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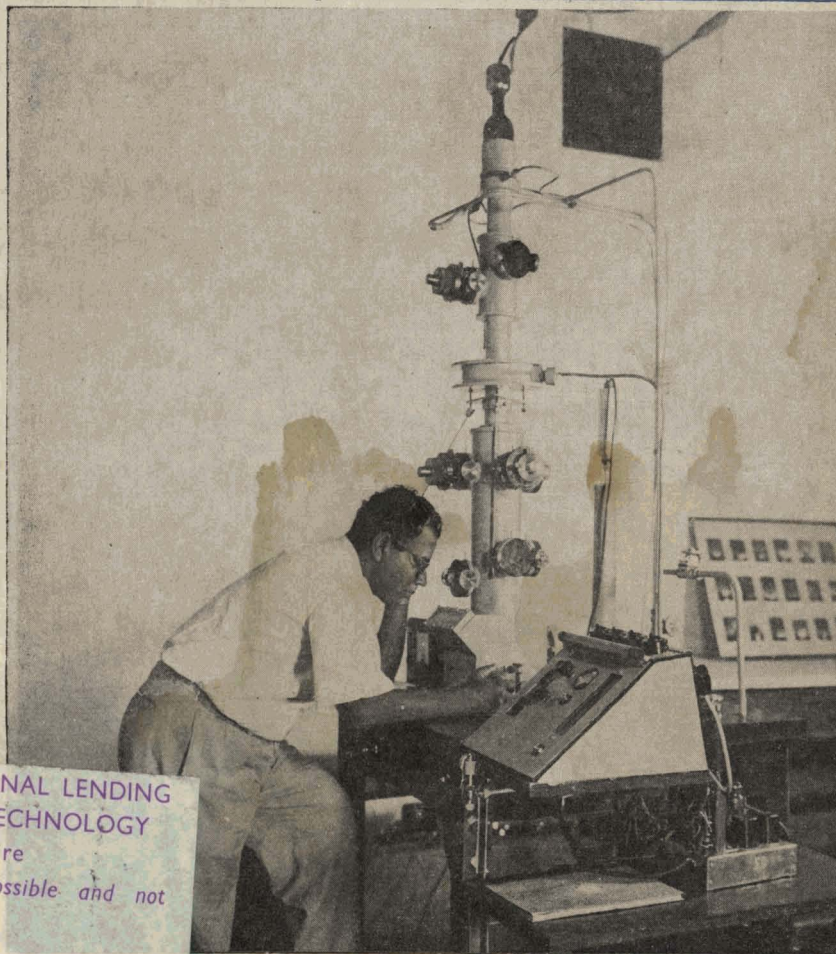
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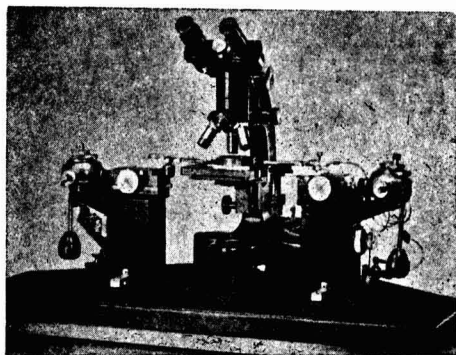
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CONTENTS

The Perkin Centenary	211
Board of Scientific & Industrial Research, Thirty-sixth Meeting, New Delhi ...	213
Diabetes as a Disturbance of Endocrine Equilibrium	215
Prof. B. A. Houssay	
Research & Engineering in Jena Zeiss Works ...	224
Hugo Schrade	
Dr. Irene Joliot-Curie (1897-1956)	231
Chemical & Textile Standards Convention ...	232
Reviews	236
Recent Publications	240
Notes & News	241
Progress Reports	252
Indian Patents	254

Supplement

Psoralea & Other Indigenous Drugs Used in Leucoderma	1-12
B. Mukerji	

For Contents of Sections B & C, see page A4
For Index to Advertisers, see page A37

COVER PICTURE

The picture on the cover shows a Finch type electron diffraction camera designed and fabricated in the National Chemical Laboratory of India, Poona. It operates in the voltage range 50-70 kV., supplied by a sturdy high tension unit, also designed in the Laboratory. The camera, which offers a powerful tool for the study of surface structures, is being employed in investigations relating to crystal growth, corrosion, etc.

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CONTENTS

SECTION B

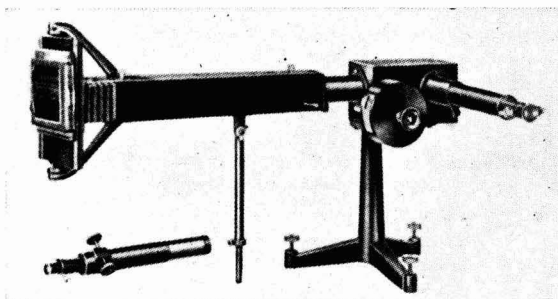
A Ballistic Method for Measuring Electrical Resistivities	213
K. G. Ramanathan & J. S. Dhillon	
A Linear Time-base Circuit for Ionospheric Investigations	217
H. Sarkar	
Cathodo-luminescence Spectra of Halides & Oxides of Some Divalent Elements & of Some $-XO_3$ Compounds	222
B. D. Saksena & L. M. Pant	
Epitaxial Crystal Growth on Iron Pyrites (FeS_2) Cube & Octahedral Faces: Part I—Growth on Cube Face of Pyrites	226
M. K. Gharpurey	
Dielectric Properties of Some Organic Molecules at X-band Frequencies	231
G. P. Srivastava & Shanker Swarup	
Studies on the Dependence of Optical Rotatory Power on Chemical Constitution: Part XLII—The Rotatory Dispersion of <i>d</i> -Camphor- β -sulphonamide & <i>d</i> -Camphor- β -sulphonanhydramide & the Kinetics of the Conversion of <i>d</i> -Camphor- β -sulphonamide into <i>d</i> -Camphor- β -sulphonanhydramide	233
Bawa Kartar Singh & (Miss) M. K. P. Amma	
Solution Behaviour of Polymethyl Methacrylate	239
S. L. Kapur	
Studies on the Irritant Factor of Pyrethrum Flowers	243
A. V. Subbaratnam & Salimuzzaman Siddiqui	
Co-ordination Compounds of Diphenyl Violuric Acid with Metals	245
R. P. Singh	
Determination of Linolenic Acid from Hexabromide Value	247
K. D. Pathak & J. S. Aggarwal	
A Micromethod for the Detection of Isomerization of Digoxin to Isodigoxin	251
B. K. Moza	
Estimation of the Acidities of Titanium Solutions	253
V. Damodaran	
Recovery of Nickel & Zinc from Silver Refinery Waste Liquors: Part III—Production of Plating Salts	258
K. Chakrabarty & T. Banerjee	
Letters to the Editor	
DIPOLE MOMENTS OF SOME SUBSTITUTED BENZENES & PYRIDINES	260
Ch. Radhakrishna Murty	
THE ABSORPTION SPECTRA OF <i>p</i> -BROMO ANISOLE & <i>o</i> -HYDROXY ANISOLE	260
V. Suryanarayana & V. Ramakrishna Rao	
THE ULTRAVIOLET ABSORPTION OF α -FLUORO NAPHTHALENE	262
S. Ramamurty & V. Ramakrishna Rao	
PREPARATION OF CERTAIN PARTIAL METHYL ETHERS OF FLAVONOLS	263
N. K. Anand, S. R. Gupta, (Mrs.) K. S. Pankajamani & T. R. Seshadri	
DIFFERENTIATION OF <i>Hibiscus</i> FIBRES FROM JUTE	263
R. G. Bose	

SECTION C

Studies on the Enzyme Make-up of <i>Vibrio cholerae</i> : Part X—Transaminase System	101
K. C. Saxena, C. R. Krishna Murti & D. L. Shrivastava	
Studies on Indigenous Insecticidal Plants: Part I— <i>Milletia pachycarpa</i> Benth.	106
T. D. Mukerjee & R. L. Tripathi	
Pharmacognostic Studies of <i>Tylophora indica</i> (Burm. f.) Merr.	111
B. Gupta & S. N. Bal	
X-ray Diffraction Studies of <i>Chapati</i> during Cooking & Storage	115
D. B. Parihar & A. K. Chatterji	
Effect of Canning on the β -Carotene Content of Mango, Papaya & Jack-fruit	118
G. S. Siddappa & B. S. Bhatia	
Proteins of Green Leafy Vegetables: Part I	121
S. H. Kamath & Kamala Sohoni	
Letters to the Editor	
SCREENING OF INDIAN SOIL SAMPLES FOR ANTIBIOTIC-PRODUCING ACTINOMYCETES	123
(Mrs.) K. Shete & V. C. Vora	

