial wartime gains, meager as they are, need to be consolidated. Therefore, the *Organization* wishes to make a survey of these industries which will facilitate in getting assistance from Government.

The *A. I. M. O.* invites its member and non-member manufacturers of newly started industries during the last three or four years, to communicate with the Central Office of the *A. I. M. O.*, Industrial Assurance Building, Opp. Churchgate Station, Bombay. Detailed information about their position now, the problems that are likely to be faced in the future and the nature of assistance desired should be given.

REPORTS FROM STATES & PROVINCES

Mysore

Board of Scientific and Industrial Research

According to the Annual report for 1945-46, the following schemes were in progress during the year:

Furfural.—Paddy husk is being employed for the manufacture of furfural at the Mysore Iron and Steel Works, Bhadravati. The monthly production is about 45 lbs. (76 per cent. purity). No operational difficulties have been experienced in the pilot plant. Furfural-phenol and furfural cresol resins have been produced on a pilot plant scale using different catalysts. The resins are expected to be cheaper than formaldehyde plastics and their economic possibilities are being worked out.

Abrasives.—The work on abrasive wheels carried out at the Indian Institute of Science, has resulted in the production of satisfactory abrasive wheels. A clay bonding process was employed in the manufacture of the wheels from carborundum powder.

Cement-asbestos products.—The Geological Department conducted investigations into the possibilities of manufacturing cement asbestos sheets and pipes from Mysore asbestos, and the results so far obtained are encouraging. In view of the encouraging results achieved by the Geological Department, the samples being reported as 80 per cent. up to specifications, the Board decided to continue the experimental work. The investigation is being transferred to the Mysore Iron and Steel Works, Bhadravati.

"Spike" disease of Sandal.—Since the spike disease could not be controlled effectively, increased production of sandalwood has not been possible. In view of the importance of the problem, and the urgency for controlling the disease, the Board resolved that a committee of silviculturists, bacteriologists, entomologists, plant physiologists and others should be appointed to collect all the available data and to prepare an exhaustive brochure on the subject to aid further research.

Mechanical Engineering Workshop.—Government have ordered that the Central Industrial Workshop and Government Electric Factory should be further expanded to enable them to manufacture factory equipment and spare parts. The nucleus of a designing section will be started in these factories to design pilot and special plants.

Central Industrial Research Institute.—A Central Industrial Research Institute is to be established in the State. A committee of seven members under the chairmanship of Sir J.C. Ghosh has been formed to work out details and prepare a definite scheme for submission to Government.

Jodhpur

Department of Industries and Commerce

The newly established Department of Industries and Commerce has chalked out a programme of industrial development in the State.

The programme includes the intensive development of the handloom, weaving and leather tanning industries, which are among the oldest cottage industries of the State. The Department will provide improved spinning wheels and fly shuttle looms, start training centres and send out demonstration parties for improving these industries. A cottage industries sales emporium has been opened to provide publicity and marketing facilities.

Large Scale Industries.—The following measures have been taken for the development of heavy chemical industries: (1) A lease for the exploitation of the Sambhar bitters has been given jointly by the Jaipur and Jodhpur States, and a joint stock company with a capital of Rs. 5 crores is being floated for the manufacture of caustic soda, soda ash and other heavy chemicals. (2) Excellent quality of limestone, gypsum and slate are available in the State. A cement factory is to be established at Sojat Road which will utilize these raw materials. (3) A dyestuffs factory is to be started with a capital of Rs. 1 crore at Eranpura Road. *Messrs.*

Thacker & Co. of Ahmedabad are in charge of the project. (4) A woollen textile mill with 50 looms and 2,500 spindles is to be established at Marwar Pali. (5) The large natural deposits of sodium sulphate under the salt pans at Dilwana are to be exploited by the State. A factory for the manufacture of sodium sulphide has been constructed at Jodhpur and is shortly going into production. (6) Marwar produces about 60,000 mds. of bones annually. A bone fertilizer factory is being established at Pali with the help of a Bombay firm. (7) Till recently all the oil seeds were being exported, there being no oil mills in the State. In view of the facilities offered by the State, 3 oil mills have now been established, and sanction has been given for 4 more. It is proposed to erect 12 additional mills in the near future. (8) Excellent qualities of quartz, felspar and barytes being available in the State, a local firm has planned to establish a glass and pottery works at Jodhpur. (9) Schemes are under consideration for the manufacture of paints and varnishes, leather goods, matches and slates.—*Contributed.*

Travancore

Geological Survey.—The University of Travancore, in co-operation with government, have appointed Mr. Lawrie, Senior Geologist of the Geological Survey of Scotland, on a contract for three years, his services having been lent to the State by the British Government. Mr. Lawrie will hold the appointment under the University. The terms of his appointment are: to start and establish a systematic survey and mapping of the State, to investigate the mineral resources of the State and to train local personnel in this work. Mr. Lawrie is expected to take charge of his duties shortly.

Tyres for motor vehicles.—The Rubber factory which is at present engaged in the manufacture of bicycle tubes and tyres will be expanded to produce tyres for motor cars, buses and lorries. A Government sponsored concern with a capital of Rs. 1 crore is to be established for this purpose. The *General Tyre Company* of Arkon, U.S.A., have been consulted on this venture.

Fisheries.—The West Coast Fisheries are establishing a factory, with modern curing and processing machinery at Vizhingam, a fishing centre in the State. Trawlers fitted with refrigerators will be used for fishing.

Coconut Research.—The foundation-stone of the first research station of the Indian Central Coconut Committee was recently laid at Krishnapuram near Kayamkollam, Travancore. The Government of Travancore will bear the expenses of buildings and equipment. The station will cost the Coconut Committee Rs. 4,21,000 non-recurring, and Rs. 72,000 annual recurring expenditure. Researches on pests and diseases of the coconut palm will be carried out in this institution.

Radio-sonde Station.—A Radio-sonde Station has been established at the Trivandrum Observatory by the Indian Meteorological Department. The data obtained daily from this station are expected to yield valuable information on the mechanism of monsoons, and in conjunction with those from other stations in India, the new station will be a valuable aid to weather forecasting.

Caustic Soda Industry.—It is proposed to set up a caustic soda plant as an adjunct to the fertilisers plant at Alwaye, to provide caustic soda for the rayon factory to be established at Perumbavoor. To ensure a product of the grade required for rayon manufacture, mercury type cells will be used for the electrolysis of brine. The plant is on order with the *Power Gas Corporation Ltd.*, who are collaborating with *Messrs. Krebs et Cie*, the patentees of the Krebs mercury-type cell.

The plant will have an output of 20 tons of caustic soda of rayon grade purity and 17.6 tons of chlorine per day. Most of the caustic soda will be marketed as lye and the chlorine will be converted into organic and other chlorine products. The hydrogen produced will be utilised in the F.A.C.T. ammonia plant. The quantity of hydrogen available for this purpose will be 0.5 ton per day.

Hyderabad

Building Research.—The Hyderabad Engineering Research Laboratory (Director: Dr. S.P. Raju) has been devoting special attention to building research. One of the problems taken up for investigation relates to thermal conditions of small dwellings. Typical dwellings selected in consultation with the City Improvement Board in Hyderabad are under observation since last summer. The data collected will be utilised in the design of suitable dwellings.

Simple, hygienic and economical cooking ranges have been developed in the Research

Laboratory to meet the needs of village and urban dwellers.

Madras

Lignite Deposits.—The question of exploiting the lignite deposits occurring in the South Arcot District has been under the consideration of the Madras Government for some time. In the course of the preliminary examination of these deposits by the Geological Survey of India, it was suggested that the opinion of a mining engineer should be obtained. Mr. Milne, Assistant Superintendent of Railway Collieries, who was deputed by the Government of India to inspect the area, recommended the sinking of a trial pit to obtain bulk samples of lignite with a view to ascertaining the nature and structure of the lignite beds and the uses to which this class of fuel can be put in practice. It is understood that the Government of Madras will undertake the sinking of the trial pit at an estimated cost of Rs. 76,000.

Central Provinces

A plea for the establishment of a provincial Geological Survey in Central Provinces and for making adequate provision for the teaching of geology, mining and metallurgy in the Nagpur University was made by Prof. N. P. Gandhi in the course of his address to the Central Provinces and Berar Industrial and Commercial Conference (April 20, 1947).

The chief minerals of the Province are manganese, coal, bauxite, iron ore and building materials. Most of the manganese ore, of which India is the second largest producer in the world, is mined in the districts of Balaghat, Nagpur, Chanda and Chhindwara of the Province.

Over 15,000 million tons of coal occur in the Province in the Wardha Valley, Chhatisgarh and the Satpura fields, of which 5,000 million tons are easily workable. These coals are generally inferior in quality to the Jharia and Raniganj coals. Of the coal annually mined in India, only about 6 per cent. comes from the Central Provinces, the average production being one and a half million tons.

Enormous deposits of high grade bauxite occur in various parts of the Province, notably in the Balaghat, Katni and Sooni districts. Large deposits of high-grade iron ores occur in Chanda and Drug districts and in the Bastar State.

The Central Provinces have also got large and wide-spread resources in various building

materials such as brick clays, kankar, laterite, basalt, limestone, marble, pottery clay, fire and pipe clay, sandstone, roofing and flooring slates, etc. which should aid her in her industrial development. There are also many minor minerals such as sillimanite and asbestos in Bhandra district, soapstone in Jubbulpore, semiprecious stones in Bilaspur, Hoshangabad, Drug and Jubbulpore, and ochres, abrasives and alluvial gold in several districts. These await careful and detailed prospecting and research.

It is noteworthy that out of the 468 licenses to prospect minerals granted in the whole of India during 1938, as many as 324 were in the Central Provinces. In the same year out of 137 mining leases granted in India, 66 were in this Province.

Iron and Steel Production in India

The Iron and Steel Panel was constituted by the Government of India: (1) to examine the feasibility of attaining a steel target of 2 to 3 million tons per annum in the first post-war five-year period, (2) to suggest suitable locations for new plants, and (3) to make recommendations regarding the nature and extent of State assistance and control that may be necessary.