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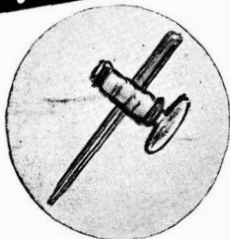
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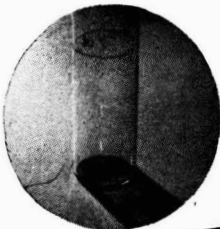
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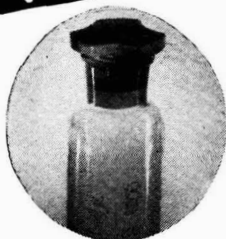
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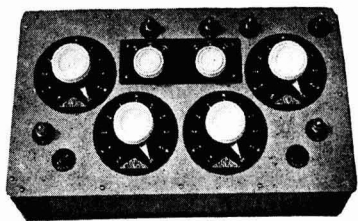
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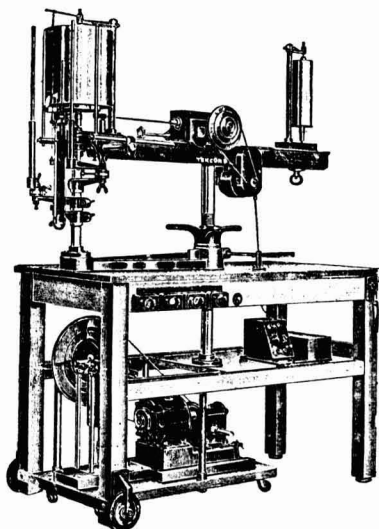
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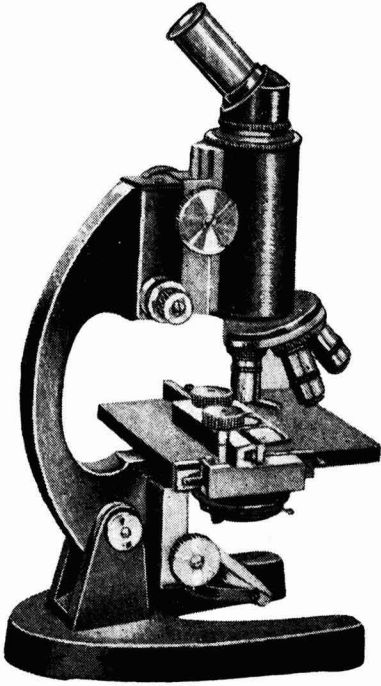
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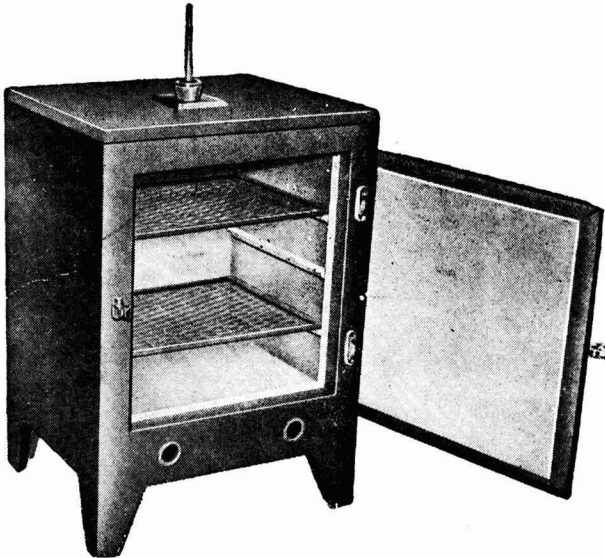
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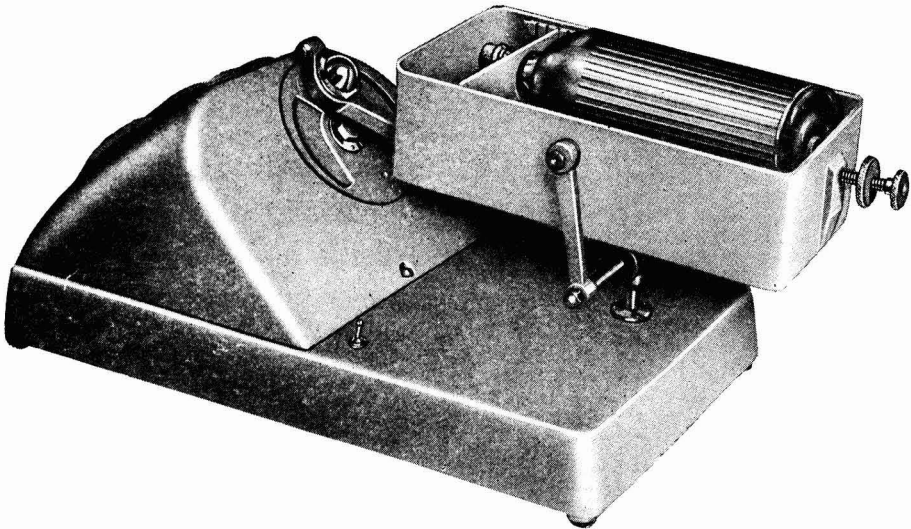
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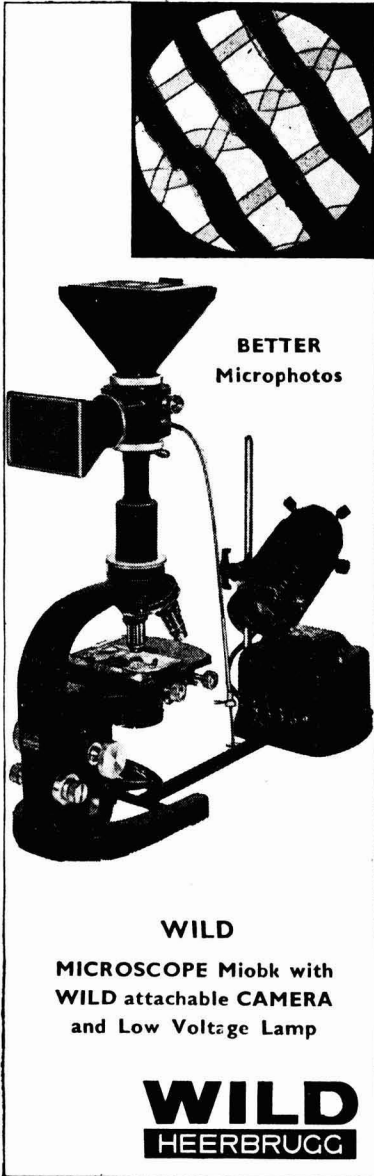
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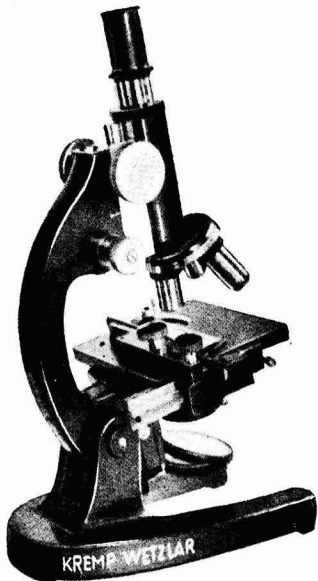
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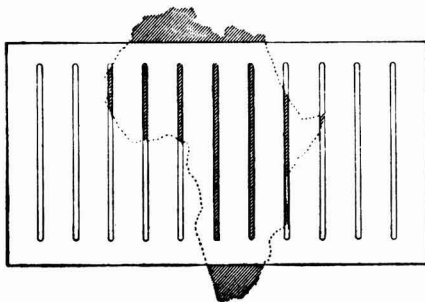
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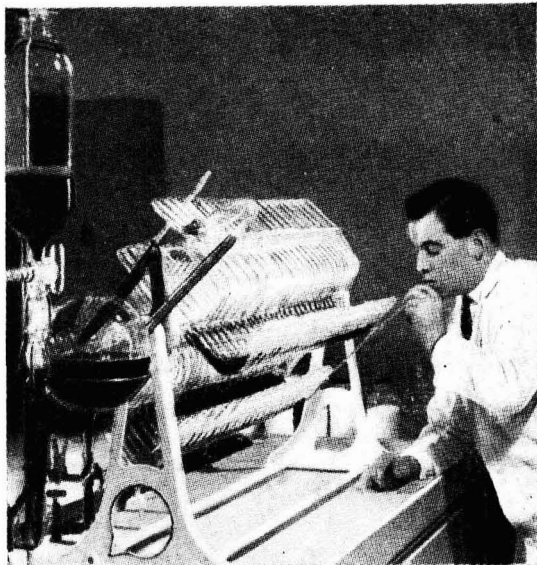
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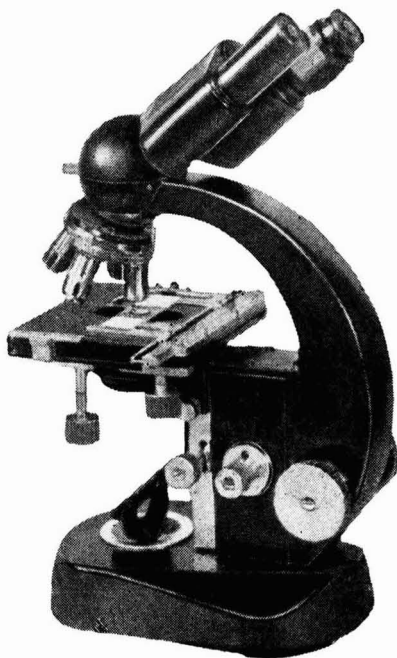
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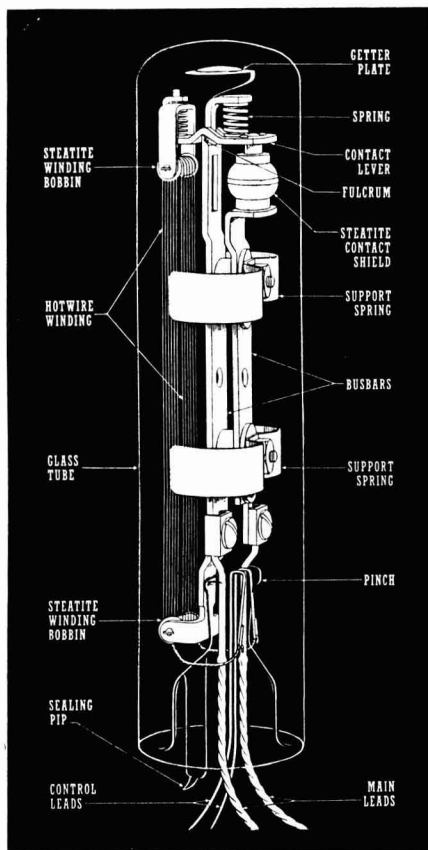
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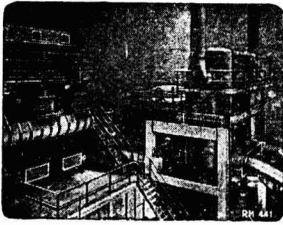
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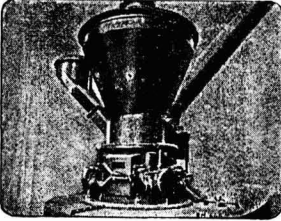
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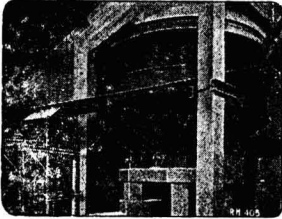
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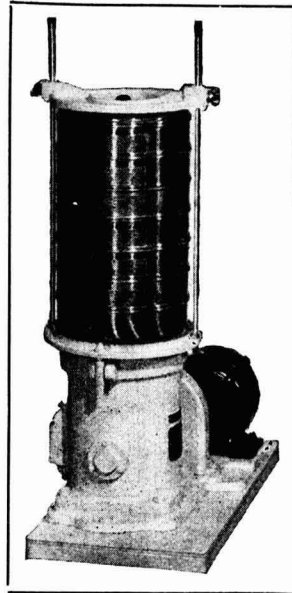
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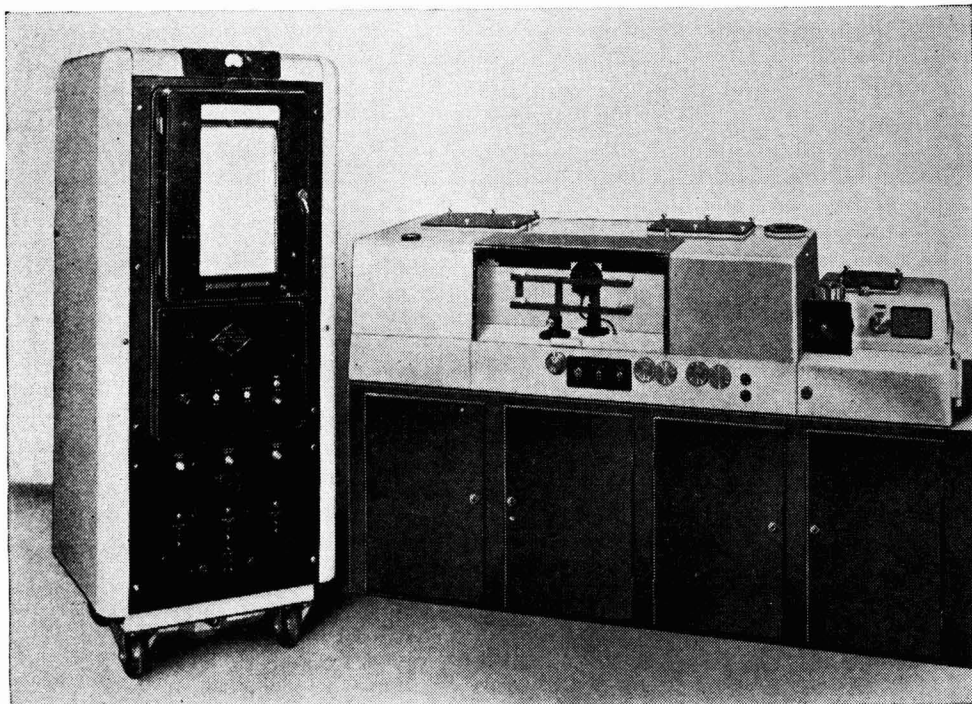
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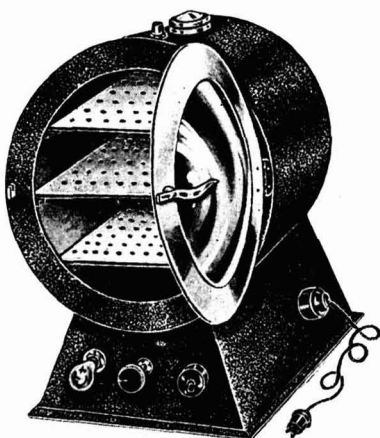
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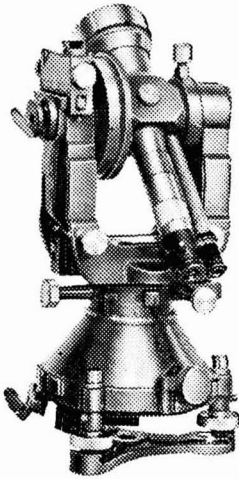
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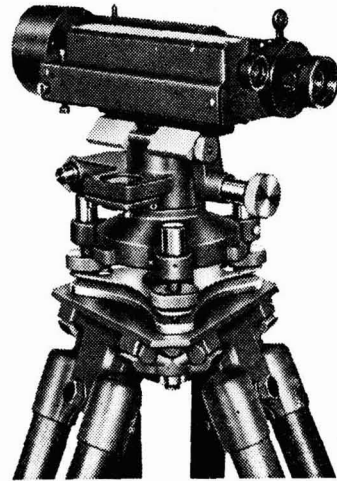
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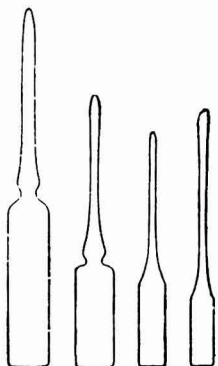
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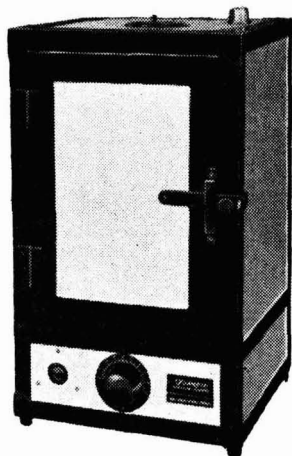
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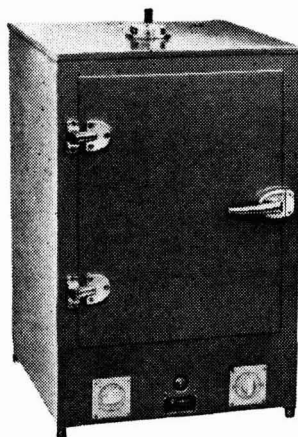
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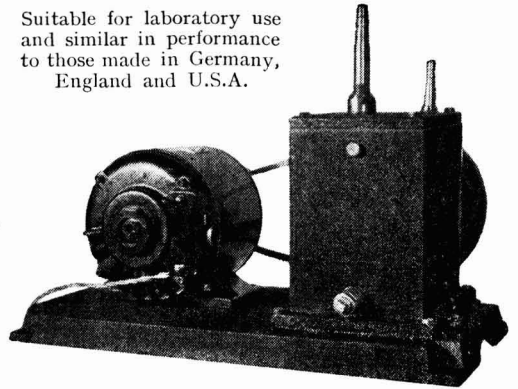
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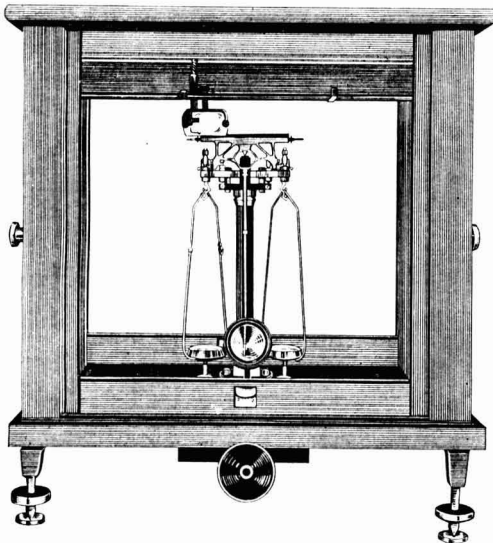
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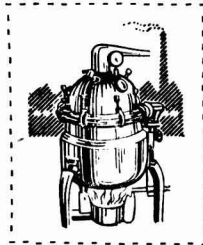
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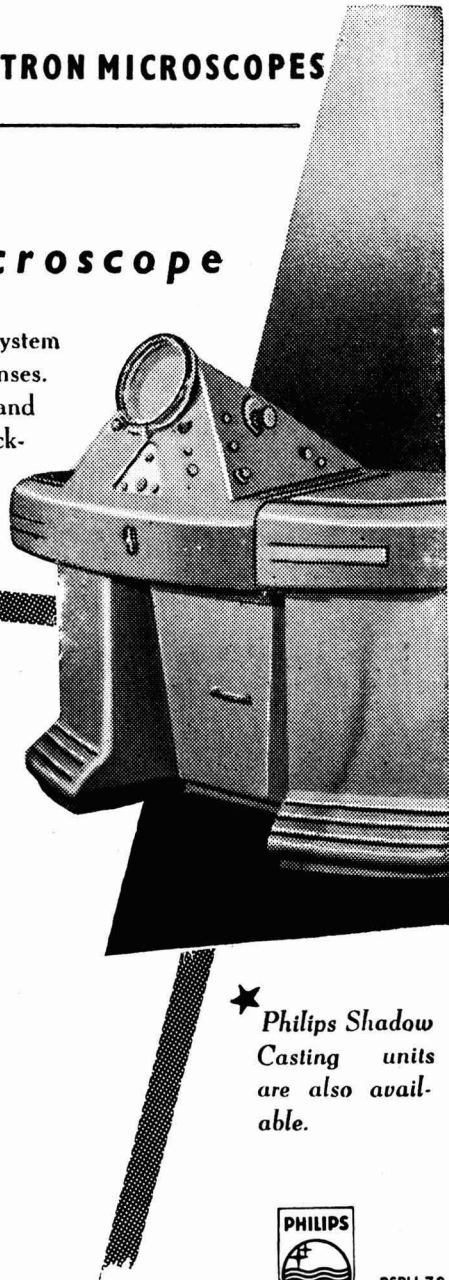
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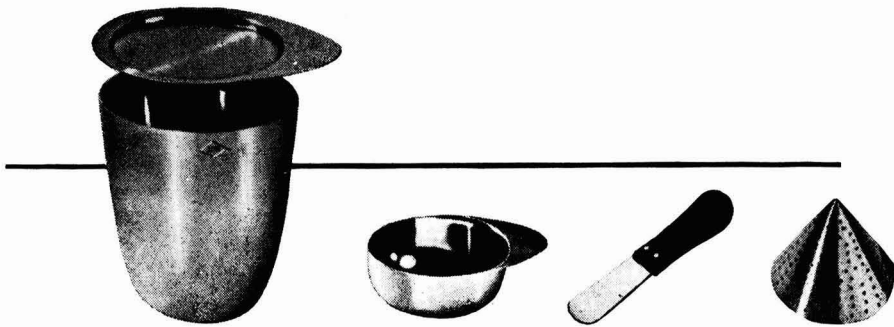
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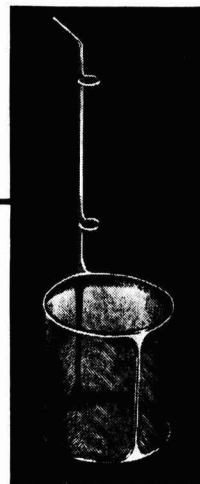
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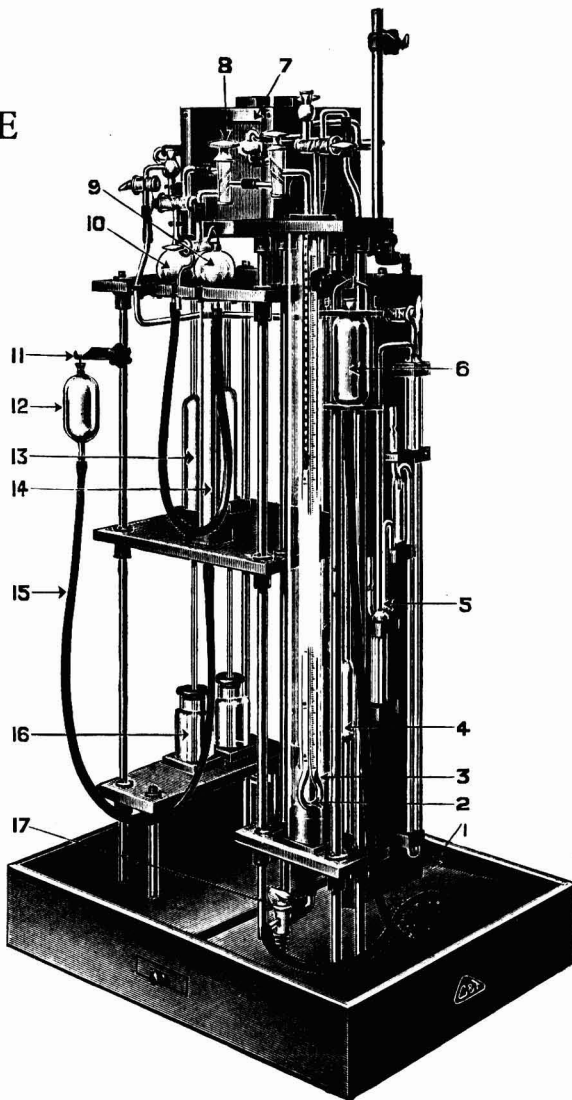
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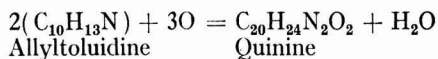
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The Perkin Centenary

IN 1856 William Henry Perkin, at the age of eighteen, discovered Mauve, the first synthetic dye. The centenary of this important event, which led to the development of the vast dyestuffs industry as well as other organic chemical industries, is to be celebrated in London in May this year under the auspices of the Royal Society, the Society of Dyers and Colourists, the Chemical Society, the Society of Chemical Industry, the Royal Institute of Chemistry, and the Association of British Chemical Manufacturers. The Perkin Centenary Celebration Committee has launched an appeal, over the signature of its Chairman, Sir Robert Robinson, for a fund of £100,000 to provide a lasting memorial to Perkin's discovery. A more specific purpose of the fund will be the promotion of technical education related to all aspects of the manufacture and application of colouring matters. The main Centenary Celebration will consist of a series of five lectures dealing with the effects of Perkin's discovery on life and industry during the past 100 years. The opening lecture on *The Life and Work of Perkin* will be by Professor John Read, and the concluding lecture on *The Development of Organic Chemistry since Perkin's Discovery* by Sir Alexander Todd. Elaborate arrangements for celebrating the Perkin Centenary in September are also being made by American organizations including the American Chemical Society.

In his Hofmann Memorial Lecture*, which is inspiring for every young chemist to read, Perkin has surveyed "the rise and progress of the coal-tar colour industry, and its relation to the Hofmann school", and "as being connected with its commencement" he has given a detailed account of his own work on the synthesis of Mauve and of the diffi-

culties that faced him in manufacturing it. "As a young chemist I was ambitious enough to wish to work on this subject of the artificial formation of natural organic compounds. Probably from reading the above remarks on the importance of forming quinine, I began to think how it might be accomplished, and was led by the then popular additive and subtractive method to the idea that it might be formed from toluidine by first adding to its composition C_3H_4 by substituting allyl for hydrogen, thus forming allyltoluidine, and then removing two hydrogen atoms and adding 2 atoms of oxygen, thus



"The allyltoluidine having been prepared by the action of allyl iodide on toluidine, was converted into a salt and treated with potassium dichromate; no quinine was formed, but only a dirty reddish-brown precipitate. Unpromising though this result was, I was interested in the action, and thought it desirable to treat a more simple base in the same manner. Aniline was selected, and its sulphate was treated with potassium dichromate; in this instance a black precipitate was obtained, and, on examination, this precipitate was found to contain the colouring matter since so well known as *aniline purple* or *mauve*, and by a number of other names. All these experiments were made during the Easter vacation of 1856 in my rough laboratory at home. Very soon after the discovery of this colouring matter, I found that it had the properties of a dye, and that it resisted the action of light remarkably well."

A process for the preparation of the new colouring matter was patented on 26 August 1856 (Patent No. 1984). In October Perkin

**J. chem. Soc.*, 69 (1896), 603.

resigned the post he was holding as assistant to Hofmann; his father and brother joined him in building a factory, and in 1857 the firm of G. F. Perkin & Sons, of which Imperial Chemical Industries (Dyestuffs Division) may be regarded as a direct descendant, was founded. By December 1857 the processes for nitrating benzene, reducing it to aniline by the method discovered three years earlier by Bechamp, and oxidizing aniline to Mauve (Mauveine; Aniline Purple; Tyrian Purple) were in operation on a large scale. Perkin then developed methods for the application of Mauve to silk from a soap bath and to cotton after mordanting with tannin and sodium stannate. Brilliant shades were thus produced, and these additions to dyeing technique have proved to be of general utility for all basic dyes. Perkin's achievements, therefore, were manifold: the isolation of the first synthetic dye formed in very small amount in a complex reaction, the translation of an accidental observation in the laboratory to manufacturing practice, and the demonstration of the value of his product to the dyer and printer. Nine years before Kekule's concept of the structure of benzene, Perkin had the vision to see the tremendous possibilities of his discovery and to lay the foundation of an industry which has had a profound influence on organic chemistry and organic chemical industries as a whole*.

The life and work of Sir William Perkin have been described by Rowe† in the Perkin

Centenary Lecture, which ends as follows: "Perkin displayed this remarkable courage, energy, initiative and versatility between the ages of 18 and 21, which is the period when most young chemists of the present generation are still undergraduates . . . There can be no better note on which to conclude this tribute to the genius of the late Sir William Perkin than to use his own words once again — 'And, of course, the end result of all our work should be the benefit of mankind', for that was indeed the result of his life and work".

From a study of Perkin's work and of the events which resulted in the establishment and continual growth of the dyestuff industry in England and Germany, it is clear that the dyestuff industry has stimulated many developments in organic chemistry, but the reverse is equally true: the discovery of new dyes and improvements in the methods of manufacturing known dyes have depended on progress in the theory and practice of general organic chemistry. We must, therefore, take steps to see that the gradually expanding Indian dyestuff industry has its roots in the soil, and that during the next few years we have in this country flourishing schools of research in organic chemistry. Dyestuff factories must not merely maintain their own research laboratories, but directly or through the Council of Scientific & Industrial Research they must also support research in the universities in the chemistry of synthetic dyes and in the wider field of organic chemistry. The Indian dyestuff industry cannot hope to prosper unless it has available within the country a perennial stream of organic chemists with sound knowledge and research experience, of whom a few at least may prove to have qualities of leadership.

*For a history of the dyestuff industry and its present position, see K. Venkataraman, *The Chemistry of Synthetic Dyes* (Academic Press Inc., New York), 1952; and Rowe, *The Development of the Chemistry of Commercial Synthetic Dyes*, 1938.

†*J. Soc. Dy. Col.*, 54 (1938), 551.

Board of Scientific & Industrial Research, Thirty-sixth Meeting, New Delhi

THE thirty-sixth meeting of the Board of Scientific & Industrial Research was held in New Delhi on 20 March 1956. The meeting of the Governing Body was held on the following day. The Prime Minister, Shri Jawaharlal Nehru, presided.