The pre-war annual consumption of steel was about 1 million tons made up of 7 lakhs tons of local production and 3 lakhs tons imported steel. The consumption of pig iron was about 1,42,000 tons and export 541,000 tons. The panel suggests a target of 2 million tons of steel to meet the country's demand. India's productive capacity of finished steel of all classes is estimated to be about 1,200,000 tons per annum and the panel anticipate that additional capacity of about 440,000 tons can be made available in the course of the next five years as under:—

<i>Tatas.</i> (a scheme of expansion which can be completed within 5 years, raising the total production to about one million tons per annum)	150,000 tons
<i>SCOB</i>	200,000 "
<i>Mysore Iron Works</i>	30,000 "
<i>Rifle Factory, Ishapore</i>	60,000 "

Even if the above extensions are completed within five years, there would still be a deficiency of nearly one million tons of steel per annum. The panel has recommended the immediate installation of a new unit with an initial capacity of 500,000 tons and an ultimate capacity of 1 million tons. The first unit will be erected in the Central Provinces and the second in Bihar near Jamalpur.

INDIAN PATENTS

[The following is a list of Patent Applications notified in the *Gazette of India*, Part II, Section I from April to May 1947. Patents from the Council of Scientific and Industrial Research are indicated by an Asterisk.]

34149. Improvement in doors or the like : *Slots for a half lap joint in one set of parallel strips are alternatively on opposite sides and the slots in the other sets of strips for the half lap joints are in one side only.*—Teasdale.
34263. Internal combustion turbine power plants : *A steam turbine and a heat interchanger which extracts heat from the exhaust gases of the lowest pressure internal combustion turbine of the compounds series for raising steam.*—Power Jets Ltd.
34285. Meat chopping Devices: *Feed screw contained within a downwardly inclined cylinder and driven by a motor having its axis inclined from the horizontal.*—Toledo Scale Co.
34516. Compositions comprising acrylonitrile polymers and copolymers and shaped articles produced therefrom: *Comprising a solution of a polymer of acrylonitrile in a solvent comprising a disubstituted formamide*—E. I. Du Pont de Nemours and Co.
34727. Salts of diamines: *Reacting a diamine with an alkyl sulphonic acid.*—Societe Des Usines Chimiques Rhone Poulenc.
34735. Means for operating brakes on trailer vehicles : *Connections from tractor vehicles to brake operating cylinder and reservoir in trailer vehicles and means for applying brakes on disconnection of vehicles*—Clayton Dewandre Co. Ltd.
34916. Spinning for the production of rovings and yarns: *Twisting is imparted to the yarns by causing them to rotate within a rotary vessel*—Martinez.
34952. Fastening devices or buckle for use with belt, strap, webbing and the like: *A quadrilateral open frame has a friction gripping member mounted to slide within the frame on the side portions of the frame and has one end portion of the frame thicker than the sides and the other end portion of the frame.*—Pioneer Parachute Co.
35038. Churns: *Churns with hollow blades with open ends and cut away portions, to give a centrifugal action to the liquid in addition to stirring by rotary motion of blades.*—Kalha and Kalha.
35186. A vibrating machine for moulds containing concrete or the like: *Vibrating Mould, clamping frame, lifting device trip gear and vibrator.*—All Tools Ltd.
35187. A machine for shaking at low frequency moulds containing concrete or the like: *A mould fed by conveyor, lifting and jolting frame, mechanism for lifting the frame and imparting low frequency shaking, and means initiating and terminating operation.*—All Tools Ltd.
35218. Scaffolding and like structures: *Structure includes at least two units, each unit comprising four uprights the uprights being connected together in pairs to form two fixed frames to which at least two horizontal members are detachably connected at their ends, one unit being erected on the top of the other with the uprights of the upper unit superimposed on that of the lower unit.*—Sullivan.
35319. Glands for rotary shafts: *A tubular sleeve bridged to a flange which is held elastically in packing engagement against a plane surface radial to the shaft.*—Morgan and Gammon.
35398. Coin-feed Ice Cream Vending Machines: *Ice cream vending machine wherein products are refrigerated with circulation of air, cooled in a compartment other than and insulated from compartment containing the products.*—Partridge.
35643. Production of protein, containing coatings on Aluminium surfaces:

- Treating aluminium surface with a solution of alkali metal carbonate and protein.*—Aluminum Co. of America.
35659. *Chemotherapeutic Compositions and method of making same: Reacting malic acid with a polyhydric alcohol to effect esterification of at least part of the malic acid.*—Westbury Chemical Co., Inc.
35670. *Synthetic Resins: Condensing a product obtained by the action of an aldehyde on amylaceous material, with urea or phenol.*—Societe "L' Impregnation".
35830. *Combustion Chambers for International Combustion Turbines: A shield extending wholly or mainly around the jet pipe and having clearance with the outside and the jet pipe.*—Metropolitan-Vickers Electrical Co., Ltd.
35831. *Combustion Chambers for Internal Combustion turbines: A baffle having a solid imperforate central portion opposite the fuel jet and at least one row, but preferably several rows, of circularly-distributed perforations surrounding said imperforate portion, is provided at the upstream end of the combustion chamber*—Metropolitan-Vickers Electrical Co., Ltd.
35976. *Toys: Comprising a disc having slots communicating with radial parts which slots covered on both ends, the disc being rotated by means of a string.*—Dutt Joshi.
35994. *Card index systems: Comprising index card holder, a slidable signal, inter engaging parts on the signal and retaining means to hold the signal position*—Wassell.
36173. *Protecting Pharmaceutical Powders: Dusting pharmaceutical powders on to a layer of edible substance and thereafter adding a top layer of the edible substances so as to form sandwich.*—Ruegg.
36284. *Apparatus for supporting and raising working platforms used in building: A guide sliding along steel standards of scaffolding, retaining means to support the guide on the standard, and gripping means for the standard.*—Joseph Bradbury and Sons, Ltd.
26750. *Apparatus for shifting a vehicle: A stop co-operates with the rack carrying head to prevent fall of rack, from raised position.*—Societe Anonyme des Ateliers de Construction de Jambes-Namur (Anciens Establishments Theophile Finest).
32531. *Electric switching systems such as tele-communication exchange systems. A registering device, interposed between the key set and the switching device, comprises six similar discharge tubes grids connected to keys.*—Standard Telephones and Cables, Ltd.
32532. *Electric switching systems for instance, automatic telephone exchange systems: Switch applies ten potentials serially to grid of triode and causes operation when proper potential reached.*—Standard Telephones and Cables Ltd.
32631. *Manner of and type font for printing Arabic, Urdu, Persian and similar scripts: Independent medial joining piece comprises a short horizontal stroke with an upward extension stroke on its left forming an obtuse angle therewith*—Director of Government Printing, H. E. H. the Nizam's Government.
32636. *Pipe couplings (12th June 1944) Resiliently faced valve member of spigot part engages a static valve seating of the socket part on coupling and engage the underface of a double faced fixed seating on the spigot part when uncoupled.*—Sterling Industries Ltd.
32792. *Conversion of hydrocarbons: Contacting the hydrocarbon with concentrated sulphuric acid at a temperature in the range -10°C to $+50^{\circ}\text{C}$.*—DePenning.
- *
32834. *Mica incorporated boards, slabs, tiles or the like. Slabs are composed of cement and pulverised mica with or without the addition of sodium silicate.*—Ray.
32843. *Therapeutic substances having both bacteriostatic and vasoconstrictive qualities: Reacting a sulfonamide with a vasoconstrictive amine.*—Abbott Laboratories.
32845. *Liquid hydrocarbonaceous fuel, with or without by-products from vegetable starting material: Heating vegetable products, of industry at 200°C - 700°C with a catalyst such*

- as amide or hydroxides of a metal of the first or second group.—Ioshi.
32853. Grain separators; Separator having means for subjecting grains for total fluid wetting and means for separating, flotation and sunken grains and drying.—Huzenlaub and Rogers.
32874. Mold for making intergral reed plates and reeds: Read and read plate moulded integralls from plastic material.—International Plastic Harmonica Corp.
33100. Box and like sectional structures and corner reinforcements therefor: Corner reinforcement of angular element having side limbs and an end limb all provided with fingers:—Bleek.
33133. Shelters particularly of the readily erectable and demountable type: Series of arched ribs spanned by wall sheathing and a unitary roof structure having purlines and roof sheathing.—National Steel Corp.
33212. Constructions of bridges and other metal frame structures: Plurality of preformed panels may be united in superposition, side by side and end to end.—Bailey.
33352. Clearing fog from open spaces: Producing a curtain-like jet of air from orifices along the sides of the area to be cleared, and discharging treated air from other orifices.—The General Electric Co., Ltd.
33472. An underbody structure for trucks, buses and the like vehicles: Members made of light perforated mild steel plates and light section angles.—Burgess.
33488. Raising natural oils and other liquids by gaseous pressure: An auxiliary chamber provided about the displacement chamber to receive the gas expelled from the chamber.—Indo-Burma Petroleum Co., Ltd.
33491. Negative plate pastes for storage batteries and to methods of making the same: Consists of lignin bearing material hydroxide or oxide of an alkali metal and of an alkaline earth, carbon black and lignin.—General Motors Corp.
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33798. Optical filters and masks for colour television apparatus: Superimposed screens the radiation-transmission properties differing from point to point and varying cyclically by relative displacement.—G. E. C. Ltd.
33889. Internal combustion turbine power plants: Two turbine compressor units connected through combustion chambers; air compressed in one provides gas for driving the other.—Power Jets (Research and Development) Ltd.
33890. Mounting of piezo-electric crystals: A wire bent to a V, with parallel limbs has apex fixed to either surface of crystal and limbs to support.—G. E. C. Ltd.
33945. Typographical element or matrix: Comprises a body portion with two side faces, a character bearing plaque mounted in the opening connecting the side faces.—Intertype Corp.
34064. Compositions comprising acrylonitrile polymers and copolymers and shaped articles produced therefrom: A solution of a polymer of acrylonitrile in a solvent comprising a cyclic organic compound composed of 3 to 8 membered ring.—Du Pont de Nemours and Co.
34129. Preparation in a condition of purity of hydrocarbons from mixtures containing them: Isolating different fractions from a mixture hydrocarbons and converting the isolated hydrocarbons of different boiling point.—Anglo-Iranian Oil Co., Ltd.
34171. Polymerisation and interpolymerisation of ethylene: Subjecting ethylene to an elevated pressure and temperature in the presence of oxygen and benzene or a chlorobenzene.—Du Pont de Nemours and Co.
35071. Production of motor fuels or constituents: The products of alkylation are fractionated for the recovery of determined fractions that are returned to the alkylation reaction zone. Anglo Iranian Oil Co., Ltd.
35099. A device for changing pressure rolls in metal rolling industry: Two