The following new research schemes have been sanctioned by the Governing Body on the recommendation of the Board:

1. *Studies in the morphology, embryology and cytology of the Pandanales*: DR. I. BANERJEE, Calcutta University, Calcutta

2. *Studies on the varietal suitability and development of suitable methods for preservation (long and short term) of important fruits and vegetables of West Bengal*: DR. A. N. BOSE, College of Engineering & Technology, Jadavpur

3. *Development of pentaerythrytol from alcohol and formaldehyde*: Director, Shri Ram Institute for Industrial Research, Delhi

4. *Cytogenetical studies on animal chromosomes after various kinds of physical and chemical treatment*: DR. S. P. RAY CHAUDHURI, Calcutta University, Calcutta

5-7. *Evolving suitable and economical specifications for construction of roads in water-logged areas; Evolving simple techniques for designing thickness of flexible pavements; and Replacement of brick soling with stabilized soil in W.B.M. roads*: Director, Building & Road Research Laboratory, Karnal

8. *Development of furfuryl alcohol and its condensation products suitable for plastics, laminates, adhesives and surface coatings*: Director, Shri Ram Institute for Industrial Research, Delhi

9. *Design of bituminous mixes for surface carpets*: SHRI R. N. DOGRA, Construction Circle, Chandigarh and DR. I. S. UPPAL, Building & Road Research Laboratory, Karnal

10. *Synthetic studies in diterpenoid acids*: DR. P. C. DUTTA, Indian Association for the Cultivation of Science, Calcutta

11. *Studies on the effect of some anti-vitamins on bacterial metabolism*: DR. B. C. GUHA, University College of Science & Technology, Calcutta

12, 13. *Studies on the Budde effect in halogens under electric discharge; Comparative study of the wall catalysed and homogeneous parts of a reaction under electric discharge*: DR. S. S. JOSHI, Banaras Hindu University, Banaras

14. *Light-scattering, boiling point and heats of mixing studies on the statistical mechanics of regular binary mixtures*: DR. P. K. KATTI, Delhi Polytechnic and SHRI S. M. BHAGAT, Delhi University, Delhi

15. *Nutritive value of canned foods in India*: DR. N. G. MAGAR, Institute of Science, Bombay

16. *Synthesis of linolenic acid*: DR. A. P. MAHADEVAN, Nutrition Research Laboratory, Coonoor

17. *Study of insect life at high altitudes in the Himalayas*: PROF. M. S. MANI, St. John's College, Agra

18. *Organic compounds of titanium, zirconium, hafnium, cerium and thorium*: DR. R. C. MEHROTRA, Lucknow University, Lucknow

19. *Study of the algae of the soils of U.P. in relation to fertility of the cultivated soils, study of their life history, physiology and possible economic importance*: DR. A. K. MITRA, Allahabad University, Allahabad

20. *Setting up a Radio Propagation Unit at Delhi*: DR. A. P. MITRA, Radio Research Committee, N.P.L., New Delhi

21. *Electrochemical approach to some aspects of the structural chemistry of synthetic polymers*: DR. R. P. MITRA, Delhi University, Delhi

22. *Manufacture of cellulose ethers, particularly ethyl cellulose and carboxy cellulose*: DR. C. NANJUNDAYYA and DR. K. S. BHUJANG, Technological Laboratory, Indian Central Cotton Committee, Bombay

23. *Use of pre-cast pre-stressed slabs and blocks in the strengthening of culverts and in small span bridges*: SHRI K. K. NAMBIAR, Chief Engineer (Highways), Madras

24. *Possibilities of pearl essence production in India*: DR. N. K. PANIKKAR, Central Marine Fisheries Research Station, Mandapam

25. *Standardization of methods of soil analysis for engineers in general and road engineers in particular*: DR. A. N. PURI, Field Research Station, Bombay

26. *Desiccation of carp seeds for piscicultural purposes*: MR. A. K. DAS, Fisheries Department, Hyderabad

27. *Reactions of surface films on liquids*: PROF. P. C. RAKSHIT, Presidency College, Calcutta

28. *The study of size distribution of rain drops in different types of precipitation in tropics*: DR. R. RAMANADHAM, Andhra University, Waltair

29. *Acid metabolism of plants*: PROF. SHRI RANJAN, Allahabad University, Allahabad

30. *Analytical study of magnetic amplifiers*: DR. S. M. SEN, M.S. University, Baroda

31. *A chemical study of gossypol and other chromogenic factors of cottonseed oil*: DR. T. R. SESHADRI, Delhi University, Delhi

32. *Synthesis and pharmacology of coumarin compounds having activities on the cardiovascular and respiratory system*: DR. T. R. SESHADRI, Delhi University, Delhi and DR. R. B. ARORA, S.M.S. Medical College, Jaipur

33. *Development of multipurpose 2-stroke engine with variable compression ratio*: PROF. O. SCHOLZE, Madras Institute of Technology, Madras

34. *Role of electrolyte imbalance in the production of hypertension*: DR. INDERJIT SINGH, Medical College, Agra

35. *Mercaptans as modifiers in emulsion polymerization*: DR. P. R. SINHA, College of Engineering & Technology, Jadavpur

36. *Cosmic radio noise investigations in VHF and UHF bands*: DR. Y. V. SOMAYAJULU, Madras Institute of Technology, Madras

37. *Spectrographic investigations of the ocean bed samples*: DR. P. TRIVENGANNA RAO, Andhra University, Waltair

New Institutes—The Governing Body approved the proposal of the Council to take over the Indian Institute for Medical Research at Calcutta in order to develop it as a Central Institute for Biochemistry & Experimental Medicine. The Governing Body also approved of the taking over of the Central Laboratories for Scientific & Indus-

trial Research at Hyderabad, now under the Hyderabad Government, and developing it as a Regional Research Laboratory. It was also decided that a similar regional research laboratory should be established in Assam to deal with scientific and technological problems of this part of the country. The setting up of a research station at Sambhar to undertake work on Sambhar Lake bitterns was also approved.

It has been decided to establish (1) a Mining Research Station at Dhanbad in collaboration with the Coal Board to deal with problems connected with the mining industry, especially safety in mines, and (2) a Mechanical Engineering Research Institute near Calcutta. The Government of West Bengal has placed at the disposal of the Council 30 acres of land for the Mechanical Engineering Research Institute and the Jalan Education Trust is donating Rs. 21 lakhs.

Executive Councils for the National Laboratories—The Governing Body has set up an Executive Council and a Scientific Advisory Committee for each National Laboratory with considerable amount of autonomous powers to manage the laboratories already well established.

The Governing Body discussed the problem of recruitment of scientific personnel under the Government in general and the National Laboratories in particular. A Committee has been set up with Prof. P. C. Mahalanobis as Chairman to work out the relevant details.

The Board and the Governing Body discussed the question of conservation and maximum utilization of India's coal resources and the development of cellulose industry, and recommended that measures should be taken to develop these industries.

Symposia—The Governing Body approved the holding of the following symposia during 1956-57: (1) Tides and surges on Indian coasts; (2) High polymers; (3) Recent advances in the field of fats and allied products; (4) Soils as a construction material; (5) Coal carbonization; (6) Glass house refractories and steel refractories; and (7) Vitreous enamels and higher temperature ceramic coatings for metals.

Diabetes as a Disturbance of Endocrine Equilibrium

PROF. B. A. HOUSSAY

Institute of Experimental Biology & Medicine, Buenos Aires, Argentina

(Continued from page 175, April 1956 issue)

ADRENALS

THE adrenal medulla can be extirpated without causing changes in the blood sugar level, glycogen content, or the blood sugar tolerance curves. The course and severity of pancreatic⁷⁹, phloridzin or hypophyseal⁴⁷ diabetes is not altered. Adrenaline, secreted by the adrenal medulla, provoked by several agents (hypoglycemia, etc.), can provoke a transitory increase in blood sugar, and accelerates recovery from hypoglycemia, e.g. insulin hypoglycemia.

The adrenal cortex plays an important part in carbohydrate metabolism and in diabetes.

Adrenal insufficiency — Disturbances in carbohydrate metabolism, seen in adrenalectomized animals, are similar to those of hypophysectomized animals, but they are usually less marked. In well-fed animals carbohydrate levels, and utilization are almost normal but blood sugar and glycogen content are low in the post-absorptive state, and decrease in fasting and conditions of stress. At first, hepatic glycogen, and later, the blood sugar falls, but muscle glycogen falls only in the advanced stages when circulation fails. In the adrenalectomized dog, the recovery of muscle glycogen after fatigue is retarded⁸⁰, and it is not stored normally after the injection of glucose⁸¹; adrenal extracts correct these disturbances, even if the pancreas has been removed. Adrenalectomized animals are usually more sensitive to insulin than normal ones, but less so than hypophysectomized animals; adrenal extracts and corticoids correct this hypersensitiveness²⁹. The glucose tolerance curve in the dog is usually high and prolonged⁸¹ or has a higher peak and greater fall²⁹. Lipogenesis is diminished in fasting and stress, and it is difficult to produce a fatty liver. Phloridzin glycosuria is less marked. Pancreatic diabetes is less

severe in the adrenalectomized rat, dog and cat⁵⁸, toad^{64,65,69} and man. Comparing pancreatectomized-adrenalectomized with pancreatectomized animals, the following differences have been found: hyperglycemia, glycosuria and ketonuria are less marked, and there is a low urinary D/N ratio; survival is longer.

The isolated diaphragm of adrenalectomized rats utilizes more glucose than that of normal rats, but less than that of hypophysectomized rats^{82,83}.

Action of adrenal hormones — Adrenal extracts⁵⁸ and the active steroids of the adrenal cortex markedly increase liver glycogen, and slightly raise the blood sugar of fasting normal, adrenalectomized or hypophysectomized animals⁷². Muscle glycogen is not increased in fasting animals, but it does increase when they are fed carbohydrates.

Prolonged treatment with large doses of cortisone produces considerable hyperglycemia in rabbits^{76,84}, hyperglycemia and glycosuria in guinea-pigs^{74,85,86} and hyperglycemia in chicks⁸⁷.

Diabetes has been obtained by glucocorticoids in rats: (a) with pancreatectomy and hypophysectomy⁷²; (b) with partial pancreatectomy^{87a}; and (c) in normal rats^{57,88-98}. Deoxycorticosterone is less active, but it can provoke glycosuria in partially pancreatectomized rats⁹⁹. Corticoids produce glycosuria, hyperglycemia, marked insulin resistance¹⁰⁰ and a high tolerance curve⁹⁸. Glycosuria and hepatic glycogen increase in proportion to the dose of corticoid given¹⁰¹. Cortisone exerts its glycosuric effect very slowly and progressively, reaching a maximum in 7-14 days; afterwards, the effect diminishes in spite of continued treatment⁹⁷. After 19-25 days of treatment, glucose tolerance diminishes, and after 25 days, all the animals show hyperglycemia⁹⁸.

Corticotrophin releases corticoadrenal hormones, thus producing a transitory diabetogenic effect (glycosuria and hyperglycemia) in normal rats^{91,102-105}.

Intense treatment with larger doses of cortisone produces only slight hyperglycemia in normal cats⁷⁶ and dogs^{106,107}.

When the pancreas was surgically reduced to 16-23 per cent (average 20 per cent) of its initial weight, a transitory corticoid diabetes occurred in 7 out of 11 dogs, and permanent diabetes developed in 5 of the 11 animals. This metacorticoid diabetes, which persisted after treatment had been discontinued, was observed in 3 of the 8 dogs treated by cortisone (1, 1, 5 mg./kg. daily, after 29, 43 and 58 days), and in 2 of the 3 dogs given hydrocortisone²².

Corticotrophin administered to hypophysectomized dogs suppresses sensitiveness to insulin, secondary hypoglycemia after glucose, and the glycemic response to adrenaline. Higher doses produce hypercorticalism: resistance to insulin, high tolerance curve, supernormal response to adrenaline. Corticoids alleviate the carbohydrate changes of hypopituitarism but do not produce hypercorticalism²⁹.

Cortisol has a more potent effect than cortisone in producing transitory diabetes in the rat^{94,108}, permanent diabetes in the dog²², and in diminishing glucose tolerance in diabetic patients with Addison's disease¹⁰⁹.

In normal human subjects and in non-diabetic patients, prolonged administration of cortisone or corticotrophin in some cases produces a slight and variable increase in the fasting blood sugar, but there is no permanent increase above the normal level. A few exceptional cases show a decrease in glucose tolerance, which returns to normal when cortisone or corticotrophin is discontinued¹¹⁰⁻¹¹⁴. The diabetogenic action of corticotrophin, first observed by Browne¹¹⁵, was later seen in some normal human subjects¹¹⁶⁻¹¹⁸. There was moderate hyperglycemia, a certain resistance to insulin, and a decrease in the re-absorption of glucose by the renal tubes, because, in some cases, there is glycosuria with little or no hyperglycemia. Apart from these cases, a diabetogenic action of corticotrophin or corticoids has seldom been reported in the large number of papers on treatment with this hormone^{110-112,114,119,120}.

Action on the islets — Considerable hyperplasia of the islets of Langerhans is produced

by prolonged administration of cortisone in guinea-pigs⁸⁶, normal rats^{57,98} and hypophysectomized rats^{66,121}, and by cortisone and cortisol in dogs²². The beta cells of the islets show: (a) in rats, hypertrophy and hyperplasia but no degeneration⁹⁸; (b) in guinea-pigs, hypertrophy and hyperplasia, some beta cells have reversible degranulation and irreversible vacuolation⁸⁶; (c) in rabbits^{84,122,123} and in metacorticoid diabetes in dogs²², hydropic degeneration (glycogen) of beta cells, and the epithelial cells of the ducts have been observed; and (d) in dogs without diabetes, hypertrophy and hyperplasia²².

Corticotrophin provokes a greater mitotic activity in the beta cells¹²⁴, an increase in the size and number of the islets, and enlargement and degranulation of the beta cells in the rat¹²⁵. The increase in islet tissue is even more evident in the hypophysectomized rat¹²¹.

With daily injections of different glucocorticoids (compounds A, E, F) during six months, prevention of diabetes was observed in a large proportion of sub-totally pancreatectomized rats. There was an initial increase in the incidence of diabetes, and after six months the percentage of diabetic rats was considerably less than in the untreated controls. All protected rats showed hypertrophy and increase in the number of islets of Langerhans, the beta cells of which had normal granulation¹²⁶. We have been unable to cure alloxan diabetes in dogs or rats by the administration of corticoids plus insulin, probably because of the strong resistance to insulin developed by corticoids.

Mechanism of corticoid action — The principal factor in the diabetogenic action of corticoids is that the amount of glucose, formed by gluconeogenesis from sources other than absorbed glucose, is, in cortisone diabetes, approximately seven times the amount formed in normal rats¹²⁷. This gluconeogenesis does not take place solely at the expense of protein^{98-100,127}. Glycosuria, observed in unanaesthetized rats, treated by cortisone, is due not only to the greater production of glucose, but also to impairment in the utilization of glucose; in anaesthetized rats this impairment is not evident¹²⁷. In cortisone diabetes, there is marked resistance to insulin¹⁰⁰, and a peripheral antagonism between insulin and cortisone⁹⁵. Excess of corticoids increases protein catabolism and

impaired lipogenesis. Cortisone hyperglycemia has been observed in adrenalectomized⁹² and in thyroidectomized rats⁹⁸; it is more marked in hypophysectomized rats⁹⁸. Therefore, the adrenals, thyroid and hypophysis are not necessary for the diabetogenic effect of cortisone.

The action of cortisone may be diphasic. In the rat, treatment causes a maximal glycosuria in 6-7 days: later, glycosuria diminishes⁹⁷. In the sub-totally pancreatectomized rat, large doses of active corticosteroids at first increase the incidence of diabetes, but later, in a great number of cases, there is a smaller incidence and marked protection⁹⁷.

In human subjects treated with cortisone over a long period, when treatment is discontinued, hypoglycemia and sensitivity to insulin may occur¹¹³. In 18 cases treated with cortisone, there was at first depression in glucose consumption; later, a higher rate of glucose consumption developed^{113,128}.

Cortisone almost always increases the severity of diabetes in the human subject but it improved the diabetic condition in three hirsute diabetic women¹¹³. In some diabetics, deoxycorticosterone diminishes resistance to insulin^{129,130}, probably by inhibition of the pituitary.

There are two possible mechanisms by which the favourable effect of corticosteroids may be exerted: (1) Corticosteroids inhibit hypophyseal functions, especially the secretion of corticotrophin. This action may take place rapidly and, after a time, it will cause atrophy and a certain degree of hypofunction of the adrenal; (2) probably, insulin secretion increases; thus, a normal blood sugar and glucose tolerance is maintained^{113,119,120,131}. If the effect of cortisone is intense, a transitory diabetes may be produced. In the rat, there is hypertrophy and hyperplasia of the islets, and the blood sugar level returns to normal. In sub-totally pancreatectomized rats, this insular hypertrophy can prevent the appearance of diabetes. If the action of cortisone is more intense, and the pancreatic reserve (capacity to respond) is diminished (specially in sensitive species such as the dog, or with surgical reduction, damage of the pancreas, or simultaneous effects of several substances), there are marked lesions of the pancreas, hydropic (glycogen) degeneration of the beta cells, and a metacorticoid diabetes develops,

i.e. a permanent diabetes, which persists after treatment has been discontinued.

Adrenals and human diabetes — It has not been proved that human diabetes is produced by adrenal hyperfunction; but its severity is increased by the existence of adrenal function. Adrenalectomy diminishes the severity of human diabetes and insulin requirement, and can arrest vascular lesions¹³².

In 49 per cent of cases of Cushing's disease, and of hyperplasia and tumours of the adrenal, glycosuria or changes in the glucose tolerance curve have been reported¹³³. Sub-total extirpation of the adrenals usually improved glucose tolerance, and in some cases, diabetes, which needed insulin treatment, disappeared¹³⁴.

THYROID

Thyroid insufficiency — Thyroid hormone increases the rate of absorption from the intestine of glucose and specially of galactose, which is retarded in hypothyroidism, and takes place at a higher than normal rate in hyperthyroidism¹³⁵. This causes low blood sugar curves following ingestion of these sugars in hypothyroidism, and high and prolonged blood sugar curves in hyperthyroidism. In hypothyroidism, blood sugar and liver glycogen content are normal or sub-normal, except in cases with cachexia in which they are low. Sugar is oxidized normally. Sensitiveness to insulin is increased in varying degrees¹³⁶⁻¹³⁹; hypoglycemia lasts longer, and convulsions occur more frequently than in normal animals.

Hyperthyroidism and diabetes — In human cases of hyperthyroidism, the blood sugar is usually normal, but occasionally a high figure is found. Slight glycosuria has been observed in 15 to 60 per cent of the cases, specially after meals. Glucose is well oxidized, and in relation to the high metabolic rate. In moderate hyperthyroidism, sensitiveness to insulin may be increased, but in severe cases, when the liver glycogen has been exhausted, there is spontaneous hypoglycemia during fasting and marked hypersensitiveness to insulin.

Liver glycogen diminishes considerably in hyperthyroidism; cardiac glycogen diminishes in more advanced stages, and finally muscle glycogen also diminishes. The effect of the thyroid on liver glycogen can be more

or less arrested by treatment with vitamins A, B and C, yeast, certain fats and a protein-rich diet.

Thyroid treatment, in some species, provokes hypertrophy and hyperplasia of the Langerhans islets at the expense of the centro-acinar cells. This treatment, even at high doses, and kept up for a long time, does not provoke diabetes in animals with an intact pancreas, though, sometimes, a transitory increase in blood sugar may be observed.

Previous treatment with thyroid increases the incidence of diabetes provoked by alloxan in rats¹⁴⁰.

If the pancreas has been diminished surgically to 15-20 per cent its normal mass, or the animals have been treated recently with alloxan or hypophyseal hormones, continuous thyroid treatment damages the beta cells, and diabetic symptoms appear in the dog. This diabetes (thyroid diabetes) is transitory and reversible if treatment is not kept up for too long a time. A more prolonged treatment causes irreversible lesions in the islets, and the animals remain diabetic permanently, even though no thyroid treatment is given (metathyroid diabetes^{21,48,141}).

The diabetogenic activity of the thyroid is far below that of the hypophysis or the adrenals. Diabetes is not a factor of hyperthyroidism; the incidence of hyperthyroidism in diabetics is not greater than in normal subjects. On the other hand, the incidence of diabetes in hyperthyroid patients is twice¹⁴², and in patients with hyperthyroid adenomatous goiter, three times¹⁴³ that in non-goitrous subjects. When hyperthyroidism and diabetes are simultaneously present in a subject, they exert a mutually unfavourable influence, and each condition must be carefully treated, specially hyperthyroidism. Ample thyroidectomy, or iodothyroidectomy facilitates treatment of hyperthyroid diabetic subjects; life is prolonged, hyperglycemia, glycosuria and ketonuria diminish, and insulin requirement is smaller.

Thyroid insufficiency and diabetes — Thyroidectomy or iodothyroidectomy does not modify the severity of diabetes in dogs^{21,49,144} but these operations have a marked preventive effect on the appearance of diabetes in sub-totally pancreatectomized rats^{48,145}. In man, thyroidectomy increases glucose tolerance, and diminishes insulin requirement, but does not cure diabetes. The development of myxedema has con-

siderably improved diabetes in many cases, and a few cases have been reported as cured but without sufficient evidence.

Many anti-thyroid substances (cysteine, thiouracil, etc.) exert an influence on diabetes, partly by provoking hypothyroidism, and partly by a direct action. The latter has been observed in thyroidectomized animals, and is connected with an increase in free SH in tissues. The following facts have been established in the rat¹⁴⁶: (a) previous treatment with these drugs or thyroidectomy markedly increases resistance to the toxic and diabetogenic effect of alloxan; (b) they also delay the onset of diabetes after sub-total pancreatectomy in the rat and decrease its frequency; (c) propylthiouracil diminishes glycosuria of rats with total pancreatectomy, force-fed and maintained with a constant dose of insulin; and (d) propylthiouracil diminishes the sensitivity to alloxan produced by diets containing high proportion of unsaturated fatty acids.

SEX HORMONES

Prevention or intensification of diabetes — The physiological and pharmacological action of sex hormones on diabetes has been mainly demonstrated in white rats. After a large (95 per cent) ablation of the pancreatic mass in these animals, diabetes appears after 1 to 2 months, and its intensity increases progressively. Diabetes appears in a much higher proportion in the male than in the female¹⁴⁷⁻¹⁵⁴. Six months after operation, 89 per cent of the males and 27 per cent of the females were diabetic.

The sexual difference is not due to different amounts of food. This was proved by experiments with paired feeding¹⁴⁹ and forced feeding¹⁵⁰. The difference is maintained between males and females receiving the same amount of food. There is no sexual difference in the acute types of diabetes, e.g. after pancreatectomy or alloxan¹⁵⁰⁻¹⁵⁴.

In sub-total (95 per cent) pancreatectomized rats, removal of the testes diminishes the incidence of diabetes, and removal of the ovary increases it¹⁴⁹. When castration was performed immediately after birth, the incidence of diabetes after sub-total pancreatectomy was similar in castrated males and females¹⁵⁵.

Restitution of the ovaries by means of a graft gave considerable protection in spayed

females with sub-total pancreatectomy. Protection was greater in those rats in which the graft provoked more frequent and prolonged cycles¹⁵⁶.

The sexual difference is due to a protective action of the ovary, and a provocative action of the testicle, which is shown by experiments in castration and restitution. In rats with sub-total (95 per cent) pancreatectomy, early treatment with oestrogens produced a biphasic effect: first the incidence and severity of diabetes was increased in some cases, and later, diabetes was reduced or even definitely suppressed in many cases.

In force-fed rats, the appearance or intensification of glycosuria and hyperglycemia during oestrogen administration has been observed: (a) in rats with partial pancreatectomy^{88,152}; (b) temporarily in normal rats⁸⁸; (c) in rats with alloxan diabetes¹⁵⁷⁻¹⁵⁹; (d) in rabbits with alloxan diabetes, stilboestrol provoked a fall in hyperglycemia and glycosuria, but also a high mortality¹⁶⁰; and (e) rats with alloxan diabetes fed *ad libitum* showed a fall in glycosuria and body weight, with an increase in liver glycogen but no improvement of the diabetic state, when submitted to oestrogen treatment¹⁶¹. The diabetogenic effect of oestrogens has also been observed in sub-totally pancreatectomized-adrenalectomized rats maintained with sub-diabetogenic doses of cortical extract⁸⁹, and in some rats submitted to these operations but not given cortical extracts¹⁵². The intensity of the initial diabetogenic effect increases as the amount of pancreatic tissue diminishes; it is also dependent on the dose of oestrogen administered, and on the diet.

The following results have been observed in totally pancreatectomized animals treated with oestrogens: (1) attenuation of diabetes in dogs¹⁶²⁻¹⁶³, monkeys¹⁶⁴ and cats¹⁶⁵⁻¹⁶⁶; the results were striking in 40 cats, most of which died in hypoglycemia¹⁶⁶; (2) no effects were observed in monkeys¹⁶⁷ and dogs^{18,19}; and (3) increase in severity of diabetes in the ferret¹⁶⁸ and in rats (Martinez, unpublished data).

The protective effect of steroids against development of diabetes following sub-total pancreatectomy in rats was first demonstrated by injecting oestradiol for 6 months¹⁴⁹, oestrogens^{150-153,169} or corticosteroids⁹⁷ for several months. Androgens, on the contrary, caused an earlier appearance and increased the incidence and severity of diabetes.

In all these experiments, the incidence of diabetes was decreased by treatment with the following substances: oestrone, oestradiol, stilboestrol, mono-benzil-diethylstilboestrol, dienestrol, phenocycline, ethyniloestradiol and ethyniltestosterone. Androgens (testosterone and methyltestosterone) markedly increased the incidence and severity of diabetes in male and female castrates. The incidence of diabetes was not modified by treatment with deoxycorticosterone and 17-ethyldihydrotestosterone. Equilenine and progesterone were inactive in the doses tested¹⁰⁷; with much higher doses, diabetes was increased by progesterone and some related steroids¹⁷⁰.

Regression of alloxan diabetes was obtained by oestradiol plus insulin. All the control rats remained diabetic or died during the 6 months of observation. The animals treated with insulin were in good condition, but when insulin was discontinued, all of them became diabetic, and none was cured. Oestradiol benzoate produced, at the beginning, an aggravation of the intensity of diabetes, and some of the animals died. Afterwards, a curative action was produced, and in 47 per cent of the rats, hyperglycemia and glycosuria disappeared. The injections were discontinued after 6 months, and the curative effect was maintained for 3 to 4 months.

With oestradiol and insulin, the curative action is more marked; it was observed in 21 out of 31 rats (65 per cent). In this type of treatment, insulin prevents the harmful effect of hyperglycemia on the beta cells of the islets of Langerhans; this allows the active agent used, in this case oestradiol, to exert its curative action.

The mechanism of the initial actions of oestrogens is still obscure. The diabetogenic action of diethylstilboestrol is not due to increased secretion of adrenal hormones, but the presence of cortical hormones is a conditioning factor (essential in many experiments) for this metabolic response. The diabetogenic effect is produced by diethylstilboestrol in sub-totally pancreatectomized rats after adrenalectomy or adrenalectomy-hypophysectomy, if they are maintained by constant sub-diabetogenic doses of cortical extracts⁸⁹; and in a few cases, in another strain of rats, a slight diabetogenic action was present although no cortical treatment was given¹⁵².

Temporary diabetes has been produced in rats by oestrogens, but permanent meta-oestrogenic diabetes has not been observed in the rats. Intolerance to oestrogens and death has precluded, until now, long-term experiments in dogs. Temporary oestrogen diabetes in rats was obtained only if the quantity of food was not decreased⁹⁰.

The preventive action of oestrogens in sub-totally pancreatectomized rats is not due to a difference in the amount of food ingested. With the same ingestion of food by forced feeding, the preventive action appears only in animals treated with oestrogens, and not in non-treated controls¹⁵². Oestrogens increase the weight of the hypophysis but reduce many hypophyseal functions. This may play a part in the mechanism of the preventive action of oestrogen treatment.

The administration of oestrogens in rats increased the weight of the adrenals. However, the protective action could not be attributed to the adrenals as it occurred in sub-totally pancreatectomized rats, already diabetic, which were then adrenalectomized¹⁵².

Action of oestrogens on the pancreas — The protective action of oestrogens seems to be due chiefly to the fact that they produce hypertrophy and hyperplasia of the islets of Langerhans and beta cells in the pancreas. The protective action is observed in the diabetes resulting from sub-total pancreatectomy^{169,171,172} but not in that resulting from total or almost total pancreatectomy (Martinez, unpublished data).

Hypertrophy and hyperplasia of the islets have been observed in hypophysectomized rats with sub-total pancreatectomy after oestrogen treatment¹⁷³.

The insulin content of the pancreas is similar in rats of both sexes and is not changed by castration^{121,174} but there is more insular tissue in the female pancreas of guinea-pigs¹⁷⁵ and rats¹⁷⁶.

Oestrogen treatment increases the insulin concentration in the rat pancreas^{19,174,177-179} but not in the hypophysectomized rat¹⁸⁰. An increase of insular tissue^{171,174,181-184} and histological signs of hyperactivity of the beta cells¹⁸⁵ have been observed.

In sub-totally pancreatectomized rats with diabetes, there is degranulation and vacuolization in the beta cells, their number decreases, and there is atrophy of the islets. In animals that do not become diabetic or recover after temporary diabetes, sub-total

pancreatectomy is followed by compensatory hypertrophy of the islets of Langerhans, accompanied by sclerosis in other parts of the pancreas. This hypertrophy may be considerable after one year or more.

The female rat has a greater volume of islet tissue than the male¹⁷⁶. After sub-total pancreatectomy, incidence of diabetes is less in females than in males, but females show hypertrophy and hyperplasia of the islets of Langerhans more often than the males. Oestrogens produce a rapid and marked hypertrophy of the islets with the formation of new islets^{169,171,183}. Reviews of these findings have been published by Rodriguez^{153,154} and Houssay^{50,51,186}. The appearance of diabetes in sub-totally (95 per cent) pancreatectomized rats is prevented by treatment with oestrogens or propylthiouracil. When both substances are given, their protective effects are additive. There is, however, a considerable difference between results obtained with each substance alone when treatment is discontinued after 3 months. Rats treated with oestrogens have hypertrophy and hyperplasia of the islets and do not later become diabetic. Rats treated with propylthiouracil rapidly become diabetic after treatment is discontinued; the protective metabolic action ceases, and there is little or no hyperplasia of the islets. Rats given both substances lose the protective effect of thiouracil when treatment is discontinued, but retain that which has been induced by oestrogen¹⁸⁷.

The hypertrophy and hyperplasia of beta cells and of islets of Langerhans may be due both to an indirect and to a direct action. A direct action was observed after intrapancreatic implantation of oestradiol into normal rats, guinea-pigs and cats, which showed first hyperplasia of the centro-acinar cells, then, newly formed islets containing hypertrophied beta cells. The formation of new islet tissue was more pronounced in parts near the oestrogen implant¹⁷².

It is very important to emphasize that the protective action of oestrogens is produced only after rather prolonged treatment. The effect is clear after 3 months, and more marked after 6 months. The factors which stimulate hypertrophy and hyperplasia of the islets are not known. This action can be due to: (a) variations in the blood content of insulin, glucose or other metabolic substances; (b) direct or indirect effect on the hypophysis

and other endocrine glands; and (c) direct or indirect effect of oestrogens on the metabolism of the tissues or islets.

Many incomplete studies, specially of acute changes, have been performed on some phases of the metabolic actions of sex hormones, but a complete study of the changes in tissue metabolism, after prolonged treatment, is still lacking.

Estrogens and human diabetes — In the human species, diabetes is more common in women than in men, with an increase from the fourth decade of life onwards. Estrogen treatment of human diabetes has given contradictory results. Improvement has been observed in cases of diabetes in menopausal women, but not in others¹⁴⁸.

In six acromegalic diabetics, high doses of estrogen caused marked improvement of diabetes¹⁸⁹. In one-fourth of pregnant diabetic women, estrogen treatment diminished the severity of diabetes and improved the insulin requirement (White, personal communication).

SUMMARY

The metabolism of carbohydrates is related to that of fats and proteins. They are all governed by a balance between the different hormones which have metabolic activity.

Diabetes is a disturbance of carbohydrate metabolism, in which the normal balance of the hormonal regulating factors is altered.

The role of the peripheral tissues is incompletely known. The hormonal factors have an important role, direct or indirect, on the utilization of glucose by the tissues.

In this regulation, the liver plays the most important part, since it is the organ which produces glucose and thus governs the blood sugar under the influence of the hormone equilibrium. If the liver is absent, diabetic hyperglycemia cannot occur.

The secretion of each hormone is regulated and there is a reciprocal equilibrium between them.

The endocrine secretion of the pancreas has a fundamental role since it maintains the blood sugar at a normal level and prevents its increase, and influences the production and consumption of glucose. The secretion of insulin is governed by the level of the blood sugar and vice versa. The central nervous system is not necessary for the secretion of insulin, but the vagus has a

secondary and accessory role causing a more rapid and perfect correction of changes in the blood sugar.

The presence of the anterior pituitary hormone prevents hypoglycemia and the decrease of glycogen during fasting diminishes the action of hypoglycemia agents, and is necessary for the development of diabetes in all its intensity. An excess of anterior pituitary hormones increases diabetes or even brings about a diabetic state (even when the adrenals, thyroid or pituitary are absent) which can be transitory (hypophyseal diabetes) or permanent (metahypophyseal diabetes). It greatly increases the resistance to insulin even when the pancreas is absent and causes a decrease in the endocrine secretion of the pancreas.

The lack of adrenal cortex brings about a gradual decrease of glycemia and glycogen in fasting. The intensity of pancreatic diabetes is markedly decreased. Cortical hormones correct all these disturbances and in high doses can produce a transitory diabetes. In dogs with reduced mass of pancreas, even a permanent diabetes (metacorticoïd diabetes) can be obtained. Adrenalectomy in man produces amelioration of glucose tolerance, or of diabetes and even cures some cases of diabetes in hypercorticalism.

The thyroid hormone increases intestinal absorption of glucose and rapidity of utilization of glycogen. Treatment with thyroid hormone does not produce diabetes in normal animals. In dogs with reduced mass of pancreas, thyroid treatment can produce transitory or even permanent diabetes. Thyroidectomy has a preventive action on diabetes of sub-totally pancreatectomized rats; it has no clear action on diabetes in dogs; it can diminish the intensity of diabetes in human beings.

Sex hormones have a definite action on the evolution of diabetes consecutive to sub-total pancreatectomy in the white rat. The ovary or estrogens diminish the frequency of this diabetes; the testicle or androgens increase its frequency and severity. A combined treatment with estrogens and insulin produces regression of a large proportion (65 per cent) of alloxan diabetes. Estrogens produce hyperplasia of islets and increase of insulin and also some action on pituitary and other glands.

In the endocrine equilibrium, any hormone can have synergic, antagonistic, condition-

ing or regulating action in respect of other hormones.

In all forms of diabetes there is an insufficiency of insulin in relation to the needs of the organisms. The deficiency is absolute when there is lack of insulin secretion. The deficiency is relative (a) when the secretion is diminished; (b) when the secretion is normal, but the requirement of insulin is increased; and (c) when there is resistance to insulin.

In diabetes there is also an imperfect regulation of the endocrine secretion of the pancreas, since it cannot adjust itself to the needs of the organism in order to bring about a normal sugar level.

In all forms of diabetes, pituitary and adrenal secretions, whether normal or not, augment diabetes. All the endocrine glands play a part in all diabetic states, either directly because of their specific function or through their influence on other organs. The importance of these actions has not yet been established.

The various forms of experimental diabetes are due to the destruction of the normal equilibrium of all these factors. With time, it is hoped, it will be possible to establish what equilibrium exists in the various forms of diabetes met with in human beings. This knowledge should give us a firmer basis for the exact diagnosis and treatment of these cases.

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HOUSSAY: DIABETES AS A DISTURBANCE OF ENDOCRINE EQUILIBRIUM

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Research & Engineering in Jena Zeiss Works

HUGO SCHRADER

Works Director, VEB Carl Zeiss, Jena

THE unique position held by the Jena Zeiss Works in the research, development and construction of opto-fine-mechanical instruments has its root in the specific accomplishments of three pioneers — Carl Zeiss, Prof. Ernst Abbe and Dr. Otto Schott.

By adopting in his 'Optical Workshops' (established in 1846 in Jena, Eastern Germany) the "rational method of constructing technical products for physical effects", Carl Zeiss initiated a development which covered the entire field of practical optics and, by perfecting the working methods and refining the implements for the regulation and control of practical work, he imparted to his workshop the character of an 'Academy of Subtle Technical Arts'.

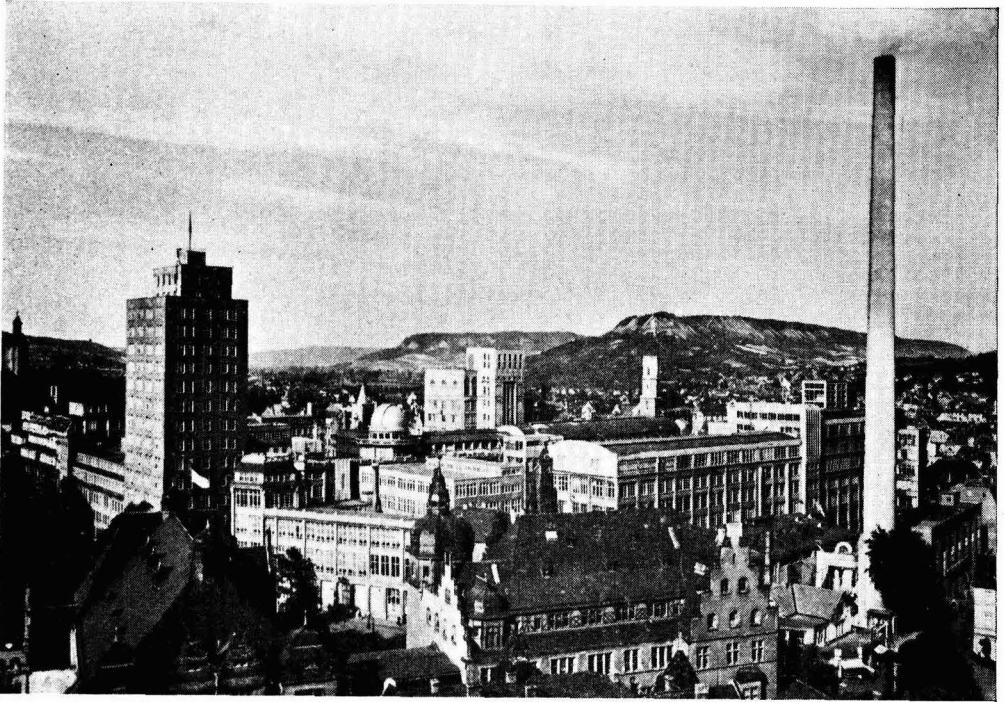
As the first scientific collaborator of Carl Zeiss, Prof. Abbe enunciated the theory of the microscope and of optical instruments in general. He laid down the principles of geometrical optics and the laws governing the limitation of rays by apertures. He thus became known as the originator of modern optics and — by introducing and consolidating in the Jena Zeiss Works an intimate co-operation between scientific and practical work — as the reformer of practical and technical optics.