- swinging arms with plate forms to support roll driving spindles, when rolls are changed.—The Tata Iron and Steel Co., Ltd.
35124. Multi-channel transmitting system: Producing separate series of identical pulses, timing and giving amplitude to each channel, translating the pulses and interleaving the trains into a single train.—Standard Telephones and Cables Ltd.
35136. Dyeing: Treating an article with a naphthol first component subjecting it to an aqueous acid solution and thereafter applying coupling component.—Du Pont de Nemours and Co.
35138. Potato peeler: Comprising a blade of curved cross-section secured to a handle and in which two cutting edges are provided.—Cohen.
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35158. Insulated electric conductors: Dielectric extruded on tubular conductor whilst fluid is caused to flow through the said conductor—W. T. Henley's Telegraph Works Co., Ltd.
35182. Arylaliphatic diamines: Condensing derivatives R_1X with compounds $Y-CH_2-Ar-CH_2-N \begin{matrix} R_2 \\ R_3 \end{matrix}$ where X and Y represent either the group— NHR_1 or a halogen atom, Ar an aryl nucleus R_1 a hydrogen atom or an alkyl group and R_2 and R_3 alkyl or aralkyl groups—Societe Des Usines Chimiques Rhone Poulenc.
35184. Amino alcohols: Diazotising diamines of the general formula $H_2NCH_2-Ar-CH_2-NR_1R_2$ where Ar is an aryl nucleus and R_1 , R_2 , alkyl or aralkyl groups—Societe Des Usines Chimiques Rhone Poulenc.
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35274. Electromagnetic telephone systems: Poleshoes lie within the confines of a dimension of the bar magnet transverse to the polar axis thereof.—Siemens Brothers & Co., Ltd.
35396. Telecommunication systems: Comprises a register with digit storage devices less in number than the maximum number of digits—Standard Telephones and Cables Ltd.
34172. High Molecular weight compounds from ethylene: Ethylene substantially free from hydrocarbons having a carbon-carbon triple bond is polymerised by subjecting to an elevated pressure and temperature in the presence of oxygen or a per compound—Du Pont de Nemours and Co.
34195. A connector for joining conductors and a process of making such joints: Conductor supported in a gap between supporting and movable means, variation in width of the gap being opposed by springs.—J. Oortgijzen.
34277. Toys: Comprising a pair of wheels connected by axle, a support secured to the axle, a toy mounted on said support, a pin eccentrically fitted to wheels and movable members connected to said pins.—Dutt Joshi.
34319. Arrangements for hermetically sealing electrical apparatus in cases: Wire passing through ceramic insulator soldered with hard solder to metallised surface surrounding upper end of hole; lower metallised end of insulator soldered to container with soft solder.—United Insulator Co., Ltd.
34322. Toys. (Addition to No. 34277): Improvements in Indian specification No. 34277 wherein the flanges of the two wheels combinedly engage with the head of a rail on either side while from the axle is suspended a weight to keep the toy in erect position.—Dutt Joshi.]

Journal of



SCIENTIFIC AND INDUSTRIAL RESEARCH

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[No. 7

Electrolytic Reduction of *m*-Dinitrobenzene to 2,4-Diaminophenol.

B. B. DEY and H. VENKATAKRISHNA UDUPA

(PRESIDENCY COLLEGE, MADRAS.)

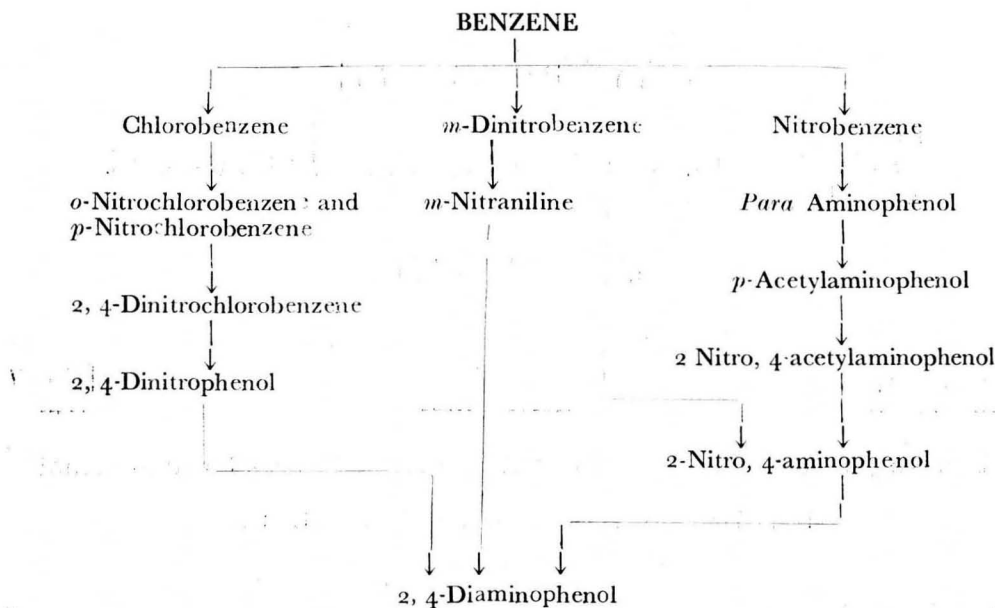
The work presented in this paper relates to the development of an economic method for the direct reduction, electrolytically, of *m*-dinitrobenzene to 2,4-diaminophenol. The latter finds extensive use in the field of photographic developers under various trade names such as 'Amidol', 'Diamol' and 'Dolmi', etc., and also in the preparation of certain valuable dyes employed in the dyeing of furs and hair. The literature on the electrolytic reduction of polynitro compounds is rather meagre, and the work reported so far shows that while the reduction proceeds readily enough, the products, in most cases, are complex and difficult to separate. Usually one nitro-group is supposed to be reduced at a time, but the course of the reduction is more complicated and not easy to follow.

On the technical scale 2,4-diaminophenol is made both by chemical as well as by electro-chemical methods. Of the chemical methods the reduction of 2,4-dinitrophenol with a metal and acid, such as iron and sulphuric acid, is the most important, but it is also prepared by the reduction of 2-nitro, 4-aminophenol, obtained by nitrating *para* acetyl aminophenol and hydrolysing the product. In both these cases, the intermediates themselves have to be prepared by a series of operations from the coal tar primaries like benzene as seen from the chart below.

Electrolytically, 2,4-diaminophenol can be prepared either by the reduction of 2,4-dinitrophenol or of *m* dinitrobenzene itself. The electrolytic reduction of *m*-dinitrobenzene directly to 2,4-diaminophenol is technically more significant as it is cheaper than either *p*-aminophenol or 2,4-dinitrophenol intermediates and can be obtained more or less quantitatively by the direct nitration of benzene so that even with a lower overall yield of 2,4-diaminophenol the process is more economical.

Hemetian,¹ Gauhe,² Pomeranz³ and Stuckenberg⁴ have described methods for the chemical reduction of 2,4-dinitrophenol, the reducing agents being phosphorus tri-iodide with water, hydrochloric acid with zinc, tin or iron. Bradt⁵ has studied the preparation of 2,4-diaminophenol by the hydrogenation of 2,4-dinitrophenol in an autoclave using nickel as catalyst, the effects of variation of temperature, time of reduction, the use of a solvent, concentration of dinitrophenol, etc., on the material yield, having been carefully noted.

Elbs⁶ investigated the electrolytic reduction of 2,4-dinitrophenol in alcoholic sulphuric acid solution at a platinum electrode. Weyprecht⁷ and also Brockman⁸ reduced 2,4-dinitrophenol electrolytically in an electrolyte of hydrochloric acid containing chloride of zinc or copper. Brand⁹ prepared



2-nitro, 4-aminophenol electrolytically by the partial reduction of *m*-dinitrobenzene at a silver or nickel cathode in a neutral solution and treatment of the resulting *m*-nitrophenyl hydroxylamine with concentrated sulphuric acid. Hofer and Jacob¹⁰ also prepared 2-nitro, 4-aminophenol from 2,4-dinitrophenol at a platinum cathode in alcoholic sulphuric acid solution using vanadium oxide as carrier. Bradt and Brown¹¹ have studied the effect of several variable factors on the current efficiency and material yield, in the electrolytic reduction of 2,4-dinitrophenol to 2,4-diaminophenol. Their methods of computing the yields of diaminophenol by the mere estimation of amino-groups with sodium nitrite—used also previously by Brown and Warner¹²,—are obviously unreliable, considering the fact that the estimation was carried out in a mixture in which other amino-compounds were also present.

The only reference in literature to the direct production of 2,4-diaminophenol from *m*-dinitrobenzene by electrolytic reduction is that of Gattermann¹³ who obtained its salt by electrolysis an emulsion of *m*-dinitrobenzene or *m*-nitraniline in concentrated sulphuric acid using a platinum cathode. The yield obtained is, however, not stated.

The preparation of *p*-aminophenol in a yield of nearly 70 per cent. by the electrolytic reduction of nitrobenzene in dilute sulphuric acid emulsion using a copper or

monel cathode and a suitable catalyst has been reported from this laboratory¹⁴, and a patent¹⁵ has also been taken out for the same. A study of the electrolytic reduction of *m*-dinitrobenzene in sulphuric acid emulsion on similar lines was undertaken with special reference to the influence of such factors as strength of acid, concentration of depolariser, composition of cathode material, current density, catalyst, etc., on the nature and yield of the product. 2,4-diaminophenol is found to form a very sparingly soluble oxalate¹⁶ which has made an almost quantitative separation of the pure product possible. The overall yields of diaminophenol obtained in our experiments varying from 35 to 45 per cent. have always been calculated from the weights of the pure dry oxalate.

The disadvantages of the Gattermann method (*loc. cit*) are two-fold. The use of concentrated sulphuric acid causes the diaphragm to be seriously corroded while the conductivity of the cell is so low that a great amount of energy is lost. Secondly, the expensive platinum used as the cathode material, and the cost of the strong sulphuric acid used initially, the recovery of which is difficult, render the process uneconomical. It has been found possible to lessen very materially the rigour of the operating conditions in the Gattermann procedure by the use of 30 to 40 per cent. sulphuric acid in which *m*-dinitro-

benzene is kept in a state of emulsion and of cheaper cathode materials such as lead, copper and monel.

The mechanism of the formation of 2,4-diaminophenol by the electrolytic reduction of *m*-dinitrobenzene, as usually understood, is that one of the nitro groups undergoes reduction to the hydroxylamine stage and this initially formed molecule of *m*-nitrophenyl hydroxylamine rearranges itself in the presence of concentrated sulphuric acid to 2-nitro,4-aminophenol (Gatterman, *loc. cit.*) which undergoes further reduction to 2,4-diaminophenol. The hydroxylamine group of the *m* nitrophenyl hydroxylamine is not a good depolariser, and according to Brockmann it seems that before it is reduced to the amine, the second nitro group is attacked by the electrolytic hydrogen, thereby making it difficult to accomplish the partial reduction of the compound. This is the probable explanation for the absence of *m*-nitraniline among the reduction products. After the mono-hydroxylamine derivative has been formed, the passage of more current reduces the second nitro-group, and though the dihydroxylamine is extremely fugitive, its presence has been proved by its colour with ferric chloride and also its oxidation by air to the dinitroso compound. This dihydroxylamine derivative is supposed to be finally reduced to *m*-phenylene diamine. The relative amounts of *m* phenylene diamine and 2,4-diaminophenol will, according to this theory, depend on the speed of rearrangement of the partially reduced initial compound, *m*-nitrophenyl hydroxylamine. If, therefore, this rearrangement can be promoted by the use of strong sulphuric acid (Gattermann) or of anti-catalysts or even of alloy cathodes employed in the reduction of nitrobenzene to *p*-aminophenol by Dey, *et. al.*,^{14,15} before the other nitro-group is attacked, higher yields of 2,4-diaminophenol can be obtained.

Hale¹⁷ has described a procedure in which nitrobenzene is reduced in a state of emulsion at a copper cathode in the presence of sticks of lead or at a lead cathode with the addition of small amounts of bismuth powder, while the reduction at an alloy cathode has been described by Imray¹⁸ in his patent specification for *p*-aminophenol. Either a suitable alloy could be used as the cathode or the reduction could be conducted at a metal electrode, the other metal being added in the form of a

salt.

From the considerations set forth above the most rational approach to the evolution of a technical method for the preparation of 2,4-diaminophenol appears to be on the lines suggested by Imray (*loc. cit.*) and by the use of anticatalysts. Curiously no work has been carried out so far on these lines. The work carried out here has had to be restricted to a few selected cathodes at current densities most suitable and convenient for the operation of the cell and with only a few addition agents. The results of the experiments are given in Tables I to VI.

Large quantities of *m*-dinitrobenzene which were required in a high state of purity were made in this laboratory starting from nitrobenzene, by the procedure outlined by Fierz David¹⁹, the *m*-dinitrobenzene being crystallised from alcohol before being used for reduction.

A few preliminary experiments had to be performed in order to prove that the product obtained by the electrolytic method, was identical with 2,4-diaminophenol. For this purpose, diaminophenol hydrochloride of the *British Drug Houses Ltd.*, 'Dolmi' of the *Kodak Ltd.*, and diaminophenol hydrochloride prepared in this laboratory by the chemical reduction of 2,4-dinitrophenol, were used for comparison. All the three samples as well as the product obtained by electrolytic reduction of *m*-dinitrobenzene were found readily to give a crystalline precipitate of 2,4-diaminophenol oxalate with a solution of potassium oxalate. The tribenzoyl derivative was also prepared and analysed and compared with those prepared from the commercial samples. They were found to be identical.

Meta-phenylene diamine oxalate is very soluble and was therefore found in the mother liquor after precipitating the diaminophenol oxalate. A sample of the benzoyl derivative prepared from the filtrate and one prepared from *m*-phenylene diamine hydrochloride (*Eastmann Kodak Company*) had identical melting and mixed melting points. Analysis for nitrogen too of the benzoyl derivative from the filtrate was found to correspond to that required by theory for the dibenzoyl derivative of *m*-phenylene diamine.

It will be seen from the above that the most satisfactory results were obtained using either copper or monel cathodes in the presence of mercuric and ceric sulphates. The reduction was carried out by passing the theoretical

Table I.—*Influence of concentration of acid*

Catholyte, 40 gms. of *m*-dinitrobenzene in 400 cc. of dilute sulphuric acid with 1 gm. of mercuric sulphate; current strength, 20 amps.; temperature, 90-95°C.; theoretical amount of current passed; lead anode; 50cc. of anolyte of the same strength as catholyte, changed every hour.

No.	Cathode	Strength of sulphuric acid %	Apparent current density Amps/sq. dm.	2,4-diaminophenol oxalate Yield.	
				Gms.	%
1	Copper	20	7.69	No diaminophenol was formed.	
2	Copper	30	7.69	7.4	14.5
3	Copper	40	7.69	24.2	47.9
4	Copper	50	7.69	22.0	43.2
5 (a)	Copper	40	7.69	12.0	23.5
6	Monel	30	4.55	8.2	16.1
7	Monel	40	4.55	19.3	37.8
8	Monel	50	4.55	22.8	44.7
9 (b)	Monel	50	4.55	17.5	34.3

(a) No mercuric sulphate was used.

(b) 0.2 gms. of mercuric and ceric sulphates were used.

Table II.—*Influence of concentration of depolariser*

Catholyte, 400 cc. of 40 per cent. sulphuric acid with 1 gm. of mercuric sulphate; copper cathode; current density, 7.69 amps./sq. dm.; temperature, 90-95°C.; theoretical amount of current passed; lead anode; 50 cc. of anolyte of the same strength as catholyte changed every hour.

No.	<i>m</i> -dinitrobenzene Gms.	Ratio (a)	<i>m</i> -dinitrobenzene recovered Gms.	2,4-diaminophenol oxalate Yield.	
				Gms.	%
1	20	1 : 10.5	5.7	3.7	20.3
2	30	1 : 7.0	....	10.8	21.2
3	40	1 : 5.3	....	24.2	47.9
4	80	1 : 2.65	....	No diaminophenol formed	

(a) Ratio of depolariser to sulphuric acid content by weight.

amount of current and any unconverted *m*-dinitrobenzene was recovered at the end, the material yield being calculated on the basis of the amount of *m*-dinitrobenzene that had been reduced.

The following remarks may be offered by way of explanation of the results observed and tabulated.

1. At a copper and/or monel cathode, 2,4 diaminophenol can be obtained in nearly 35 to 45 per cent. yield by employing sulphuric acid of 40 per cent. strength and using mercuric sulphate or both mercuric and ceric sulphates in combination as catalysts. Lower strengths of acid do not favour the formation of 2,4 diaminophenol, and the use of any strength higher than 50 per cent. has not only no advantage in increasing the yield but suffers from the disadvantage of having the cathodes and anodes rapidly corroded.

2. The effect of changing the depolariser concentration is shown in Table II. It appears from the results that the ratio, part by weight of *m*-dinitrobenzene to 5.3 parts by weight of sulphuric acid content seems to be the optimum to obtain the ma-

ximum yield of diaminophenol.

3. A current density of 7.69 amps./sq. dm. in the case of copper and 4.55 amps./sq. dm. in the case of monel seems to be the optimum when sulphuric acid of 40 per cent. strength is used,

4. In order to study the temperature effects it was necessary to employ a solvent like benzene and toluene to keep the depolariser in an emulsified condition. This is necessary in view of the fact that *m*-dinitrobenzene has a high melting point (89.5°C.). When the reduction was carried out in this way the catholyte at the end of reduction was not so deeply coloured as in the other cases, and even the sulphate that was obtained was much less coloured. However, the yields were not good when reductions were carried out at low temperatures such as at 75°C. When both ceric sulphate and mercuric sulphate are employed together with a monel cathode, and the reduction carried out at 80°C. the yield was better (Expt. 4, Table IV.). Passing more than the theoretical amount of current has not been found to increase the yield.

Table III.—*Influence of current density*

Catholyte, 40 gms. of *m*-dinitrobenzene in 400 cc. of 40 per cent. sulphuric acid with 1 gm. of mercuric sulphate; copper cathode (area, 2.6 sq. dm.); monel cathode (area, 4.4 sq. dm.); temperature: 90-95°C; theoretical amount of current passed; lead anode; 50 cc. of anolyte of the same strength as that of the catholyte changed every hour.

No.	Cathode material	Apparent	Current	<i>m</i> -dinitrobenzene recovered	2, 4-diaminophenol oxalate yield	
		G. D.	strength		Gms.	%
		Amps/sq. dm.	Amps.	Gms.	Gms.	%
1	Copper	3.85	10	6.0	16.5	38.0
2	"	5.77	15	5.5	16.5	37.7
3	"	7.69	20	...	21.2	47.9
4	"	9.54	25	8.5	15.0	37.3
5	"	15.50	40	5.5	11.0	25.0
6 (a)	Monel	2.27	10	5.7	14.7	33.6
7	"	4.55	20	...	19.3	37.8
8	"	6.82	30	21.8	6.6	7.0

(a) 0.9 gm. of mercuric sulphate and 0.2 gm. ceric sulphate were used.

5. The effect of employing cathodes of different materials are shown in Table V. Monel and copper have been found to be suitable and a detailed study of these cathodes only has been made.

6. An exhaustive study of the effects of adding ceric sulphate and mercuric sulphate on the material yield is shown in Table VI. Without the addition of these, the yield of diaminophenol is very low. Neither ferrous sulphate nor dipping a strip of lead along with the addition also of mercuric sulphate improves the yield of diaminophenol.

7. Corrosion of the cathode was not so much in the case of monel as in the case of copper. In all the cases the portion of the cathode which was exposed to the spray of the acid only was corroded. The anolyte acid increases in strength during the course of electrolysis. As a result of this the anode is corroded and hence the anolyte has to be changed occasionally in order also to diminish the voltage of the cell. The anolyte can be used over and over again by sufficient dilution.

8. The catholyte usually turns very dark and the crude sulphate obtained is coloured and a large part of *m*-dinitrobenzene goes unaccounted for as *m*-phenylene diamine and

other by-products, whose chemical separation and isolation was found to be very difficult. Since only the theoretical amount of current is passed it is possible that partial reduction to dihydroxylamine derivative takes place which may, however, have undergone reduction to *m*-phenylene diamine. Though it has not been possible to isolate the fugitive dihydroxylamine derivative, its presence has been demonstrated both by its characteristic colour reaction with ferric chloride and by its oxidation by (air) oxygen to the dinitroso compound. (Ref. Brockman's 'Electro-Organic Chemistry', p. 256).

It is remarkable that the addition of mercuric sulphate and ceric sulphate should serve to increase to such an extent the yields of 2,4-diaminophenol at a copper or monel cathode. A plausible suggestion is that mercury ions catalyse the re-arrangement of *m*-nitrophenylhydroxylamine to *o*-nitro, *p*-aminophenol and thus contributes to the increased yields of diaminophenol by the reduction of the remaining nitro-group to the amino-group. This reduction is favoured further by the cerous sulphate as well as by the deposited mercury which by its high over-voltage brings about vigorous reduction of the nitro-group.