In collaboration with Ernst Abbe and Carl Zeiss, Dr. Schott — in the JENAer Glaswerk Schott & Gen. — succeeded in the production of new kinds of optical glasses and in introducing those scientific glass-making methods which alone made it possible to advance opto-scientific instrument manufacture to its high standard.

In the course of four generations of uninterrupted service on the part of Zeiss scientific investigators, engineers and highly qualified craftsmen, there has been amassed a steadily increasing abundance of knowledge and experience, capability and talent and of routine and innovation forming that proverbial 'Jena Climate' which now as before

provides so invigorating and creative an atmosphere for research and the building of scientific instruments. Established 110 years ago, the Jena Zeiss Works now employ 18,000 people and represent not only the largest but also the most important optical enterprise of the world as regards the range and volume of their opto-fine-mechanical and physico-technical manufacturing programme. This remarkable rise and worldwide reputation the Zeiss works owe to the unsurpassed and continuously improving quality and performance of their products, which are the final results of intensive research work and which, pursued on a broad basis, also includes research on fundamentals. The entire field of research and investigation of the Zeiss works is determined by the scientific branches of physics, mathematics, chemistry, biology, mineralogy and medicine.

The increasing demand on the part of research and industry calling for the employment of microscopy, photometry and spectroscopy in the invisible regions of the spectrum prompted the Zeiss works to devote special efforts to the design and development of instruments for all wavelengths. Since in the invisible regions the eye must be replaced by objective types of radiation receivers as indicating devices, such as photocells, multipliers or thermocouple elements, the Jena Works included also these in their research and manufacturing programmes. In addition to optical microscopy, their classical field, the Zeiss Works have developed electron microscopy and have provided instruments permitting direct vision in the region of large, organic molecules, such as viruses, for studying the finer structural details of cells, and affording an insight into the fine structures in other provinces which could not be rendered visible by optical microscopy. There is a staff of excellent physicists who devote specialized attention to the design of new



VEB CARL ZEISS JENA MAIN WORKS

instruments and appliances in the fields of physics of solids and wave physics, emission research, electron optics and physical chemistry.

Opto-finemechanical and physico-technical instruments leaving the Jena Zeiss Works have long been known for their excellent performance, not only in the laboratory or in the measuring room when using them with every care and under even temperature conditions, but, traditionally, they are expected to operate with invariable precision if handled less carefully and under adverse climatic conditions. They include instruments whose single components are made and assembled to an accuracy amounting to fraction of a micron (0.00004 in.) but which, in practical work, are exposed to temperatures ranging from $-30^{\circ}\text{C}.$ to $+60^{\circ}\text{C}.$ without their functions being impaired. They are expected to render the same reliable service in the arctic and icy wastes of highest mountain regions, as in the salty air of the equator or in tropical humidity, and are to stand up equally well in the dry and dust-laden air of

the desert as in the moist and often acid-containing air of underground mines.

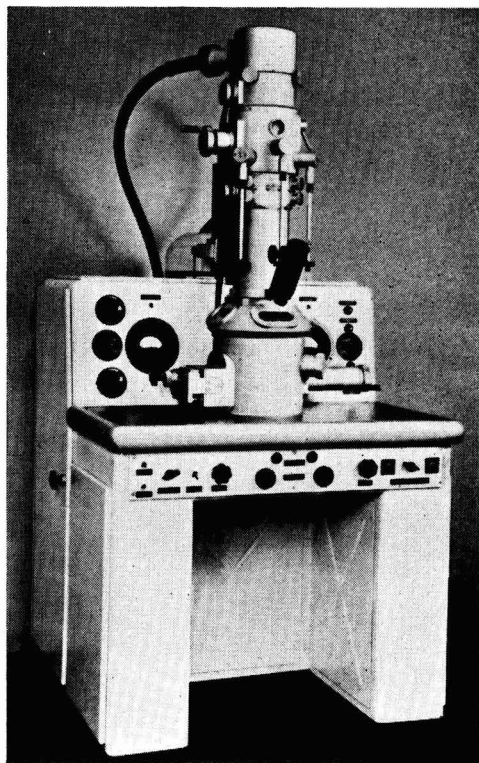
It is this constancy and matter of course behaviour under most exacting conditions which earned for Zeiss instruments made in Jena the worldwide reputation they enjoy.

Zeiss instruments are in use in research institutes, industrial laboratories and workshops, surveying offices, clinics and hospitals as well as in many cultural centres in the eastern and south-eastern countries of Asia. Supplied in steadily increasing numbers to China, India, Pakistan, Indonesia, Malaya, Burma, Ceylon, etc., they render indispensable service in surveying and in topographical and cartographical registration of wide tracts of land, including inaccessible jungles or mountain ranges.

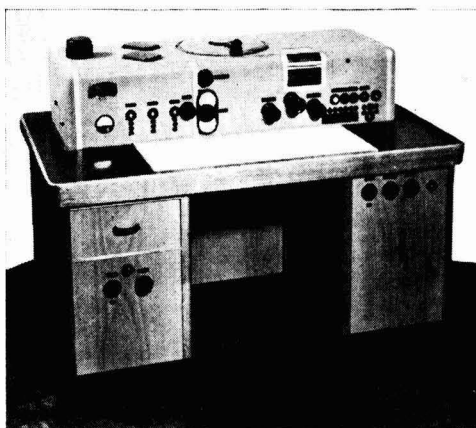
Microscopes made in Jena form a major part of Zeiss exports to the Far East and south-east Asia. There is a particular demand for the medical research type 'Lumipan' as also for the 'Neophot', reputed to be the finest camera-microscope for metallographical purposes, together with

the convenient test strip attachment and the 'Citoplast' microscope for a variety of stereoscopic observations. At the 1955 Leipzig Fair, the new Polarizing Microscope, 'Polmi A', aroused special interest. Being for the first time equipped with plane-field optics furnishing a remarkably large visual field, the new microscope is particularly well suited not only for mineralogical and petrographical purposes, but is equally well adapted to chemical industries, as also for medical and biological work with particular reference to cellular research.

Whereas the maximum obtainable magnification in optical microscopy is about 2,000 diameters, the Jena Electron Microscope 'Elmi D 2' furnishes a series of magnifications of 2,000, 6,400, 8,000, 12,000, 20,000 and 28,000 diameters which may be subsequently increased by a $5\times$ auxiliary microscope, thus resulting in a maximum magnification of 150,000. An outstanding feature of this instrument is the unique preservation



ZEISS ELECTRON MICROSCOPE TYPE 'ELMI C'



ALL-AUTOMATIC INFRARED RECORDING SPECTROPHOTOMETER 'UR 10'

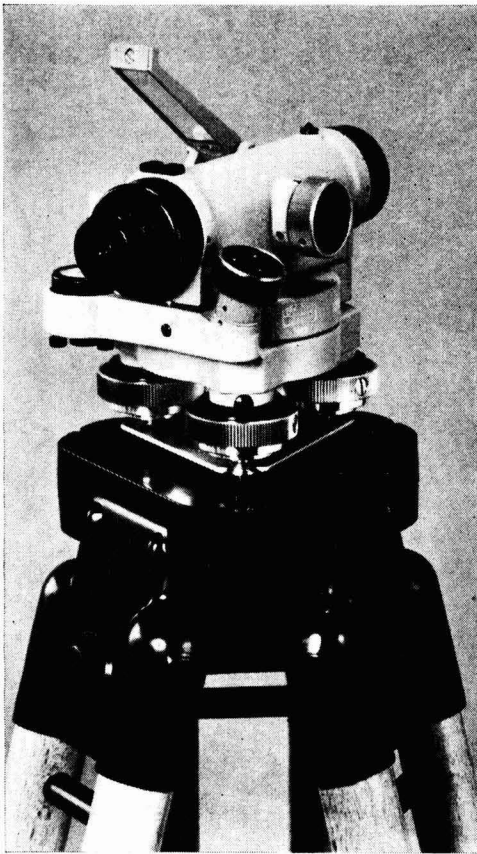
of the image in the centre of the field when changing the magnification.

The physico-optical line of Zeiss measuring instruments includes the Abbe Food Products and Dipping Refractometers, Interferometers, either stationary for laboratory use or portable for mine gas examination. They are supplied for numerous fields of application: in medicine, in veterinary clinics, food-examination offices, chemical and technical institutes, industrial and metallurgical laboratories and mines. Another notable instrument in this branch is the Schlieren Apparatus which adapts itself to a wide range of thermo-, aero- and hydrodynamical problems as well as in technological and medical research as well as to electrophoresis and diffusion work. Other instruments in this field which are exported are the well-known Pulfrich Photometer and the different equipment for spectrochemical emission analysis, viz. the Quartz Spectrograph 'Qu 24', the Spectrum Projector, the Rapid Photometer and the Abbe Comparator. Of the new models of instruments developed in the field of spectrochemical analysis, the All-automatic Infrared Recording Spectrophotometer UR 10, covering the spectral region from 1 to 25μ , attracted particular attention at the 1954 Leipzig Fair and represented one of the export attractions at the Leipzig Fair in the spring of 1955. The same applies to the Zeiss Projection Electrometer and to the Electrical Indicating Devices for measuring radiations with various types of receivers.

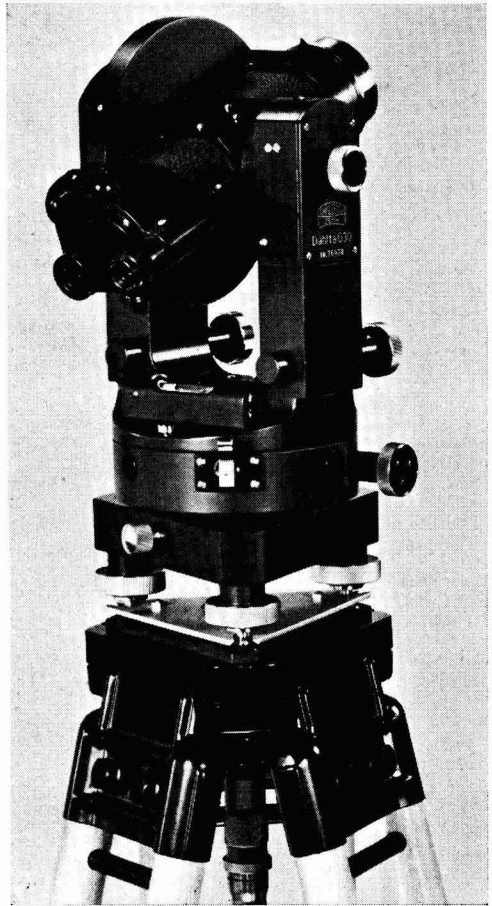
They are designed for use in the Zeiss Universal Spectrophotometer with interchangeable quartz, glass and rock-salt optical units for the ultraviolet, visible and infrared regions of the spectrum.

Zeiss exports of surveying instruments to east and south-east Asia are now assuming proportions approaching the limit of the Jena production capacity, more especially where such instruments as the Seconds Theodolite 'Theo 010', the Theodolite '030' and the Engineers' Level 'Ni 060' are concerned.

The Theodolite '030' is now being equipped with Logarithmic Tacheometer Wedge, 'Lotakeil' — an innovation permitting the direct optical measurement of distances up to 600 m. with an accuracy of ± 3 cm. for 100 m. and of ± 15 to 20 cm. for



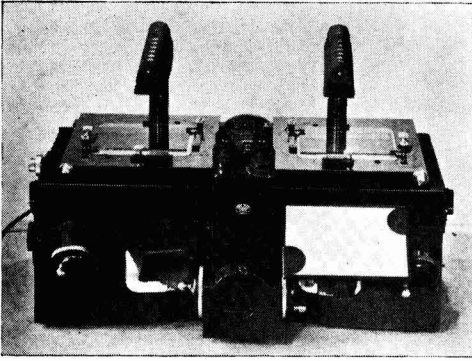
ZEISS DUMPY LEVEL 'Ni 060'



REDUCING TACHEOMETER THEODOLITE
'DAHLTA 020'

600 m. The 'Lotakeil' may also be used in conjunction with the Reducing Tacheometer 'Dahlta 020'. This innovation places at the disposal of the surveying profession an optical distance-measuring equipment affording large-scale traversing work to be carried out optically at a considerable saving in time.

The Jena surveying instruments production schedule further provides equipment for terrestrial and aero-photogrammetry, including the 'Phototheodolite 19/1318', 'Stereocomparator 1818' the Reflector Stereoscope with Tracing Stereometer and Stereoaugraph '1318'. The latter is designed for the line plotting of photograms taken with the Phototheodolite and repre-



STEREO COMPARATOR 1818 MODEL

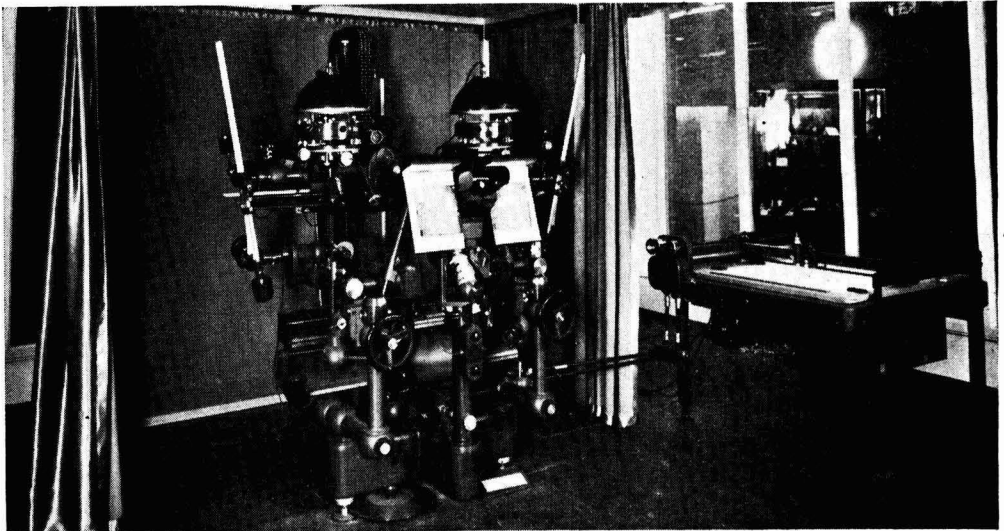
sents the most suitable and economical instrument for ground photogrammetry.

For large-area topographical and ordnance surveys the aero-photogrammetrical method is not only the most time-saving, but also the most exact and economical procedure. To obtain the necessary air-photo plan, or mosaic, the oblique aerial photographs taken with an aerial surveying camera require to be rectified, i.e. they are converted into strictly vertical photographs to the prescribed scale with the aid of the Zeiss All-automatic Rectifier 'SEG I' and are then conveniently composed to form the complete air-photo plan from which the final map is plotted by

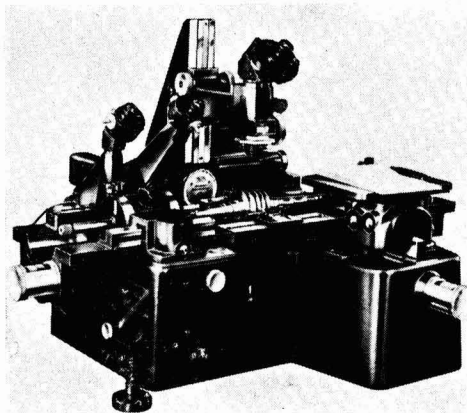
the Stereoplanigraph. The latest model of the Stereoplanigraph built in the Jena Zeiss Works is a stereoscopic type of plotting machine, which to an astonishing degree of accuracy attends to all plotting and mapping operations and truly represents a universal plotting machine of highest quality and performance. It is a top-flight product of the German opto-finemechanical industry.

To keep abreast of the drastic changes in manufacturing methods which occurred during the past generation, when production assessed by human judgement and based upon experience was gradually replaced by modern engineering methods known as 'interchangeable manufacture', the Jena Zeiss Works developed those particular tools and instruments which are indispensable for satisfying the much narrower limits of permissible variability and which provide the scientific basis of interchangeable manufacturing methods.

In keeping with the Zeiss tradition the new Fine-limit Measuring Instruments soon shared the same excellent reputation with the remaining opto-scientific products turned out by Jena and now represent a main item of the exports of the Jena Works. They cover the entire range of precision tools from the Optical Bevel and Optical Gear Tooth Micrometer up to the Universal Measuring Microscope and to the Interference Co-n-



STEREOPLANIGRAPH

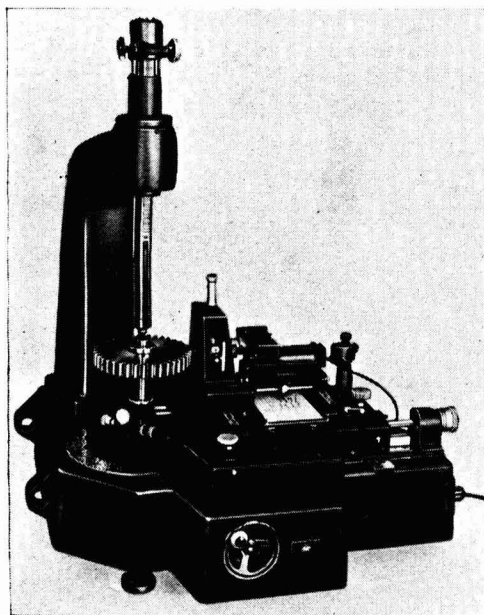


UNIVERSAL MEASURING MICROSCOPE

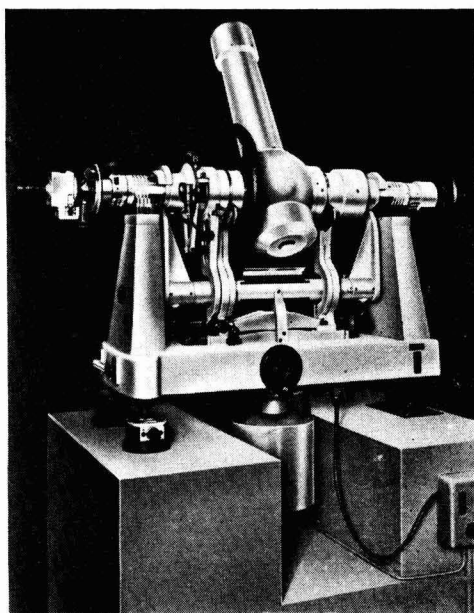
parator permitting the determination of one hundred thousandth of a millimeter. They include Dial Gauges and Micrometers as well as Mechanical High Precision Indicators, Master Gauge Blocks, Universal Metroscopes and the Involute Gear Tester, thus offering a well-considered and comprehensive system of testing and checking means forming the scientific basis and prerequisite for quality production.

Astronomical instruments, Observatory Domes and Zeiss Projection Planetaria, have largely contributed towards consolidating the worldwide reputation of the Jena enterprise. The manufacturing programme of this department ranges from telescopes of imposing dimensions for research purposes down to the small sizes for amateurs. It contains, to cite a few, such instruments as Refracting and Reflecting Telescopes, Astrographs, Spectrographs, Coelostats, Comet Finders, Transits, Co-ordinate Measuring Instruments, Blink Comparators and many others. One of the outstanding products in this line is the 1.20 m. Schmidt Reflecting Telescope built in 1954 for the Hamburg-Bergedorf Observatory, and a second one of 2 m. for the German Academy of Science is now nearly complete and will be the largest Reflecting Telescope with the exception of the Mt. Palomar telescope in the United States of America.