Table IV.—*Influence of temperature*

Catholyte, 40 gms. of *m*-dinitrobenzene in 400 cc. of 40 per cent. sulphuric acid with 1 gm. of mercuric sulphate; copper cathode; apparent C. D., 7.69 amps./sq. dm; monel cathode; apparent C. D., 4.55 amps./sq. dm.; theoretical amount of current passed; lead anode; 50 cc. of anolyte of the same strength as that of the catholyte changed every hour.

No.	Cathode material	Solvent employed	cc.	Temperature °C	<i>m</i> -dinitrobenzene recovered Gms.	2, 4-diaminophenol oxalate yield.	
						Gms.	%
1	Copper	Benzene	50	70.75	7.5	10.0	24.1
2	"	"	30	70.70	20.0	6.4	25.1
3	"	Toluene	35	75	7.8	9.0	22.8
4 (a)	Monel	"	40	80.83	4.7	16.4	36.4
5 (b)	"	"	35	80.83	....	15.0	29.4

(a) 0.2 gm. of mercuric and ceric sulphate were used.

(b) 90 amps. hrs. were passed.

It is therefore seen that 2,4-diaminophenol can be manufactured by the electrolytic reduction of *m*-dinitrobenzene at copper or monel cathode and lead anode with a catholyte consisting of sulphuric acid of *d* 1.31 containing 0.5 to 2.5 per cent. of mercuric sulphate and ceric sulphate, calculated on the weight of *m*-dinitrobenzene taken. In simplicity and economy of operation and low upkeep charge, the process is superior to the other processes using nitro or nitro-amino-phenols and should therefore be suitable for adoption on a technical scale. The *m*-dinitrobenzene is reduced in a state of emulsion in sulphuric acid of 40 per cent. strength. The cathode and anode are of metals which are low in cost and of which plentiful supplies can be had, and the cell-voltage, about 3.5 to 4.5 volts is also reasonably low.

Experimental

The current was supplied by a dynamo with an output of 100 amperes at 6 volts.

The diaphragms were of German biscuit porcelain specially resistant to acid.

The anodes in all cases were of lead and consisted of cylinders 1" in diameter and 2" in height. The anolyte was sulphuric acid

of 40 per cent. strength, and had to be changed every hour to prevent corrosion of the anode.

In the experiments listed in Tables I to VI, the following cells were used.

Copper Cathode.—The cathode was of copper sheet bent into the form of a cylinder 5" diameter and 5" high with two slots one inch wide cut on opposite sides to within half inch from the bottom to allow the play of two glass stirrers. The cathode chamber was a litre pyrex beaker provided with a lid of asbestos cement, with suitably placed holes for the cathode and anode leads, for the thermometer and the bearings for the stirrers. Since only 400 cc. of sulphuric acid is used as catholyte, the area of the cathode actually functioning was 2.6 sq. dm.

Lead Cathode.—The experiments were conducted in a cell similar to the above with a cylindrical cathode of lead of the same size, the cathode surface actually functioning being the same as before.

Monel Cathode.—This consisted of two concentric monel cylinders of 4" and 3" diameter fixed to one another and used inside a 1-litre pyrex beaker. The area functioning as cathode was 4.4 sq. dm.

Table V.—*Influence of material of cathode*

Catholyte, 40 gms. of *m*-dinitrobenzene in 400 cc. of 40 per cent. sulphuric acid; temperature, 90-95°C.; Theoretical amount of current passed; lead anode; 50 cc. of anolyte of the same strength as that of the catholyte changed every hour.

No.	Cathode material	Apparent C. D. Amps./sq. dm.	Catalysts added		<i>m</i> -dinitrobenzene recovered Gms.	2, 3-diaminophenol oxalate yield.	
			Gms.	Gms.		Gms.	%
1	Copper	7.69	HgSO ₄	1.0	..	24.2	47.9
2	Monel	4.55	"	1.0	..	19.3	37.8
3(a)	Carbon	14.3	..	..	12.9	7.1	21.0
4	Lead	7.69	..	..	..	4.2	8.2
5	"	7.69	HgSG ₄	1.0	2.5	8.6	18.0
6	Nickel	7.69	..	..	No diaminophenol formed.		
7	"	7.69	[HgSO ₄ Ce (SO ₄) ₂]	[0.2 0.2]	..	12.7	24.9

(a) 30 per cent. sulphuric acid was used.

Nickel Cathode.—This also was of the same description as that of the copper cathode and the area functioning was 2.6 sq. dm.

Carbon Cathode.—Two rectangular carbon pieces, 5" long and 2.5" broad were suitably inserted through the asbestos lid fitted to a one litre pyrex beaker. The ca-

Table VI.—*Influence of catalysts*

Catholyte, 40 gms. of *m*-dinitrobenzene in 400 cc. of 40 per cent. sulphuric acid; copper cathode, apparent C. D., 7.69 amps./sq. dm.; monel cathode, apparent C. D., 4.55 amps./sq. dm.; temperature, 90–95°C.; theoretical amount of current passed; lead anode; 50 cc. of anolyte of the same strength as that of catholyte changed every hour.

No.	Cathode Material	Catalyst added	<i>m</i> -dinitrobenzene Recovered		2, 4-diaminophenol oxalate yield	
			Gms.	Gms.	Gms.	%
1	Copper	..	..	..	12.0	23.5
2	"	Ce (SO ₄) ₂	0.2	..	13.7	26.9
3	"	HgSO ₄	0.2	13.0	13.7	39.8
4	"	HgSO ₄	1.0	..	24.2	47.9
5	"	FeSO ₄	1.0	..	6.8	13.3
6 (a)	"	HgSO ₄	0.2	5.0	14.6	32.7
		Ce (SO ₄) ₂	0.2			
7	"	Lead strip dipping with HgSO ₄	1.0	9.8	12.0	30.0
8	Monel	Ce (SO ₄) ₂	1.0	17.8	7.7	27.2
9 (b)	"	Ce (SO ₄) ₂	1.0	13.0	11.5	33.5
10	"	HgSO ₄	0.2	15.0	15.1	47.3
		Ce (SO ₄) ₂	0.2			
11	"	HgSO ₄	1.0	4.5	16.6	36.7
		Ce (SO ₄) ₂	1.0			
12	"	HgSO ₄	1.0	10.5	16.2	43.0
		Ce (SO ₄) ₂	1.0			
13	"	HgSO ₄	1.0	9.0	7.5	20.0
		Ti ₂ O ₃	1.0			
14	"	HgSO ₄	0.5	13.5	43.3	39.8
		Ce (SO ₄) ₂	0.5			

(a) 89 amp. hrs. were passed.

(b) 84 amp. hrs. were passed.

In expt. 14, 100 gms. of *m*-dinitrobenzene in a litre of 40 per cent. acid were taken.

thode surface functioning was 1.4 sq. dm.

The *m*-dinitrobenzene was kept in a state of emulsion by stirring with glass stirrers. All the experiments were carried out with a cylindrical porous diaphragm, 4.5" high and 1.8" diameter, and with lead cylinders 1" diameter and 2" high as anode. During the course of the electrolysis, the strength of the anolyte acid increases and the resistance of the cell also increases in consequence. The anolyte is changed at this stage and a fresh volume of anolyte (50 cc.) is added, the anolyte being changed periodically like this to prevent corrosion of the anode and also to keep the cell voltage within reasonable limits.

At the end of the reduction, the acid solution was filtered to recover any unreacted *m*-dinitrobenzene and the filtrate concentrated till a solid started separating, under reduced pressure in an atmosphere of hydrogen. The solid that separated on cooling was filtered on a glass sintered crucible, the solid pressed to remove as much of the sulphuric acid as possible, and the process of concentrating and cooling repeated till no more solid separated out. The separate portions of the sulphate were mixed together and boiled with 75-100 cc. of water depending on the amount of solid obtained and 20 gms. of norit, and filtered. The slightly brown liquid was poured into 500 cc. of 95 per cent. alcohol, cooled in the refrigerator and the precipitated sulphate filtered off. The alcohol was almost completely recovered and used over again after distilling it over lime. The residue left after distilling off the alcohol was mixed with the original acid and concentrated once again and cooled, the solid coming out being worked up in the same way as mentioned above. The sulphate was finally dried in vacuum over sulphuric acid and weighed.

Precipitation of Diaminophenol Oxalate.—5 gms. of the above sulphate are dissolved by warming with 50 cc. of water and filtered from a slight residue. Potassium oxalate (5 gms.) dissolved in 15 cc. of hot water are then added, the temperature being near 40°C. The diaminophenol oxalate which was precipitated as a white crystalline mass on scratching the sides of the beaker was filtered on cooling and washed carefully with 10 cc. of cold water, dried in vacuum over sulphuric acid and weighed. The yield of diaminophenol is calculated from this weight.

Example.— Expt. 2, Table III.

5.5 gms. of *m*-dinitrobenzene was recovered at the end of the reduction. The weight of *m*-dinitrobenzene that had been reduced, therefore, amounts to 34.5 gms. The weight of sulphate obtained was 23.0 gms. 5 gms. of this sulphate gave 3.6 gms. of diaminophenol oxalate, so that the total weight of diaminophenol oxalate was 16.6 gms. Hence 34.5 gms. of *m*-dinitrobenzene gave 16.6 gms. of diaminophenol oxalate. The weight of diaminophenol oxalate from 34.5 gms. of *m*-dinitrobenzene according to theory is 43.99 gms. Hence the percentage yield of diaminophenol oxalate is 37.7.

The yields have been calculated as above in all the experiments that are tabulated in Tables I to VI.

Preparation of Diaminophenol hydrochloride from diaminophenol oxalate.—Diaminophenol oxalate is soluble to the extent of one part in 33 parts of boiling water,¹⁶ and one part in 1,200 parts of cold water. 50 gms. of diaminophenol oxalate were boiled with 500 cc. of water and the theoretical weight of anhydrous calcium chloride dissolved in 50 cc. water was added in small quotas to the boiling solution. The precipitated calcium oxalate was filtered off and the filtrate (A) was treated with 5 cc. of concentrated hydrochloric acid and boiled with 10 gms. of norit and then concentrated under reduced pressure in an atmosphere of hydrogen to about 60 cc. 150 cc. of concentrated hydrochloric acid were added and the diaminophenol hydrochloride that was precipitated was filtered and dried first in a vacuum sulphuric acid desiccator and later in a sodium hydroxide desiccator, and weighed. The filtrate was mixed with (A) from a second experiment, and hydrochloric acid gas passed to saturate the solution. The weight of diaminophenol hydrochloride obtained from 50 gms. of diaminophenol oxalate was 37 gms. (80 per cent.)

Experiments to prove the identity of the electrolytic product with 2,4-diaminophenol.—

(1) 10 gms. of 2,4-dinitrophenol, 40 gms. of tin pellets, 120 cc. of 1.16 pure hydrochloric acid were heated for 4 hours. 70 cc. of concentrated hydrochloric acid were added again after filtering off the excess tin. The hydrochloride of diaminophenol was filtered on a glass sintered crucible and dried in a sodium hydroxide desiccator. The yield was almost theoretical.

1 gm. of the above hydrochloride in 10 cc.

of water treated at 40°C. with 1 gm. of potassium oxalate in 5 cc. water gave 1.1 gms. of diaminophenol oxalate which turned dark in the steam oven.

Benzoyl derivative: melting point, 235°C.

(2). 1 gm. of 2,4-diaminophenol hydrochloride of *British Drug Houses Ltd.*, in 10 cc. water treated with 1 gm. of potassium oxalate in 5 cc. of water at 40°C. gave 1.1 gm. of 2,4-diaminophenol oxalate. Addition of potassium oxalate in excess of what is required by theory in both experiments led to colouration of the oxalate on allowing to stand for some time. However, no change in the yield was observed.

Benzoyl derivative: melting point, 235°C.

Benzoyl derivative of 'Dolmi' of *Kodak Ltd.*, melting point, 234°C.

Benzoyl derivative of 2,4-diaminophenol from monel cell, melting point, 233°C.

Mixed melting point, 232°C.

The benzoyl derivative from monel cell was analysed for nitrogen, after drying in a steam oven.

0.1604 gm. gave 9.8 cc. of nitrogen at 30°C. and 764.5 mm.

Found, nitrogen—6.97 per cent.

$C_{27}H_{20}O_4N_2$ requires nitrogen—6.42 per cent.

Presence of m-phenylene diamine.—1 gm. of *m*-phenylene diamine hydrochloride (*Eastmann Kodak Co. Ltd.*) was dissolved in 10 cc. of water and treated with 1 gm. of potassium oxalate in 5 cc. of water and warmed. Yield, 0.35 gms. This was put into 10 cc. of cold water and shaken when the entire quantity dissolved.

Benzoyl derivative: melting point, 240°C.

Benzoyl derivative from the filtrate after filtering the oxalate from monel cell, melting point, 239°C.

Mixed melting point: 240°C.

The benzoyl derivative from the filtrate, after drying in a steam oven, was analysed for nitrogen.

0.2479 gm. gave 19.2 cc. of nitrogen at 25.5°C. at 765.2 mm.

Found, nitrogen, 8.67 per cent.

$C_{20}H_{16}O_2N_2$ requires nitrogen, 8.86 per cent.

Summary

1. A complete review of the previous work on the production of 2,4-diaminophenol by chemical and electro-chemical methods has been given. This valuable photographic developer is usually prepared by the reduction of 2,4-dinitrophenol by either of the

above-mentioned processes. It is also prepared by the mono-nitration of *p*-aminophenol and the further reduction of the 2-nitro-4-aminophenol so obtained to 2,4-diaminophenol.

2. As far as could be ascertained the only reference in literature to the production of 2,4-diaminophenol by the electrolytic reduction of *m*-dinitrobenzene, appears to be that of Gattermann (*loc. cit.*) who used a platinum cathode and strong sulphuric acid, but did not specify the yield obtained.

3. A method has now been fully worked out using 40 per cent. sulphuric acid and keeping the *m*-dinitrobenzene in a state of emulsion at 90°C. to 95°C. by mechanical stirring, the cathode being made of monel or of copper and using mercuric sulphate or both mercuric and ceric sulphates in combination as catalyst.

4. Diaminophenol has been isolated as either the pure oxalate or as the sulphate in a maximum yield of 45 per cent. of the *m*-dinitrobenzene that had been reduced.

5. The formation of *m*-phenylene diamine in small quantities as a by product was proved by the preparation and analysis of the dibenzoyl derivative from the mother liquor left after the sparingly soluble diaminophenol oxalate has been precipitated.

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A Study of Argemone Oil as a Drying Oil

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ARGEMONE oil¹ from the seeds of *Argemone mexicana*, L., N. O. Papaveraceae, Hindi—*Pila-dhatura* or *kutaila*, has an appreciable acetyl value. About two-thirds of it is accounted for by the presence of some diglycerides and the rest by the glycerides of ricinoleic acid. The latter amounts to nearly 10 per cent. of the component acids of the oil. The drying property of the oil is not very well understood. The seeds of *Argemone mexicana* yield about 35 per cent. of oil and in view of the wide occurrence of the plant in the wild tracts of the United Provinces and the Punjab, a fuller investigation of the drying quality of the oil appears desirable.

Processes² have been developed whereby castor oil is dehydrated in the presence of catalysts to give high quality drying oils. In a similar way, it should be possible to augment the drying capacity of argemone oil upon dehydration of the ricinoleic glycerides in it with suitable catalysts. Some of the latter already found efficient³ with castor oil, lend themselves for trial with argemone oil. Another way to shorten the drying time of an oil is to prepare blown oils from or incorporate driers in it. In addition to these modifications, argemone oil offers the possibility of conversion of its diglycerides with more ricinoleic acid into triglycerides and dehydrating the latter subsequently. The present investigation therefore records the result of a study of the drying quality of argemone oil, dehydrated argemone oil and some of its preparations.

Argemone oil itself takes a long time (*vide* Experimental) to give a dry film at room temperature (35°C.). However with a drier composed of lead (0.3 per cent.) and traces of manganese (0.01 per cent.) or cobalt (0.01 per cent.) as linoleates, it gives a dry film within 24 hours. Lead linoleate alone is not helpful. It is seen further that the time of film formation of linseed oil is not materially affected when argemone oil up to as much as 40 per cent. is admixed with it.

A general survey of the results shows that

the drying time of argemone oil is shortened upon dehydration with practically each of the catalysts selected for experiment. The fall is maximum with bentonite and potassium hydrogen sulphate and minimum with sodium pyrosulphate, copper sulphate (4 per cent.) or bond clay. It accords well with the rise in the iodine value and the amount of water released during dehydration in most of these cases. However, with phosphoric acid, copper sulphate (8 per cent.) and different amounts of kaolin as catalysts, the amount of water released and the diminished time of film formation suggest dehydration to have occurred in the oil, although its iodine value in these cases shows little rise. On the other hand, with ferric ammonium alum (desiccated) and sodium bisulphate, the amount of water released is of the same order as above, yet the drying time of the oil does not show corresponding diminution. These anomalies may be due⁴, in the first set of cases, to the failure to obtain the maximum or true iodine value due to conjugated double bonds that usually come into being during dehydration, and in the second, to the dehydration having occurred in a way other than to produce unsaturation, a conclusion borne out by the iodine value which has remained stationary in the two cases. Increasing the time of heating or raising the temperature to 300°C. eliminates more water but at the same time, the secondary changes also tend to increase.

Hot aeration and polymerization of argemone oil can give rise to oxidised oils of varying degrees of thickness. Similarly viscous products are obtained when, with a view to bring about esterification, argemone oil and ricinoleic acid are heated together at 200°C. and the reaction product dehydrated with kaolin. The result is the same if the oil and the acid are heated under reduced pressure. The oxidised oils and the esterified oils have shorter times of film formation than the original oil. The diminished iodine value in these modifications of the oil is a measure of the polymerization that has occurred in the respective cases.

Experimental

Time of drying.—Two drops of the oil were spread evenly over a fixed area of a clean, dry, smooth glass microscopic slide. The latter was placed on a levelled asbestos piece exposed to air and light at room temperature (35°C.) or else in an air oven at 110°C. The time of drying was noted when no mark was left on the film upon touching it with a clean dry finger. The film remained either oily (O), tacky (T), or dry (D) after various intervals of time. At least 4 slides were coated with the same sample to ensure a reliable result.

Driers.—Lead, cobalt and manganese linoleates, obtained by the interaction of the acetates of the metals with linoleic acid in alcohol, were dissolved in petroleum ether. The strength of the solutions was determined from the amount of the metal oxide left behind when a known volume of the solution was evaporated and then ignited in a tared crucible. As much drier solution (0.01—1 cc. of 10 per cent. solution for 10 gm. oil) was used as would correspond to the amount of the metal to be present during the experiment.

Table I.—Effect of various drier compositions on Argemone oil and linseed oil (Temperature of drying, 35°C.)

Drier.	Argemone oil			Linseed oil			
	%	hrs : 10	18	24	10	18	24
0.3 lead		O	O	T	T	D	D
0.3 lead + 0.01 cobalt		O	T-D	T-D	T-D	D	D
0.3 lead + 0.01 manganese		O	T-D	D	T-D	D	D
0.3 lead + 0.01 manganese + 0.01 cobalt.		O	T-D	D	T-D	D	D

Lead alone (0.1-0.55 per cent.) gave a tacky film with argemone oil. The time of film formation for linseed oil (18 hrs.) remained unaffected by admixture with it of as much as 40 per cent. of argemone oil.

Catalytic dehydration of the argemone oil.—The procedure of Forbes and Neville³ with castor oil was adopted. The oil (50 cc.) free from moisture, along with the dry catalyst was taken in a 500 cc. flask fitted with a

Table II

Catalyst	% catalyst.	Time of heating hrs.	Temperature °C.	Iodine value	Amount of water gms.	Drying time at 110°C. mins.
Nil	..	..	..	121.3	..	430
Bentonite	20	45	225-40	131.0	0.3770	218
Pot. hyd. sulphate	5	30	230-40	127.4	0.1110	228
Phosphoric acid (on 4 gm. coke)	4	11	230-40	124.2	0.2946	256
Copper sulphate (anhydrous)	8	30	240-50	124.8	0.2970	244
Kaolin	20	30	230-40	124.6	0.1747	234
Kaolin	16	30	230-45	121.8	0.1457	240
Kaolin	12	30	230-40	121.3	0.1508	261
Iron ammonium alum (Exsiccated.)	4	—	260	123.1	0.2088	284
Sod. hyd. sulphate	2	30	230-50	122.7	0.1474	291
Bond clay	4	50	230-40	125.4	0.1139	284
Sodium pyrosulphate	1	30	225-40	123.6	0.0824	190
CuSO ₄ (anhydrous.)	4	30	235-55	121.3	0.0321	284
Sod. pyrosulphate	1	60	240-50	124.1	0.1350	270
Iron ammonium alum (Exsiccated)	4	—	310	126.9	0.5572	234

TABLE III.—Drying time of argemone oil and some of its preparations.