Zeiss Planetarium Projectors operated in pre-war times in many capital cities of the world were in post-war years supplied to Stalingrad, Prague and Stalinogrod (Poland). One such is to be erected soon in Peking, while the order for a second one for the People's Republic of China is expected.

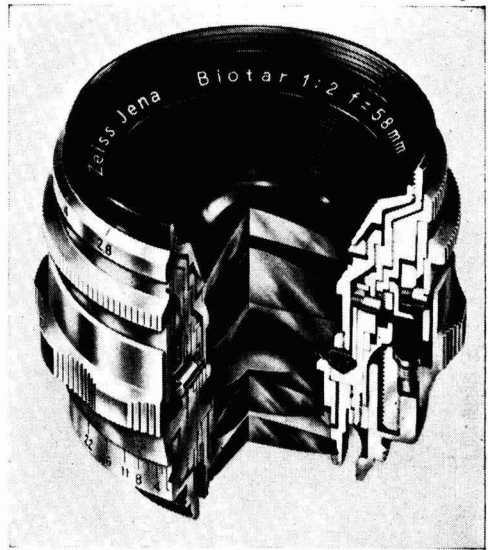


ZEISS INVOLUTE GEAR TESTER

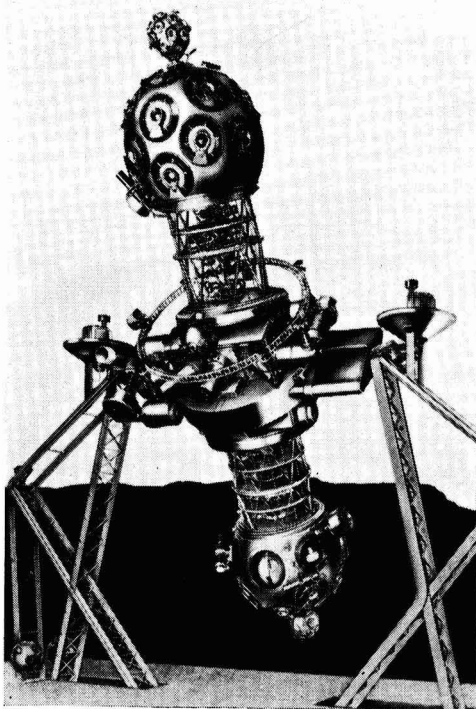


TRANSIT INSTRUMENT

The Opto-medical Division of the Jena Zeiss Works has been for years supplying to eastern and south-eastern countries of Asia microscopes for medical and bacteriological work as well as specialized equipment for surgery, gynaecology and ophthalmology. The shadow-free operating room illuminant 'Pantophos 800', which is now provided with a new swivelling device for convenient illumination in any direction, is practically devoid of heat radiation and automatically switches over to a secondary battery should the main supply system fail. An instrument claiming particular attention is the Colposcope I facilitating the early discovery of latent growths and pathological degenerations. Other instruments supplied by the Opto-Medical Division include Slitlamps, Ophthalmoscopes, Retinal Cameras as well as the Hartinger Coincidence Refractometer and the Adaptometer. Zeiss ophthalmic lenses, introduced as Zeiss Punktals, or



SECTIONAL VIEW OF THE ZEISS PHOTO LENS 'BIOTAR'



LARGE MODEL PLANETARIUM PROJECTOR

protective types known as Zeiss Uro-Punktal and Zeiss Umbral lenses represent a continuously growing export item.

Ever since their first appearance in the nineties, Zeiss Prism Binoculars proved to be a source of satisfaction to a multitude of owners in all parts of the world. Their popularity made them a synonym of the name 'Zeiss'. Other products of this group are the Zeiss Theatre Glasses and Rifle-sight Telescopes.

Zeiss Photographic Optics include recording, processing and projection types of lenses used in every branch of scientific research, industry and by thousands of amateur photographers. Equipped with Jena lenses, the new Zeiss 'Werra' camera attracted particular attention at the Leipzig Fair of 1955. Embodying new technical features and selling at a reasonable price, this camera is rather an attractive investment for amateurs. For domestic recreational and cultural entertainment the Zeiss production programme carried several types of portable cinema projectors which in the last few years have been enjoying a constantly growing popularity.

Dr. Irene Joliot-Curie (1897-1956)

WE regret to announce the death of Dr. Irene Joliot-Curie, French Physicist and Nobel Prize winner, on 17 March 1956 at the age of 58.

Dr. Irene Joliot-Curie was born in Paris on 12 September 1897. After passing her Baccalaureat in 1914, Irene Curie registered at the Faculty of Sciences, but for the entire duration of war, she devoted herself mainly to the X-ray service directed by her mother and participated in the equipping and maintenance of the Red Cross radio-electric material in the war zones. As soon as the war ended, Irene Curie entered the Radium Institute as her mother's laboratory assistant. She completed her higher studies and obtained a 'Licence es Sciences Mathematiques et Physiques' in 1920.

Dr. Irene Curie began her scientific work in 1921 with the study of chlorine isotopes. She then launched into research on the radioactivity of radium and polonium and with a thesis on *Research on the 'alpha' rays of polonium, fluctuation of their course, speed of their release, their ionizing power*, she obtained her doctorate in 1925.

Irene Curie married Frederic Joliot in 1926 and from then on worked in close collaboration with her husband. Various experiments relating to the study of 'alpha' radiation led her to seek new methods, which turned out to be extremely useful in the accumulation of relatively important quantities of radium 'D' and of polonium extracted from radium, and for the purpose of preparing sources of absolutely pure and high intensity polonium. Later she collaborated with her husband in research on the projection of atomic nuclei, which led to the discovery of the neutron and then to proof of the materialization of purely electromagnetic radiation, as well as the existence of artificially induced radioactivity. It was for these last-mentioned experiments that she and her husband received the Nobel Prize for Chemistry in 1934.

After working for two years as Director of Research at the Radium Institute, Irene



DR. IRENE JOLIOT-CURIE

Joliot-Curie became a member of the International Radium Standardization Commission in 1934 and in 1935 occupied the post of Director of Research at the National Council for Scientific Research. A member of the Executive Committee of the Astrophysical Research Service, she was first appointed Reader

at the Faculty of Sciences of Paris University in 1937 and Professor during the same year. In 1939 she became a Member of the Higher Council for Scientific Research and in 1946, when the French Atomic Energy Commission was set up, she became one of its four Directors. In 1947 she succeeded Prof. Debierne as Director of the Radium Laboratory and was appointed Titular Professor at the Sorbonne University. Dr. Irene Joliot-Curie held the post of Under-Secretary of State for Scientific Research in 1936.

A member of numerous scientific societies, Irene Joliot-Curie was a Foreign Corresponding Member of the Belgian Royal Academy of Medicine, the National Academy of Sciences, India, and the Academy of Sciences of the U.S.S.R.

Dr. Irene Joliot-Curie is the author of 54 scientific works, of which some were produced in collaboration with her husband. She has also published a major treatise on *The Chemistry of Natural Radio-Elements*.

Dr. Irene Joliot-Curie was awarded the 'Medaille de la Reconnaissance Francaise' (Medal of French Recognition) in 1918 and had been an Officer of the Legion of Honour since 1939.

Chemical & Textile Standards Convention

THE Chemical and Textile Standards Convention, organized by the Indian Standards Institution at Bombay during 9-15 January 1956, was the second convention to be held. The first convention held in December 1954 at Calcutta was mainly concerned with certain fields of engineering and building industries. These conventions are organized with a view to focus public attention on problems of standardization in different fields of industry, and to assist the trade, industry and the organized consumer sector, to a better appreciation of the nature of the problems involved and the ways in which they could be resolved.

The convention, which was attended by about 600 delegates, was inaugurated by Shri T. T. Krishnamachari, Union Minister for Commerce and Industry, and Iron and Steel.

The convention was divided into three sessions on Textile Industries, two on Chemical Industries, and three joint sessions on Introduction of Metric System of Weights and Measures in Indian Industry, ISI Certification Marking and Statistical Quality Control. Sixty-four papers were presented.

Textile session

Shri Nityanand Kanungo, Minister for Industry, Government of India, presided over the session. The subjects discussed were: (1) Standardization and the handloom industry; (2) Textile standards and the consumer; and (3) Standardization of materials used by the textile industry.

Eight papers were presented on the subject of standardization in handloom industry which discussed the difficulties the weavers of handloom cloth were undergoing, the remedies to overcome them, and ways and means of controlling the quality of handloom cloth. The main handicap of weavers, it was pointed out, was the difficulty in obtaining the correct quality of yarn and good quality dyes and chemicals. The shades obtained for the cloth are not uniform and the cloth produced lacks uniform texture and finish. The supply of known qualities of yarn, standard dyes and

chemicals, and facilities for dyeing and testing at convenient centres were some of the measures suggested to overcome the handicaps facing the industry.

Textile standards and the consumer — Mr. J. C. Burns, Vice-Chairman of the Mill-Owners' Association, Bombay, presided. Seven papers were presented to this session. The subject of standards in cloth manufacture aroused considerable interest. It was unanimously agreed that standards should be used to regulate the quality of textile fabrics.

In one of the papers it was pointed out that the present method of marking cloth is not satisfactory, and certain necessary information regarding cloth in the finished state, which is necessary to safeguard the interest of the consumer, was lacking. Short life of cloth, shrinkage, colour fading and other defects are some of the complaints of the consumers. There is, therefore, a need for an organization which is in close contact with the consumers and the processors to see that the consumer obtains cloth with satisfactory qualities such as wearing property, durability, quality, colour, etc. Several suggestions were put forward regarding the standardization of cotton textiles, such as introduction of self-explanatory marks, stamps, labels, and a 'consumer service through informative labelling'.

Standardization of materials used in textile industry — This session was held under the chairmanship of Shri G. D. Somani, President, Mill-Owners' Association, Bombay. Six papers were presented.

Most of the textile mill requirements such as chemicals, mill stores and accessories, which were previously imported, are now manufactured in the country, but the quality of the materials needs further improvement if they are to be accepted by the consumer without any reservation. Six papers were presented to this session which dealt with (1) Physico-chemical properties and quality of rayon; (2) Standardization of vegetable tallow; (3) Review of Indian Standards;

(4) Standardization of bobbins; (5) Problems relating to standardization of materials with special reference to processing conditions and performing conditions; and (6) Standardization of starch.

Chemical session

Methods of sampling and analysis — Shri C. R. Rao, General Manager, Tata Chemicals Ltd., Bombay, presided.

The papers presented to this session were grouped under two heads: (1) Methods of sampling and analysis; and (2) Composition versus performance specifications for chemical industries.

Methods of sampling and analysis — Of the nine papers presented to this section, four dealt with sampling of coal and coke, two with manganese ores and the others with Orissa graphite, marine salts and applications of complexones respectively.

The paper on methods of sampling coal for the cement industry discussed the measures by which sampling could be made more reliable. They are: (1) installation of washing and screening plans at the collieries; (2) installation of mechanical arrangements for subdivision of gross samples; (3) automatic sampling; and (4) sampling of coal as used. In the paper on methods of sampling and analysis of coke and coal, it was shown that errors due to analysis, by different persons, in different laboratories, were not as great as errors due to sampling procedures at different stages, and lack of effective sampling procedures alone lead to wrong evaluation of coal.

During the discussion of the paper "Characteristics of Orissa graphite", it was pointed out that the physical properties of graphites are more important than their chemical composition, and that it would be desirable to lay down different standards for graphites for different uses.

The suggestion to modify the sampling procedure as prescribed in IS: 253-1951 for common salt, and to adopt the quick-assay method developed by the Central Salt Research Institute, Bhavnagar, for the analysis of common salt was discussed in one of the papers. It was considered that the modified sampling method would not be quite suitable when large heaps of salt are handled. It was proposed that the quick assay method should be examined further with a view to adopt it as an alternative method for routine analysis.

Composition versus performance — Col. A. N. Kapur, Chief Superintendent, Technical Development Establishment, Kanpur, presided over the session dealing with composition versus performance specifications in chemical industries.

The usefulness of a particular material cannot be easily judged on the basis of its composition or performance. Composition specifications demand critical analysis of samples. The disadvantages of such a method lie in making the specification too rigid and in not allowing any initiative on the part of the manufacturer to improve the product. The advantage lies in the uniformity of the product manufactured. Performance specification tests are usually time-consuming, but they do not enforce uniformity of product. It is, therefore, difficult to lay emphasis on either of the specifications, but a composition specification with a reasonable direct or indirect performance test is generally a more easily workable basis.

While discussing the paper on specifications of lubricating oils, it was pointed out that analytical tests, such as the copper strip test, would give misleading results, as discolouration of the strip is due to sulphur type of inhibitors added to the oil to improve its performance. Engine performance tests are considered to be more reliable. It was suggested that work should be carried out to correlate laboratory tests with engine performance tests with the help of radio isotopes. Though physico-chemical tests provide important indications of the performance of the oil, engine performance tests are essential. A composition specification was preferred because the ultimate product would be uniform and would also give a uniform performance. Engine oils of the same composition have been found to give, in some cases, different performance data. This is attributed to the presence of dissolved carbon suboxide.

On the subject of paints, it was emphasized that physico-chemical methods of paint evaluation gave reliable results. A single point practical method of evaluation was suggested to correlate paint performance with composition. It was also pointed out that performance data, in terms of physical and chemical characteristics of paints, investigated over a period of 5-10 years, would enable a better understanding of the performance specification and chemical composition.

The mobilometer was considered to give more reliable and consistent values for paint viscosity than the Ford Cup viscometer.

Composition specification for paints, it was observed, limited the initiative of the manufacturer, and it was, therefore, suggested that performance specification should receive more emphasis as it would give more latitude for the manufacturer in the choice of raw material.

A scheme for assessing the weathering resistance of paints by exposure tests, to be carried out at different centres in India, was proposed. It was pointed out that, under rigid conditions, a relation could be established between accelerated weathering tests and exposure tests.

Two of the papers presented to this session dealt with non-slip deck paints and anti-fouling paints used in the navy. The use of arsenic in anti-fouling paints was considered unnecessary as they do not give protection against barnacles. So far, there were no facilities for testing non-slip paints, but an apparatus has been recently set up at the Naval Headquarters, Bombay, for such testing work.

Introduction of metric system in industry

This joint session was held under the chairmanship of Shri Nityanand Kanungo, Minister for Industry, Government of India, who observed that the decision of the Government to adopt the metric system of weights and measures as the sole system along with decimal coinage should receive more publicity so that the great masses in the country could become aware of the impending change. A Standing Metric Committee had been established to advise the Government on the form of legislation, the phasing of the change and other matters connected with the introduction of the new weights and measures. A Bill for introducing metric system would be placed before the Parliament shortly.

Shri Pitambar Pant, who opened the discussion, pointed out that the following essential aspects of the problem of change-over to the metric system required discussion: (1) Nomenclature; (2) means of publicity; (3) question of standards, the way in which they can help in the smooth change-over; (4) proper phasing of the change-over; (5) conversion in Railways and Posts & Telegraphs Department — the most important industrial activities in the public sector;

(6) supply of weights and measures, maintenance of standards and organization of administration of reform; (7) general problem of replacement and/or modification of the existing equipment and problems of engineering; and (8) training of personnel by means of handbooks, conversion tables, education, etc.

Shri Pant was of the view that adoption of the international nomenclature in full would give maximum advantages, avoid confusion and bring India in line with other countries employing the metric system.

Statistical quality control

This joint session was held under the chairmanship of Lala Shri Ram, who observed that statistical quality control (SQC) could help the ISI in formulating realistic standards, and the industry in manufacturing standard goods of quality. He had found from experience that widespread use of SQC techniques led to significant economies in production coupled with improvement in quality without extra investment. Each industry, he observed, had problems peculiar to its own and has to deal with them individually. Explaining the usefulness of SQC techniques in the formulation of standards, he emphasized the distinction between the design and acceptance clauses in a standard. Widespread use of control charts gives a quantitative estimate of the range of variation of different quality characteristics of a product during manufacture. This information can be used to arrive at the quality limits of different characteristics of a product to be specified in design clauses in the standard. Quality limit of existing standards can also be revised on the basis of performance data collected by the industry to make standards more realistic. The acceptance clauses, which include the method of sampling and method of interpretation of test results of samples for ascertaining conformity of a lot, can only be based on the theory of probability, which is one of the techniques of SQC.

Dr. S. Vaswani, inaugurating the discussion, stressed the importance of carrying out tests, based on scientific principles, for the determination of the quality of raw materials, accessories and stores needed by each industry. The SQC techniques, she said, would be of considerable assistance in this respect as they would indicate the number of samples to be tested by the buyer

and how the test results should be interpreted to arrive at correct decisions. The SQC techniques are different from the conventional methods of quality control. In the latter, the quality of products is controlled only at the inspection stage by eliminating defective goods, but the former is meant to reduce the production of defective goods by controlling the quality of products at various stages of manufacture.

Regarding the role of SQC in the formulation of standards, it was pointed out that the limits of quality characteristics and their allowable range of variation should be specified in standards after proper study of actual conditions existing in industry. In conclusion Dr. Vaswani observed that SQC seldom yielded spectacular results if introduced in a haphazard way and that it should be introduced as a whole. Another important prerequisite for the success of SQC was the training of personnel in the factories engaged in the work. Experience has shown that maximum benefit of SQC is derived only by those factories where the management, technicians, operatives, etc., had clear ideas of the basic principles underlying SQC.

In the discussion that ensued, the various applications of SQC in chemical and textile industries were presented, and the use of SQC in standards for laying down acceptance clauses were advocated.

Certification marking

This session was held under the chairmanship of Shri K. R. Damle, Chairman of the Tariff Commission.

The chairman observed that the Government of India and the State Governments had formally decided to implement Indian Standards for the purpose of Government purchases, and what was now necessary, was the implementation of the standards on a nation-wide scale. He observed that industry and trade should work for industrial self-regulation in public interest through general adoption of standards. If industry

and trade volunteered for self-regulation, the task of the ISI would be considerably lightened. Shri Damle also pointed out that the Tariff Commission, as a rule, always recommended the formulation of Indian Standards in the case of those industries which seek protection.

Initiating the discussion, Dr. Venkateswaran gave an interesting account of the use of trade marks and certification marks dating from the Roman Period. He observed that the ISI (Certification Marks) Act, 1952, could be improved in order to further protect the Certification Mark of the ISI. Dr. Venkateswaran suggested that the Standard Mark of the ISI should be registered as a Certification Trade Mark under the Trade Marks Act, 1940, as it would give civil protection to the Mark.

The five papers presented to this session dealt with the certification schemes in use at present in different parts of the country. The Certification Marks Scheme of the ISI formed the subject of one of the papers.

The paper on Agmark and its working revealed that the following commodities are at present graded on a voluntary basis for internal consumption: ghee, butter, edible oils, fruits, rice, *gur*, cotton and eggs. Those graded compulsorily for export are tobacco, sann hemp, wool and bristles. It was intended to extend the compulsory grading scheme to pepper, ginger, cashew kernels, and vegetable and essential oils.

Other papers presented were: Quality marking scheme for handloom cloth in Uttar Pradesh; A certification and inspection scheme for tea-chests-plywood; and Inspection of cotton piece goods meant for export.

In the discussion that followed, it was pointed out that Indian Standard Specifications could be used by other bodies like the Cotton Textiles Fund Committee for their certification scheme. The methods of applying the certification mark and other related problems were also discussed.