Sample	Method of Preparation	Iodine value	Drier %	Drying Temp. °C.	Drying Time	Remarks
Original oil	..	121.3	..	35	40 hrs	
Do.	..	121.3	0.3 Pb + 0.01 Mn	35	24 hrs	
Do.	..	121.3	..	110	7 hrs & 10 mins	
No. 2. Oxidised oil :	100 gm. of oil aerated at 150°C. for 7 hours.	118.2	0.3 Pb + 0.01 Mn	35	20 22 hrs	
No. 3.	No. 2, polymerised further in presence of alumina (1.5%), zinc dust (3%) at 280°C. for 40 minutes.	98.2	Do.	35	18-20 hrs	Black, varnish like
No. 4.	No. 2, polymerised as above for 10 minutes.	107	Do.	35	18 20 hrs	Thick
No. 5. Esterified oil:	10 gm. of oil heated at 200°C. with ricinoleic acid (5 gm.) for 3 hours and then treated at 240°C. with kaolin (1.6 gm.) for 40 minutes in carbon dioxide atmosphere. Free acid removed by hot sodium carbonate.	108	..	110	2 hrs & 10 mins	Viscous, Ester value 195
No. 6.	Heated together as above but under 200 mm. No kaolin treatment.	94	..	110	2 hrs & 40 mins	Viscous, Ester value 237

cork carrying a 300°C. thermometer, a gas inlet tube, both reaching down to the bottom of the flask, and an exit tube. Heating was done in a graphite bath. The water eliminated was swept out of the apparatus throughout the heating by a current of dry carbon dioxide. It was absorbed in a tared calcium chloride tube connected to the exit tube. The dehydrated oil was freed from the catalyst by centrifugation. The results for the amount of water, the iodine value (Wiji's method) and the drying time for the dehydrated oil are recorded in Table II.

The drying times of argemone oil and some of its preparations are given in Table III.

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Studies on Industrial Enzymes

Part IV—Influence of the form of nitrogen on the formation of diastase

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In a previous communication¹ it was shown that formation of diastase is profoundly influenced by the nature of nitrogen; the more complex forms of organic nitrogen favour the production of higher percentages of fungal diastase. We have extended these studies to include forms of nitrogen not tried before.

Experimental

The technique for growing the fungus and the analytical procedure adopted for determining the concentration of the enzyme (Lintner Units) are similar to those described earlier².

The media for each experimental tube was composed of:—

Soluble starch (B.D.H.),		
3% sol'n.,	..	1.0 cc.
Salts mixture solution	..	0.5 cc.
Nitrogen (different forms)	..	2.0 mgm.
pH. adjusted to	..	6.5
Total volume made up to	..	4.0 cc.

The tubes after sterilisation and inoculation with fungal spores were incubated for 4 days and the entire contents, after maceration, analysed for diastatic activity. The results expressed in Lintner Units are given in Tables I, II, III and IV.

Table I.—*Nitrates as nitrogen sources.*

Nitrogen source :	Sodium Nitrate	Potassium nitrate	Calcium Nitrate
Activity in Lintner Units	251.0	285.0	187.5

Discussion

Broadly four groups of nitrogen compounds have been tried: (1) inorganic nitrates, (2) ammonium salts of inorganic acids, (3) ammonium salts of organic acids and (4) amino acids. While nitrates constitute good sources of nitrogen, the associated cation appears to influence diastase formation; K⁺ promotes and Ca⁺⁺ inhibits the formation. Of the ammonium salts of organic acids tried, the acetate has proved particularly beneficial, yielding the highest quantity of diastase for a given quantity of nitrogen; the lowest in the series is given by oxalate. The close relationship of glycine with ammonium acetate is borne out by its comparatively high efficiency as a producer of diastase. Ammonium salts of inorganic acids are not suitable sources of nitrogen because of the unfavourable shift of pH. due to the accumulation

Table II.—*Amino acids and amides as nitrogen sources.*

Nitrogen source :	Arginine	Alanine	Glycine	Tryptophane	Aspartic acid	Glutamic acid	Asparagine	Urea
Activity	117.9	237.7	222.8	137.7	174.7	220.1	191.8	177.6

Table III.—*Ammonium salts of organic acids as nitrogen sources.*

Nitrogen source :	Am. acetate	Am. citrate	Am. fumarate	Am. lactate	Am. oxalate	Am. propionate	Am. succinate	Am. tartarate
Activity	390.7	206.5	150.9	220.2	118.1	165.7	248.3	240.2

Table IV.—*Ammonium salts as nitrogen sources.*

Nitrogen source :	Am. chloride	Am. sulphate	Am. nitrate	Am. phosphate
Activity	4.1	5.5	33.1	3.4

of acid brought about by a more rapid and preferential assimilation of the ammonium ion. Partial support to this contention is lent by the fact that ammonium nitrate does not prove so toxic as others (see Table II) since the nitrate ion is also assimilable although at a much slower rate.

Viewed as a whole, the results suggest that the fungus is capable of utilising sources of nitrogen widely different in constitution; about 100 to 125 Lintner Units of diastase per mg. of nitrogen are elaborated by the fungus when it is provided with any of the ten sources of nitrogen; sodium nitrate, glycine, alanine, glutamic acid, ammonium salts of acetic, citric, lactic, succinic, tartaric and malic acids (see Tables). In other words, it is evident that all these sources of nitrogen are efficient from the point of view of diastase formation. The organism is apparently endowed with mechanisms comprehensive enough to transform the simple nitrate ion into the several protein complexes including those that are enzymatically active. It is, however, possible

that of these ten forms of nitrogen, some may be more readily convertible than others; this point can be elucidated only when the rate of formation of diastase by the fungus is determined

Summary

1. Studies on the influence of the form of nitrogen on the formation of diastase by *Asp. oryzae*, have been extended to include compounds of nitrogen not previously investigated.
2. Ammonium acetate offers the best source of nitrogen from the point of view of diastase formation.
3. The fungus is capable of utilising a great variety of nitrogen compounds and is apparently endowed with a comprehensive chain of mechanisms through which it elaborates the enzymatically active protein.

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Studies on Industrial Enzymes

Part V—Extraction, concentration and purification of fungal diastases

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Enzymes represent a special group of catalytically active proteins, and their extraction and purification involve, in general, methods analogous to those practised in the preparative chemistry of proteins. We have made a systematic study of the optimum conditions for the efficient extraction, concentration

and purification of fungal diastase from moldy bran.

Experimental

A comparative study of the efficiency of extraction of the enzyme with the following solvents has been made:

(a) Water
 (b) Toluene-saturated water
 (c) M/20 disodium phosphate
 (d) 50 per cent. (by vol.) alcohol
 and (e) 60 per cent. (by vol.) alcohol.

In the case of aqueous solvents, the moldy up and after 30 minutes, centrifuged. The total solid content of the centrifugate as also its diastatic activity were determined in the usual way.

The adsorbate was eluted with M/13 trisodium phosphate and the eluate analysed

Table I

Extractant	Water	Toluene water	M/20 disodium phosphate	50% alcohol	60% alcohol
Total solids extracted ..	16.36	18.50	17.87	7.56	7.13
Total Lintner Units extracted	181,759	167,240	172,982	116,877	99,820
Activity in Lintner Units per gm. of total solids ..	11,110	9,040	9,680	15,460	14,000

bran was macerated for 4 hours at 30°C.; in the case of alcoholic solvents, lower temperatures (0—5°C) were employed for extraction. The results expressed as percentages on the weight of the moisture-free bran are given in Table I.

The results show that :

- (1) With aqueous solvents higher percentages of total solids are extracted.
- (2) While the total quantity of material extracted by aqueous solvents is high, the preparation is of a lower grade of purity showing that non-enzymatic solubles are also extracted.
- (3) With alcoholic solvents, however, the yield of extractives is low,—less than half of what is obtained with water, but the enzymatic purity of the preparation is about 150 per cent. of that of the aqueous extracts.

The aqueous extract was subjected to a further purification by :—

- (1) adsorption followed by elution : five adsorbents have been tried,
- (2) fractional precipitation with graded amounts of
 - (a) ammonium sulphate
 - and (b) alcohol.

Adsorption of amylase.—Five different adsorbents were employed in these studies ; they are (1) Aluminium hydroxide poly, (2) Aluminium hydroxide C_γ, (3) Norit (4) Fuller's Earth and (5) Tricalcium phosphate. The adsorbents were suspended in water and the suspension diluted to contain 100 mgm. of the adsorbent per cc.

Aliquots of the enzyme extract (10 cc.) were treated with known volumes of a suspension of the adsorbent (5 cc.) at a definite pH. The mixture was well stirred

ed for its total solid content (after making correction for the solutes of the eluant) and for its diastatic activity. The results are given in Table II.

The data show that :

- (1) Of the adsorbents investigated, aluminium hydroxide poly. is the best adsorbent. 6.2 per cent. of the activity is recovered in the eluate and an increase in purity of about two and a half times is attained.
- (2) Alumina C_γ and tricalcium phosphate are not good adsorbents.
- (3) Norit removes colour and a good proportion of the non-enzymatic impurities and, incidentally, enhances the purity of the enzyme most of which remains unadsorbed in the centrifugate. Treatment with norit improves the colour of the preparation.
- (4) Fuller's earth does not adsorb any enzyme but removes a higher proportion of the non enzymatic impurities.
- (5) Norit and Fuller's earth may prove themselves useful in a preliminary removal of non-enzymatic impurities.
- (6) In view of the fact that norit and Fuller's earth are adsorbents of the vitamins of the B complex, treatment of the enzyme extract with these adsorbents will prove useful in recovering the vitamins without affecting the yield of diastase.

Precipitation of diastase

- (a) Alcohol precipitation —Requisite amounts of cold absolute alcohol (0—5°C.)