REVIEWS

VACUUM VALVE IN PULSE TECHNIQUE, Vol. IX by P. A. Neeteson (Electronic Valves Series published by Philips Technical Library, Eindhoven, Holland); 1954. Pp. 170 + viii

The pulse technique is of great importance in all developmental work on electronic regulation, control, computation and the like. It is, however, somewhat unfortunate that the operation and performance of even some of the more important elements, round which this technique has grown, is not well understood. Neeteson's book seeks to fill in this lacuna by presenting a unified and connected method of treatment of the basic materials of the technique involving the use of vacuum valves. Following an introductory note the book begins with a short but very readable account of the basic theory of switching (Section 2). The application of this theory to simple switching circuits is then illustrated in Section 3. Electron tubes as switching device are then introduced (Section 4) followed by a short note on the method of operational calculus (Section 5). Section 6 gives a fuller treatment of electron tubes as switching elements. This includes a detailed study of the effects of both positive and negative going pulses on the grid of a triode, and on the anode circuit of a diode and a triode valve. The remainder of the book (Section 7) is devoted to a discussion of the multi-vibrator family consisting of the three basic types, viz. astable, monostable and bistable.

As mentioned in the introduction, the main aim of the author has been "to indicate the methods of determining the behaviour of a network in which electronic tubes are used as switches". In this the author has succeeded to a large measure. Nevertheless, there are some defects which it is the duty of the reviewer to point out. Some of the discussions, for example, could have been curtailed with advantage. Thus, equation 23.6 could have been obtained in a much simpler way without affecting the illustration of the method of treatment suggested. At some places, the statements made are rather misleading. The statement on page 42 that the "occurrence of overshoot will depend on

the shape of the grid current-grid voltage characteristic and on the initially applied voltage waveform at the grid" is confusing and needs qualification (as is apparent from the example given thereof). The arrangement of the discussions in Section 6 — some simpler and some more rigorous — of the problem when a grid-current flows leaves much to be desired. On the other hand, the section on operational method could have been expanded and made more informative. There are also some printing errors. However, apart from these minor blemishes, the book is an illuminating survey of a rather obscure field, and will be read with interest and profit by those engaged in the teaching of the fundamentals of the pulse method as also by those carrying on original research on subjects involving the use of the pulse technique.

S. DEB

THE METALLURGY OF ZIRCONIUM. Edited by Benjamin Lustman & Frank H. Herze, Jr. (National Nuclear Energy Series, McGraw-Hill Book Co. Inc., New York), 1955. Pp. xviii + 776. Price \$ 10.00

The National Nuclear Energy Series is a comprehensive survey of the scientific and technological advancements in the United States programme for the development of nuclear energy. *The Metallurgy of Zirconium* belongs to the Materials Procurement Project Division of the series, and fifty experts have collaborated in the compilation of this valuable volume.

The book gives an extensive account of the present status and the projected future of zirconium and its alloys, and is divided into twelve chapters. The first chapter is devoted to a historical résumé of the developments leading to the nuclear engineering applications of zirconium which are based on its high melting point, outstanding corrosion resistance, good strength at room and elevated temperatures and, above all, its low thermal neutron absorption cross-section when it is hafnium-free. The second chapter is devoted to a discussion of the metal in non-nuclear applications as in chemical equip-

ment, alloys and electronics. Chapter 3 deals with the occurrence of zirconium and gives estimates of the reserves in the United States. Chapters 4 and 5 provide a discussion of the production metallurgy of zirconium. The Chapter 4 is divided into four major parts: thermodynamic properties, Kroll process, other processes, and hafnium removal. The de-Boer process, which is essentially a process for refining zirconium sponge, is covered separately in Chapter 5. The evaluation of any prospective reduction process, as well as improvements in production processes, depend largely on a knowledge of the thermodynamic properties of the materials involved. It is, therefore, gratifying to note that authentic data on the thermodynamic properties of zirconium and its compounds have been provided in the book. Possible methods of separating hafnium from zirconium are presented but the method used by the United States is not specified. It would be of interest to mention here that a separation method based on solvent extraction with methyl isobutyl ketone containing thiocyanate was declassified and presented by the United States at the recent Conference on the Peaceful Uses of Atomic Energy. The chapter on iodide-decomposition process lays special emphasis on the design of equipment and is one of the best in the volume.

Chapter 6 is concerned with the melting and shaping of zirconium and its alloys, and would be of immense benefit to the commercial manufacturer as well as to the research worker.

The second half of the book is devoted to an exhaustive treatment of the physical and mechanical metallurgy, and the corrosion properties of zirconium and its alloys. Joining and finishing of zirconium are discussed in Chapter 7. Chapter 8 on physical metallurgy gives the thermal, electrical, magnetic, thermionic and elastic properties. Well-reasoned discussions of transformation and deformation mechanisms are provided and the chapter is illustrated with numerous photomicrographs. In Chapter 9 the alloying behaviour of zirconium is surveyed from theoretical viewpoints. Thirty-seven alloy systems are discussed and thirty-two binary equilibrium diagrams are presented. Chapter 10 on mechanical properties and Chapter 11 on corrosion characteristics unfold a great deal of data, hitherto not available,

and it should be mentioned that good care has been taken to exclude spurious information resulting from material contamination or improper processing. The closing chapter (Chapter 12) deals with the analytical chemistry of zirconium. This is followed by an appendix covering metallography, and industrial hygiene and safety.

Considering the joint authorship, the text is remarkable for its continuity except for very occasional overlapping of subject matter, which is inevitable in such a compilation. Each chapter has been planned with an eye on further development of zirconium technology and carries at the end a fairly exhaustive list of references.

The present volume is an excellent summing up of the prevailing situation on zirconium and would go a long way in stimulating intelligent interest in the metal and its potentialities. It is a useful book of reference for the prospective manufacturer and an inspiring guide for the research worker.

BRAHM PRAKASH

POLAROGRAPHIC TECHNIQUES by Louis Meites
(Interscience Publishers Inc., New York)
(*Distributors in India*: Asia Publishing
House, Bombay), 1955. Pp. xiii + 317.
Price \$ 6.00

This book is intended to serve as an introduction to polarographic technique and to enable the beginner in electro-analytical work to understand the theoretical background and the basic experimental principles involved. The author has achieved his objective in an admirable manner. After a brief general introduction, the various apparatus and circuits employed in polarographic technique are fully explained with clear diagrams. In this connection it may be added that the detailed descriptions of the directions given to the beginner for carrying out the manipulations involved in polarographic analysis form a special feature of this book. Chapters 3-5 deal lucidly with the fundamental principles of the current voltage curves and the interpretation of some of their characteristics. In short, the book contains all the information necessary for a beginner to use the polarographic technique with confidence. It also contains two important appendices and a list of some 126 references which should not be missed by research workers in particular.

Professor Meites's book is comparable to other standard text-books published in the

past few years on instrumental analysis in electrochemistry, such as *Polarography* by Kolthoff, *Electroanalytical Chemistry* by Lingane, *New Instrumental Methods in Electrochemistry* by Delahay, etc.

The book is attractively printed and bound in the American style. It should find a place in the libraries of all research institutions and universities.

K. S. G. DOSS

HIGH VACUUM TECHNIQUE — THEORY, PRACTICE, INDUSTRIAL APPLICATIONS AND PROPERTIES OF MATERIALS by J. Yarwood (Chapman & Hall Ltd., London), 1955. Pp. viii + 208. Price 25s.

The work under review is the third revised edition of the brief but useful monograph entitled *High Vacuum Technique*. It consists of six chapters with bibliography and index. In these chapters the subjects dealt are: (1) the production of high vacuum, (2) the measurement of high vacua, (3) the measurement of pumping speed, (4) degassing and gettering, (5) the applications of high vacua in industry, and (6) the properties of materials important in high vacuum technique.

The author, while dealing with the enumerated topics, has introduced the latest developments in apparatus with a clear description of some important industrial processes. The book brings together, in a small compass, various facts regarding the relevant properties and the uses of materials employed in vacuum work.

The technique is so presented as to enable the physics student as well as the vacuum technician to clearly grasp the salient and important facts encountered in the science and technique of high vacua. The book should, therefore, be found very useful both by those who study the science of high vacua for its own sake and those who employ high vacua in experiment and industry.

SWAMI JNANANANDA

ILLUMINATING ENGINEERING COURSE by H. Zijl (N. V. Philips Gloeilampenfabrieken, Eindhoven, Holland) [*Distributors in India*: Philips Electrical Co. (India) Private Ltd., Calcutta], 1955. Pp. viii + 625. Price 40s.

This book belongs to the Technical Series on 'Light' being published by Philips Gloeilampenfabrieken, Holland.

The title of the book, however, appears to be somewhat misleading since the book is more in the nature of a collection of a series of discourses on illumination engineering than being a text-book. The discourses are spread over 23 chapters in about 240 pages dealing with radiation, photometry, vision, task analysis, lamps, interior lighting fittings and systems. But the subject matter is not balanced, which may be due to the author's interest only in particular aspects of the subject.

The conditions restricting the laying out of various lighting systems, tables of coefficients of utilization of various systems of installations using both incandescent and fluorescent sources are given. Here, a chapter on 'wiring' would have been very useful, for the least that the designer of illumination should know is that concerning adequate and safe wiring for appropriate and economic illumination. An extensive series of short questions together with their answers is included at the end of the book.

The author has presented his subject in a readable way and the book is well illustrated. The technical standard expected of the reader in order to follow the subject matter is not high. There is, however, no index which somewhat reduces its value as a reference book.

W. M. VAIDYA

FRUIT — A review of production and trade relating to fresh, canned and dried fruit, fruit juices and wines (Published for the Commonwealth Economic Committee by H.M.S.O., London), 1955. Pp. 170. Price 5s.

This review is one of a series of publications issued annually by the Committee with the aim of presenting in a convenient form up-to-date summaries of production, international trade and consumption for a group of allied commodities, with special reference to the part played by the Commonwealth countries. This issue of *Fruit* gives statistical data for the more recent post-war years up to and including 1954.

World exports of both fresh and canned fruits in 1954 were the largest ever recorded and those of dried fruits the heaviest since the war. Exports from the Commonwealth, which accounted for 1 million tons out of a total of some 8 million tons, were also at a high level, though only in the case of canned

fruits was a new record established. The world output of oranges and other citrus fruits, about half of which is produced in the United States, is now nearly two-thirds greater than before the war. While the increase in deciduous fruits, of which apples are by far the most important, is not so great, partly owing to some decline in the output of the United States, there have been important developments; European production, exclusive of cider and perry fruit, has risen by 50 per cent and Commonwealth production by over 45 per cent.

Fresh fruit—The estimated world production of deciduous fruits, excluding cider and perry fruit (which is important in Europe), was 18½ million tons in 1954, compared with 18¾ million tons in 1953, and that of citrus fruits nearly 14½ million tons as against 14¼ million tons. The main fruits of importance in world trade other than deciduous and citrus are bananas, grapes and pineapples. No reliable production statistics are available for bananas, but trade figures show that production has been expanding. Grape production, the bulk of which is used for wine in Europe, has fully recovered from the war-time setback and there has been some expansion in the output of fresh pineapples.

The continued expansion of the international trade in fresh fruit in 1954 which, with a total of nearly 7 million tons, showed an increase of nearly 4 per cent over that of 1953, was largely the result of heavier exports of bananas; there was some increase for grapes, but little change for oranges and other citrus fruits, and some decline for both apples and pears. The Commonwealth provided larger supplies of each of these fruits, with oranges nearly double the pre-war average, and bananas showing a further marked recovery. Commonwealth exports of apples, however, although heavier than in recent years, were still appreciably less than before the war.

Canned and dried fruits—Canned fruit production in all Commonwealth countries was at record levels in 1954, and, with a near-record pack in the United States, the world output was about 2¼ million tons, nearly ¼ million tons more than in 1953. Commonwealth countries exported over 180,000 tons of canned fruit, which was not only 1½ times higher than that in 1938, but nearly half of the world total. United Kingdom imports expanded sharply in 1954 and, at 217,000 tons, were as heavy as in 1938.

Raisin production in the main countries in 1954, at about 420,000 tons, was 12 per cent lower than in the preceding year. Of the tree fruits, there were smaller packs of both dried prunes and figs, and possibly also of dates, for which complete data are not available. World export of raisins and currants were greater than in 1953 in spite of reduced shipments from Australia and the U.S.A., the declines for these two important sources being more than offset by increased consignments from Greece and Turkey.

Fruit juices—Largely owing to a 15 per cent increase in the pack of the United States, by far the largest producer, the world output of fruit juices continued its marked upward trend in 1954 and totalled about 570 million gallons. British West Indies, South Africa and Australia accounted for 22 per cent of the total production. Canada and the United Kingdom continue to be the leading importers of fruit juices.

Wine—France, Italy and the most other Mediterranean countries had good grape harvests in 1954 and the world output of wine exceeded 4,600 million gallons, about 200 million gallons more than in 1938. The quantity of wine entering international trade, at 486 million gallons, was also up to pre-war and nearly a quarter as much again as in 1953; this increase, however, was due largely to increased shipments from Algeria (by far the largest exporter) to France, which accounted for two-thirds of the total trade.

Recent Publications

- *BRITISH CHEMICALS AND THEIR MANUFACTURERS — 1955 (The Association of British Chemical Manufacturers, London), 1955. Pp. 192
- *CHEMICAL PILOT PLANT PRACTICE, Vol. 1 by Shelby A. Miller (Interscience Publishers Inc., New York) (*Distributors in India*: Asia Publishing House, Bombay), 1955. Pp. viii + 152. Price \$ 3.50
- *IRON ORES OF INDIA by M. S. Krishnan (Indian Association for the Cultivation of Science, Calcutta), 1955. Pp. 177. Price Rs. 5
- *METALLURGICAL THERMOCHEMISTRY by O. Kubaschewski & E. L. Evans (Pergamon Press Ltd., London), 1956, pp. xiv + 410. Price £ 2 15s.
- *AN INTRODUCTION TO FLUVIAL HYDRAULICS by Serge Leliavsky (Constable & Co. Ltd., London), 1955. Pp. xii + 257. Price 30s.
- *PEACEFUL USES OF ATOMIC ENERGY — PROCEEDINGS OF THE INTERNATIONAL CONFERENCE IN GENEVA, AUGUST 1955 — VOL. 2 — PHYSICS; RESEARCH REACTORS (United Nations, New York), 1956. Pp. viii + 471
- MACHINE DRAWING by H. A. Dandekar & C. E. Krishnamurti (Oxford University Press, Bombay), 1956. Price Rs. 5
- ELECTROMAGNETIC PRINCIPLES OF THE DYNAMO by E. B. Moullin (Oxford University Press, Bombay), 1956. Price 30s.
- AN INTRODUCTION TO SOCIAL ANTHROPOLOGY by Majumdar & Madan (Asia Publishing House, Bombay). Price Rs. 12/8
- FUNDAMENTALS OF ELECTROACOUSTICS by Fischer (Interscience Publishers Inc., New York) (*Distributors in India*: Asia Publishing House, Bombay). Price \$ 6.00
- CHEMICAL PILOT PLANT PRACTICE by Jordan (Interscience Publishers Inc., New York) (*Distributors in India*: Asia Publishing House, Bombay). Price \$ 3.50
- SCIENCE FOR PROGRESS by Ames-Baker-Leahy (Prentice-Hall) (*Distributors in India*: Asia Publishing House, Bombay). Price \$ 5.50
- SCIENCE FOR YOUR NEEDS by Ames-Baker-Leahy (Prentice-Hall) (*Distributors in India*: Asia Publishing House, Bombay). Price \$ 4.50
- ELEMENTARY PRINCIPLES OF CHEMISTRY (U.T.P.) by P. S. Jewell (Oxford University Press, Bombay). Price 6s. 6d.
- EDUCATION AND ANTHROPOLOGY (STANFORD) by George D. Spindler (Oxford University Press, Bombay). Price \$ 5.50
- VACUUM VALVE IN PULSE TECHNIQUE by P. A. Neeteson [Philips Electrical Co. (India) Private Ltd., Calcutta]. Pp. 170. Price Rs. 13/8
- ATOMIC ENERGY RESEARCH AT HARWELL by K. E. B. Jay (Butterworths Scientific Publications, London). Price 5s.
- SEQUENTIAL ANALYSIS OF STATISTICAL DATA (Oxford University Press, Bombay). Price \$ 7.75
- TABLES OF THE CUMULATIVE BINOMIAL PROBABILITY DISTRIBUTION by Harvard (Oxford University Press, Bombay). Price \$ 8.00
- EXPERIMENTAL STUDIES ON THE INFLUENCE OF CERTAIN HORMONES ON THE DEVELOPMENT OF AMYLOIDOSIS by Latwalahti (Ejnar Munksgaard, London) (*Distributors in India*: Asia Publishing House, Bombay). Price Rs. 13/2
- THE CHEMICAL COMPOSITION by Hedberg (Ejnar Munksgaard, London) (*Distributors in India*: Asia Publishing House, Bombay). Price Rs. 10/8
- PROCEEDINGS OF THE SYMPOSIUM ON CO-ORDINATION CHEMISTRY (Ejnar Munksgaard, London) (*Distributors in India*: Asia Publishing House, Bombay). Price Rs. 17/8
- PROCEEDINGS OF FIRST INTERNATIONAL CONGRESS ON MEDICAL LIBRARIANSHIP by Libri (Ejnar Munksgaard, London) (*Distributors in India*: Asia Publishing House, Bombay). Price Rs. 43/12
- DIFFUSION AND HEAT EXCHANGE IN CHEMICAL KINETICS by D. A. Frank-Kamenetskii (Oxford University Press, Bombay). Price \$ 6.00
- APPLIED GROUP-THEORETICAL AND MATRIX METHODS by Bryan Higman (Oxford University Press, Bombay). Price 50s.
- PRACTICAL MYCOLOGY — MANUAL FOR IDENTIFICATION OF FUNGI by Funder (Hafner) (*Distributors in India*: Asia Publishing House, Bombay). Price \$ 6.50
- THE GENEVA SERIES ON THE PEACEFUL USES OF ATOMIC ENERGY. Edited by J. G. Beckerley (Macmillan & Co. Ltd., London), 1956. Price £ 16 10s.
- PRINCIPLES OF GUIDED MISSILE DESIGN: VOL. I — GUIDANCE by Arthur S. Locke (Macmillan & Co. Ltd., London). Price 93s. 6d.
- PRINCIPLES OF NUCLEAR REACTOR ENGINEERING by Samuel Glasstone (Macmillan & Co. Ltd., London), Price 60s.
- ANDROGENS — BIOCHEMISTRY, PHYSIOLOGY AND CLINICAL SIGNIFICANCE by Dorfman-Shipley (John Wiley & Sons Inc., New York). Price \$ 13.50
- THERMAL POWER FROM NUCLEAR REACTORS by Thompson-Rodgers (John Wiley & Sons Inc., New York). Price \$ 7.25
- AIRCRAFT GAS TURBINES by Smith (John Wiley & Sons Inc., New York). Price \$ 8.75
- MATHEMATICS IN THEORY & PRACTICE by Sawyer (Odhams)
- MAN'S CONQUEST OF MATTER & SPACE by Britton *et al.* (Odhams)
- THE WORLD OF LIVING THINGS by Mottram *et al.* (Odhams). Price 232s.

*Received for review in the *Journal of Scientific & Industrial Research*.