Table II

Adsorbent	Centrifugate		Eluate		Overall loss of activity (%)
	Activity per mgm. of total solids	Recovery (%)	Activity per mgm. of total solids	Recovery %	
Original enzyme	..	19.9	100.0	..	0.0
Al. hyd. poly.	..	2.4	10.6	51.3	62.4
Al. hyd. C ₇	..	23.8	78.5	9.8	7.6
Trical. phosph.	..	13.4	73.1	16.9	11.5
Norit	..	22.8	89.3	4.5	1.3
Fuller's Earth	..	22.0	97.8	4.5	1.9

Table III.—*Alcohol precipitation*

Alcohol concn. %	Filtrate (F)				Precipitate (P)				Total Recovery (F + P)
	Total solids mgm.	Activity per 50 mgm. solids	Total activity Recovered	Recovery %	Total solids mgm.	Activity per mgm. total solids	Total Activity Recovered	Recovery %	
40	159.2	500.0	1590	77.20	29.4	271.2	161.0	7.9	85.1
50	148.2	459.4	1362	65.46	45.0	640.0	576.5	22.0	87.48
60	124.6	287.2	715.6	34.41	67.0	842.6	1129	54.3	87.67
70	122.6	2.1	50.5	2.43	67.2	1389.0	1866	91.7	94.18
80	102.6	..	..	..	68.0	1360.0	1850	9.0	91.00
Original enzyme	201.7	510.6	2060	..	..	..	..	..	..

Table IV.—*Ammonium sulphate precipitation.*

Concentration of Am ₂ SO ₄	Filtrate colour	Total activity of ppt. in L. U.	% Activity recovered
1. Original enzyme	..	2060	..
2. 1/3 saturation	..	303	15.0
3. 1/2 "	Brown	659	32.0
4. 2/3 "	Yellow	1565	76.0
5. 3/4 "	Pale yellow	1688	81.0
6. Full saturation	..	1833	89.0

were added to 10 cc. batches of enzyme solution (also cooled to 0–5°C.) to give a final alcohol concentration of 40, 50, 60, 70 and 80 per cent. in the mixture which, after standing in ice for 5 minutes, were filtered, the precipitates washed with cold 95 per cent. alcohol and immediately dissolved in water and made up to 50 cc. The filtrates were made up to a suitable volume and the diastatic activity of the extracts determined. The results are tabulated in Table III.

(b) Precipitation with ammonium sulphate—Requisite volumes of a saturated solution of ammonium sulphate were added

to 10 cc batches of the aqueous enzyme extract to give 0, 1/3, 1/2, 2/3, and 3/4 saturation of ammonium sulphate. The two were intimately mixed, allowed to stand at room temperature for 5 minutes and filtered. 6 gm. of ammonium sulphate were added to 10 cc. of the aqueous extract to saturate the solution and after dissolving as much of the sulphate as possible, the liquid was allowed to stand for 5 minutes at room temperature (25°C.) and filtered. The precipitates were dissolved in water, made up to 50 cc. and the diastatic activity determined. The results are given in Table IV.

The data presented in Tables III and IV reveal that :

- (1) At 70 per cent. (by vol.) of alcohol, 91.7 per cent. of the total activity is recoverable in the precipitate.
- (2) There is approximately a three-fold increase in the enzymatic purity of the precipitate.
- (3) The alcoholic supernatant after the removal of the active precipitate contains in solution nearly 50 per cent. of the total solids, the vitamin and amino acid make-up of which merits investigation.
- (4) The principal advantage of employing alcohol as the precipitant consists in the fact that a clean and active precipitate is obtained which does not need any further processing; the precipitant from the filtrate can

be recovered by simple distillation and the residues recovered for further treatment.

- (5) With ammonium sulphate 89 per cent. of the enzyme is obtained at full saturation; due to the presence of ammonium sulphate in the precipitate and the difficulty of removing it, it has not been possible to determine the purity of the preparation. The method, however, does not represent an advance over that of alcohol precipitation which yields a "clean" filtrate and a "cleaner" precipitate.

Our thanks are due to the Council of Scientific and Industrial Research for their generous support and to Sir J. C. Ghosh for his active interest.

Letters to the Editor

Carotenoid Pigments of Pyrethrum Flowers

In the course of investigations on the subsidiary constituents of pyrethrum flowers (*Chrysanthemum cinerariaefolium*), the presence of certain carotenoid pigments was noticed in solvent extracts of the flowers from Kenya and also from the Nilgiris (Madras) plantations.

For the isolation of these pigments, both petrol ether and acetone concentrates of the flowers were firstly freed of chlorophyll, fats and waxes by treatment with a saturated solution of barium hydroxide, after the modified method of Petering *et al.* Xanthophylls, carotenoid acids and other aqueous alcohol soluble pigments were then removed from the carotenoid solution by the usual extractions with 85 per cent. alcohol and 90 per cent. methanol. The resultant solution of hydrocarbon carotenoids in petrol ether was chilled in freezing mixture and traces of a colourless sterol which settled down, were filtered off. The clear filtrate was dried over anhydrous sodium sulphate and concentrated under reduced pressure in a current of carbon dioxide.

The total carotenoid content of the flowers was then estimated colorimetrically by

matching the colour of the petrol-ether concentrate (in a Klett colorimeter) against a 0.04 per cent. potassium dichromate solution, which was previously standardised with different concentrations of a pure sample of β -carotene. Chromatographic analyses were also carried out by adsorbing an aliquot portion of the concentrate on activated aluminium oxide, when two yellow bands and a lower third distinct reddish orange band, characteristic of β -carotene separated. The pigments from these bands were eluted with 40.60 petrol ether containing 1 per cent. ethyl alcohol, and the colour of the solutions compared with standard dichromate solution. The results obtained are given in Table I.

Table I.

Source	Solvent	Total carotenoid ugm./gm.	β -carotene μ gm./gm
Nilgiris	Petrol ether	4.7	0.69
„	Acetone	4.5	...
Kenya	Acetone	3.3	...

The percentage concentration of β -carotenoid in different samples of pyrethrum flowers

from various areas in India are under investigation. It may be mentioned in this connection that no reference to these colouring pigments has been made in the extensive literature on pyrethrum.

Our thanks are due to Dr. S. Siddiqui for his kind interest in the work and to Mr. J. C. Sadana for his valuable help in some of the estimations.

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search, Delhi.
July, 16, 1947.*

¹. Petering *et al.*, *Ind. Eng. Chem.*, 1940, **32** 1407; *Ind. Eng. Chem. (Anal.)*, 1941, **13**, 236.

Some rich Sources of active Carotenoid

Ever since the importance of β -carotene as a precursor of vitamin A was recognized, investigations are being undertaken in different laboratories to find out potent sources of this provitamin. Such investigations are particularly important for this country, as a large bulk of the Indian population is vegetarian and in such dietaries β -carotene is the main source of vitamin A.

The rinds of fruits such as orange, sweet

lime and plantain were selected for this investigation. They are now looked upon as waste products and are available in abundance. If rich in β -carotene they should constitute economic raw materials for the large scale production of this valuable provitamin.

Experimental

Oranges and citrus fruits were collected during the season and their peels separated. They were subjected to preliminary treatments to destroy oxidative enzymes.

The peels were dried in a water oven at 100°C. and powdered. The total carotenoids were estimated according to the method of Seaber¹ suitably modified to meet our requirements. The dry powder was extracted with sulphuric ether in a continuous extractor using hydroquinone to prevent oxidation of the carotenoids. Chlorophylls and xanthophylls were removed by saponification with alcoholic caustic potash and phase separation between 90 per cent. methyl alcohol and petrol ether. The petrol layer was dried over anhydrous sodium sulphate and the total carotenoids estimated by the Klett-Summerson photoelectric colorimeter with filter 4500A in place. The results are shown in Table I.

The results indicate that blanching before drying gives very satisfactory results.

Further experiments were carried out to find out the nature of these carotenoids by

Table I.—Carotenoid content of orange and sweet lime peels (mgms. per 100 gm. of the fresh peel).

Fruit	(a)	(b)	(c)	(d)	(e)
Orange	3.51	...	...	2.51	4.55
(Moisture 73 to 81 %)					
...	9.48	...	...	5.12	12.16
...	8.47	11.13	5.17	8.87	13.47
...	5.40	7.52	4.47	3.67	5.47
Sweet lime	8.84	11.60	6.96	8.26	9.64
(Moisture 60 to 72 %)					
...	11.60	5.16	7.48	1.37	...
...	10.16	12.60	8.32	5.04	7.88

(a) dried at 100°C. without any previous treatment; (b) blanched for 30 secs. and dried at 100°C.; (c) autoclaved and then dried; (d) mixed with anhydrous Na_2SO_4 and dried; (e) dried in vacuum.

Table II.—Orange: Effect of storage on carotenoid content.
(mgm. per 100 gms. of the fresh peel).

Treatment	Days:	0	33	51	78	133
Steam dried		5.40	2.28	2.24	1.72	1.35
Blanched		7.53	2.25	2.15	1.61	1.26
Autoclaved		4.47	3.44	2.61	1.74	1.28

Table III.—Sweet lime peel: Effect of storage on carotenoid content.
(mgm. per 100 gms. of fresh peel)

Treatment	Days :	0	63	83	120
Steam dried		10.16	2.77	2.12	1.80
Blanched		12.60	3.35	2.81	2.31
Autoclaved		8.32	3.38	3.13	2.72
Vacuum desiccated		7.88	2.01	1.68	1.37

developing chromatograms with dicalcium phosphate and alumina in succession as follows¹. The extract after phase separation was chromatographed first on dicalcium phosphate and eluted by petrol ether (Moore²), and this quantity when further adsorbed on alumina according to Kuhn and Grundmann³ could be quantitatively eluted with benzene—petrol ether mixture (1:1) showing a low percentage of cryptoxanthin in the dicalcium phosphate eluate. The results thus indicated that about 50 per cent. of the total carotenoids from the rind was carotene. This figure in the case of sweet lime was still higher. Slight variations were found in the distribution in different seasons.

The effect of storage on the carotenoid contents of peels was examined. Samples of powdered peels were stored in screw-cap glass containers at room temperature, and the

carotenoids estimated at intervals. The results are given in Tables II and III.

It will be seen that there is a slow destruction of carotenoids during storage. Experiments relating to storage and biological assay of carotenoids are in progress.

R. G. Chitre.
D. B. Desai.

I.R.F.A. Nutrition Research Unit. Seth G.S.M. College Bombay, Jan 13, 1947.

¹ Seaber, W.M., *Analyst*, 1940, 65, 266.

² Moore, L. A., *Ind. Eng. Chem., Anal. Ed.*, 140, 12, 726.

³ Kuhn, R. and Grundmann, C., *Ber*, 1934, 67, 593.

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