Low-cost insulation

MESSRS J. P. W. HOUTMAN* AND Asghar Husain (Laboratory of Chemical Engineering, University of Indonesia, Bandung, Indonesia) have investigated the heat insulating properties of 'Java Isolatie'—a low-cost heat insulation developed from indigenous materials like bamboo, rice-straw and cowdung. 'Java Isolatie' is widely used in Indonesia for insulating steam pipes.

Different combinations of this insulation, containing either bamboo or rice-straw or both, were laid on ordinary commercial steel pipes (inner diameter 2.64 cm. and outer diameter 3.37 cm.) and tested. The length of the test section was 82-83 cm. In case both the materials were used, the first layer consisted of strips of bamboo of desired thickness placed along the length of the pipe to form a casing. Rice-straw in the form of rope (thickness, 2 cm.) was wound round the bamboo layer or over the bare pipe. Finally, the insulation was coated with a mixture of cowdung (2 parts by weight), lime (0.1 part), and water (1.9 parts). The coating was allowed to dry for one week before carrying out any tests.

The total thickness of each insulation was kept constant at 4 cm. The thicknesses of the different layers varied from 1 to 3 cm. in different combinations. The heat insulation capacity of each combination was determined by passing steam at 5 atm. pressure through the test section and measuring the amount of condensate formed during a certain period after the whole system had come to a steady state. In a separate experiment, heat loss in the other parts of the apparatus, also heavily insulated, besides the test section was determined, and a correction for that was included. The temperature of the metal surface of the test section and the surface of the insulation was measured by using thermocouples. From these data, the thermal conductivity of each insulation was calculated using Fourier's equation.

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The results showed that the rice-straw and cowdung combination in the proportion of 3:1 (by thicknesses of layers) had the best insulating properties among all the insulations tested. Its thermal conductivity was 0.052 B.t.u./hr. ft. °F. as compared to 0.056 B.t.u./hr. ft. °F. for the same combination of bamboo and cowdung. The density of the said insulations was 0.306 and 0.494 g./cu. cm. respectively. A general survey of all the results indicated that cowdung contributed little to the heat-insulating properties. Moreover, this coating was weak and developed cracks during heating. Rice-straw was found to be the best material with respect to heat-insulating capacity, followed by bamboo.

Trials were also carried out with rice-straw coated with cement or porous cement. The cement coating was prepared by using 40 g. of water per 100 g. of cement; for porous cement, 2 cc. of 20 per cent Teepol solution were used in addition. Teepol was stirred into water to a foamy mass and cement added. The results obtained with these combinations in the proportion of 3:1 showed a slight improvement in the case of porous cement (0.066 B.t.u./hr. ft. °F. for cement and 0.065 B.t.u./hr. ft. °F. for porous cement); the porous cement layer was also found to develop cracks. Finally, an insulation consisting of a 4 cm. thick layer of rice-straw and a coating of cement just sufficient to cover it (0.5 cm. thick), was also tested. It was comparable in its thermal conductivity (0.055 B.t.u./hr. ft. °F.) and density (0.431 g./cu. cm.) with the other combination, and did not develop any cracks.

It was, therefore, concluded that the best method of making 'Java Isolatie' is to wind rice-straw rope over the pipe to the desired thickness, and to coat it with cement just sufficient to cover it. For external use, it may be further covered with cloth, etc. In this manner, the insulation is easy to lay and its cost of production is low [*De Ingenieur*, No. 51, 67 (1955), 93-96].

A NEW THEORY PUT FORWARD BY Dr. J. S. Chatterjee, of the Institute of Radiophysics & Electronics of the University of Calcutta, promises to solve one of the long-standing baffling problems of geophysics—the earth's magnetism. A general exposition of the theory against a background of the current knowledge on the subject was the subject of the 1956 Mahendralal Sircar Memorial Lecture by Dr. S. K. Mitra, Director of the Institute, delivered at the Indian Association for the Cultivation of Science, Calcutta.

The exact nature and origin of the earth's magnetism, despite the theories and explanations advanced, are imperfectly understood. Even the location of the seat of the magnetization is not known definitely. In the core, or even beyond a few scores of km. depth inside the earth, the temperature is so high that any magnetic material which may be present is not likely to retain its magnetism. Theories based on core magnetization arising from the magnetic effect of closed loops of electric currents flowing there proved very unsatisfactory. The possibility of magnetization of the thin crust of the earth, 20-30 km. thick, where the temperature is not too high, has also been considered. But this requires the presence of enormous quantities of magnetic material in the earth's crust to account for the observed magnetic intensity, and even if it is present, it is difficult to conceive the source of the intense magnetizing force to magnetize it.

Dr. Chatterjee, re-examining these questions, pointed out that the magnetite present in the sintered form in the rocks of the earth's crust beyond a few km., where the temperature reaches 700°-800°C., just below the critical temperature, is easily magnetizable to saturation by even a small magnetizing force acting on it. He then showed that the quantity of magnetite present, if magnetized like this, is more than sufficient to account for the observed intensity of the earth's field.

The only other essential requirement to produce magnetization is a worldwide uniform magnetizing force, the value of which need be only quite small. It is tentatively suggested that this force is provided by the field of magnetic

storms resulting from the earth's encounter with high speed charged particle emanations from the sun, specially when the sun shows intense sunspot activity.

Creation of rare minerals

RARE MINERALS SELDOM FOUND near the earth's surface have been created at the University of California, Los Angeles, by subjecting common minerals to extreme pressure and temperatures obtaining at extreme depths in the earth's crust. From common quartz (cocsite), a dense mineral that can exist in nature only at a depth of 40 miles or more in the earth has been created. Jade has been made from feldspar and aragonite from limestone [*Science*, **123** (1956), 20].

Radio mapping of Mars

MORE PRECISE KNOWLEDGE, which may disclose new topographical features of Mars, will be available after the completion of a project of preparing a photographic map of Mars by the Observatory of Agassiz, belonging to the Harvard University, U.S.A. The map will be obtained by projecting radar beams over the entire surface of Mars and the reflected beams onto a screen being photographed by the Observatory's radio telescope. The difficulties experienced in exact observation of the Mars's disc, namely the enormous distance from earth and the properties of light being affected by the earth's atmosphere, are thus overcome by using the radar beams which can pierce the atmosphere unaffected and can reach infinite distances (*Unesco*).

Isograph — an electronic root finder

AN ENTIRELY ELECTRONIC INSTRUMENT, the isograph, avoiding all mechanical moving parts and working on the principle of harmonic synthesis, has been designed and constructed at the Institute of Radiophysics & Electronics, Calcutta University, for use in solving higher degree polynomial equations frequently occurring in many problems in mechanical, electrical and radio engineering. A polynomial in z of the general form

$$f(z) = \sum_{m=0}^{m=n} a_m z^m$$

can be expressed as

$$f(z) = \Sigma a_m r^m \cos m\theta + j \Sigma a_m r^m \sin m\theta$$

The values of r and θ for which both the real and imaginary parts vanish simultaneously are the roots of $f(z)$. Thus the basic procedure that the instrument should undertake for finding the roots of $f(z)$ is to generate individual terms

$$a_m r^m \cos m\theta$$

and

$$a_m r^m \sin m\theta$$

and add the cosine and sine terms separately, with provision for varying both r and θ to make the sum of the cosine and sine terms zero.

Voltages proportional to the sine and cosine terms are generated with the help of a delay line, the line being fed from a matched frequency-sweep generator, the frequency of which is swept by the time base voltage of a cathode-ray oscillograph. Variation in oscillator frequency corresponds to the variation of the argument of the harmonic components. Thus by controlling the amount of frequency sweep of the oscillator, any desired interval of the argument can be expanded thereby increasing the accuracy of measurement of the argument of the root.

Sine and cosine voltages are obtained with the help of short and open-circuited delay lines respectively, the different harmonic components being obtained by tapping from the proper points on the line. The harmonic components are fed into the respective coefficient multiplier circuits (basically potentiometer multipliers, the outputs from which are in turn fed into the r multiplier-adder circuit. The final output obtained is

$$\Sigma a_m r^m \cos m\theta$$

with the line open-circuited and

$$\Sigma a_m r^m \sin m\theta$$

when it is short-circuited.

The procedure for finding the roots is as follows: With the line open-circuited, the oscillator is adjusted to sweep between 0.383 and 0.707 f_c in each cycle (f_c = cut-off frequency of the filter). The r th potentiometer is manipulated such that zero output is obtained somewhere on the oscilloscope time base. For increased accuracy

the attention is concentrated on the region about the zeros and the frequency sweep gradually decreased by controlling the frequency dial of the sweep frequency oscillator and keeping the zero of the output at the centre of the cathode-ray oscillograph face. Finally when the frequency sweep is zero with zero output on the oscillograph, the frequency dial of the oscillator is read. From the prepared curve relating θ and frequency, θ is obtained or the oscillator dial can be directly calibrated in θ . The solution is checked by observing whether the output is again zero with the far end of the line short-circuited. If this is so, the r - θ combination determined constitutes one of the solutions. Other solutions are obtained similarly [*Indian J. Phys.*, **38** (1955), 468].

Telescope image converter

THE EFFORTS OF ASTRONOMERS and physicists at several institutions in U.S.A. and Europe towards the development of an ideal image converter give promise of probing through space three times farther than is now possible. They envisage the application of television principles to the telescope to increase the apparent light-gathering power, i.e. enabling study of stars, etc., only one-tenth as bright as the faintest now observable. Scientists from Palomar, Yerkes and the U.S. Naval observatories, and the National Bureau of Standards are closely co-operating with manufacturers like Radio Corporation of America, and Farns-Worth Electronics, etc., in building the necessary parts of the image converter and its testing.

Just as ordinary photography gives a picture of a portion of the sky, the image converter first produces an electronic picture of a stellar view on a photoelectric surface, which is then transferred by way of a television-like tube to a photographic plate. Images too faint to be photographed are picked up as the light quanta are utilized more efficiently. An important feature of the device is a thin film of aluminium foil which transmits electrons but stops atoms and molecules which otherwise quickly ruin the photocathode. Attempts are being pursued to produce a practical design of the device suitable for widespread routine use so that in case of failure of an image tube, one can

simply plug in an instant a new tube replacing the spoilt one [*Sci. Newsletter*, **68** (1955), 389].

Surface tension by null method

AN IMPROVED VERSION OF the null method described by Meier has been successfully employed by workers at the Physics Laboratory, Nizam College, Hyderabad (Deccan), for determining the surface tension of liquids. In this method, the up-thrust of liquid on a thin rectangular cover glass slip immersed in it is balanced by the downward pull due to surface tension round the perimeter of the glass slip.

By replacing the torsion wire and torsion arm of the Searle torsion balance by a wire of steel S.W.G. No. 30 and a long thin strip of bamboo or aluminium respectively, a deflection of 5 mm. for a pull of 0.01 g. and a pull due to surface tension on the glass strips of 100-300 dynes depending on the liquid used were achieved. A stout piece of copper wire attached to the brass-screw stem carrying the torsion arm enables the sensitivity of the balance to be varied as it is slightly bent up or down. The torsion arm can be made horizontal by turning a nut working in the screw stem.

The experimental liquid is contained in a wide glass dish (more than 10 cm. in diam.) placed on a platform that can be raised or lowered. A thin glass plate is hung from a notch (3 in. from the end) in the torsion arm. To start with the torsion arm is adjusted to be horizontal by means of the nut. The dish is raised slowly till the bottom of the glass plate just comes in contact with the liquid surface and is pulled in. The flat ground end D of a vertical tube (1 cm. diam.) CD connected to a manometer through a clip K is brought to be just in contact with the liquid surface. The clip K is closed and the open end of the manometer is so adjusted as to bring the meniscus in CD to the level of liquid outside and the manometer level is read by means of a cathetometer correct to 0.005 cm. Next the departure from horizontality of the torsion arm is restored, without disturbing CD, either by addition of more liquid to the dish or by raising the supporting platform. Now the manometer is again adjusted to lower the meniscus in CD

to the original level of the liquid in the dish (i.e. to the end D) and the reading taken. The difference H between the initial and final manometer levels represents the change of pressure at the original liquid surface due to the addition of liquid into the dish. An expression independent of the density of the liquid or the depth of immersion of the plate can be derived by which the surface tension of the liquid can be calculated knowing H and the dimensions of the glass plate used. Using fresh, chemically pure liquids, the surface tension values at the same temperature determined by this method are found to be reproducible within 0.1 per cent and they are quite close to the accepted values. The method can be extended to the determination of the surface tension at the interface of two immiscible liquids [*Indian J. Phys.*, **38** (1955), 522].

Ion exchange in alloy analysis

AN ACCURATE METHOD FOR the analysis of cobalt-base jet-engine alloys by the use of ion-exchange resin techniques has been developed. The method permits quantitative determination of nickel, manganese, cobalt and iron in the presence of niobium, molybdenum, tantalum, tungsten, silicon and copper.

The alloy is first dissolved in aqua regia, after which the niobium, tantalum, tungsten and silicon are rendered insoluble by hydrochloric acid dehydration. The solution is treated with hydrogen sulphide to precipitate molybdenum and copper, and filtered. Repeated evaporation of the filtrate with hydrochloric acid and hydrogen peroxide provides a chloride solution of the elements in the proper valency for the ion-exchange fractionation.

The solution of metal chlorides is transferred to an anion-exchange column, and the nickel and manganese, with chromium and some other elements, are collected in the first fraction by washing with 9N hydrochloric acid. Cobalt is collected in a second fraction by washing with 4N hydrochloric acid, and iron in a third by washing with 1N hydrochloric acid.

The first fraction is divided into two parts which are used to determine manganese and nickel by the persulphate-arsenite titration and

dimethylglyoxime gravimetric methods respectively. Cobalt is determined in the second fraction by electrolysis from a weakly ammoniacal chloride solution containing hydroxylamine hydrochloride, and iron is determined in the third fraction by reduction with stannous chloride and titration with dichromate [*Chem. Tr. J.*, **137** (1955), 1382].

Ceramics for nuclear energy service

RESEARCHES CARRIED OUT AT a number of research institutions under the sponsorship of the Atomic Energy Commission, U.S.A., have resulted in the development of a variety of ceramic materials with several actual and potential applications in nuclear technology.

In the field of fuel elements, with the bulk of applications of ceramics and ceramic-metal combinations (cermets), uranium dioxide has been found to possess good refractory properties and resistance to aqueous corrosion. Differential thermal analysis studies on oxygen contents and the effects of particle size and degree of crystallinity on the reactivity of uranium dioxide powders prepared by various techniques showed that oxides having large crystallites react more slowly at higher temperatures. With properly selected starting materials, uranium oxide in bulk form can be prepared by isostatic pressing and sintering at 1,750°C., possessing 96 per cent theoretical density.

Thorium oxide is a potential breeder material. Under the same firing conditions, the addition of 0.5 per cent (by weight) calcium oxide results in increasing the density of bulk thorium oxide shapes to 96 per cent theoretical from the 86 per cent without the addition. Investigations indicated that calcium is taken into solid solution in the thorium oxide producing anion vacancies promoting more rapid sintering. Results of the sintering rate studies suggested that surface diffusion is primarily responsible for the rapid densification of the ThO₂-CaO compacts.

Two cermets which offer interesting possibilities for use in fuel element fabrication and structural components of reactors and have received recent attention are (1) a combination of chromium and aluminium and (2) siliconized silicon carbide (SiC-Si). A composi-

tion with 72 per cent chromium and 28 per cent alumina was found suitable for fabricating consistently pore-free bodies (density, 5.9) of moderate shrinkage. This material possessed adequate high temperature strength properties (above 800°F.); satisfactory sustained load carrying ability by stress rupture behaviour; and negligible oxidation resistance up to 2,000°F. and good thermal shock resistance. By impregnating a porous graphite body with molten silicon, non-porous SiC-Si bodies (density 3.1) having about 10,000 lb./sq. in. tensile strength and a thermal conductivity better than that of stainless steel were obtained. Their thermal neutron absorption cross-section is about 0.1 barn. The moderator efficiency is roughly proportional to density. Commercial forms of high density (range 1.85-1.92) graphite produced by multiple impregnation of graphite with pitch have very good erosion resistance without affecting other properties.

Rare-earth oxides with relatively high thermal neutron absorption cross-section are useful as reactor control materials. Sm_2O_3 and Gd_2O_3 both form ceramics of medium strength and density when fired in dry pressed form at 1,300°C., the density slightly increasing at 1,500°C. Hafnium oxide, boron carbide (B_4C and B_6C) also offer promise for control or shielding applications.

Ceramic coatings designed for application in high temperature (1,000°C.) alloy parts used in reactors were developed from materials having low neutron absorption cross-sections, by the National Bureau of Standards. High-barium frits containing small amounts of phosphates, beryllia, lime, zinc oxide, etc., are milled with additions of mixtures of ceria and chromic oxide. They improved the corrosion- and thermal-shock-resistance from quenching, of uncoated specimens.

High temperature corrosion studies showed that single-crystal magnesia, molybdenum disilicide and sintered thoria exhibit good resistance to corrosion by sodium liquid vapour; graphite, sintered magnesia, sintered alumina, sintered zirconia, molybdenum disilicide, tantalum carbide, 'Vycor' and 'Kennametal' were found to offer resistance to corrosion by liquid bismuth; chromium carbide, sintered alumina, graphite and Vycor resist molten tin.

The possibilities of cheaper disposal of radioactive wastes by adsorbing them in clay pellets and fixing the dangerous isotope by sintering the mass in place using heat from radioactive decay are being explored at the Oak Ridge National Laboratory.

Glass windows, through which the ray-filled interiors of hot laboratories are seen, and which do not darken under radioactive bombardment, are other significant developments. In the field of food sterilization, silver-activated phosphate glass, which darkens to an extent depending on the radiation level to which it is exposed, is finding wide use in radiation dosimeters [*J. Franklin Inst.*, **260** (1955), 455].

Magnetic refrigerators

A NEW-TYPE REFRIGERATOR THAT will maintain extremely low temperatures in the region of absolute zero has been developed at Arthur D. Little Inc., Cambridge, Mass. The design, based on a cyclic principle of magnetic cooling, represents a major departure from ordinary refrigerating systems. There are no moving parts or flowing fluids in this cooling system. It uses, instead, a plastic capsule three inches long, containing a special chemical salt as the refrigerant. Operation of the refrigerator is controlled entirely by external magnetic fields.

Although the principle of magnetic cooling has been used previously to achieve extremely low temperatures, this is the first example of an apparatus which can develop low temperatures and also maintain them for long periods [*J. Franklin Inst.*, **260** (1955), 557].

New liquid scintillation phosphors

A NEW CLASS OF LIQUID SCINTILLATION phosphors has recently been investigated. Out of 40 compounds so far tested, 7-diethylamino-4-methylcoumarin (I) and 2-(*p*-dimethylaminophenyl) benzothiazole (II) have shown special promise compared to a standard consisting of 0.4 per cent 2, 5-diphenylloxazole (PPO) and 0.002 per cent 1, 6-diphenylhexatriene (PPHT) in toluene. Taking the mean pulse height obtained using a cobalt-60 source with this phosphor, flushed with nitrogen, as 100 per cent, various preparations of

compound I, tested as 0.4 per cent solution in toluene, gave pulse heights from 86 to 100 per cent. Compound II gave pulse heights of 90 per cent. The addition of a secondary solute such as PPHT or POPOP [1, 4-di-(5-phenyl-2-oxazolyl) benzene] had little or no effect on the scintillation properties of these solutions. In all cases, flushing with nitrogen to remove air increased the pulse height by about 30 per cent [*Science*, **122** (1955), 1139].

Substitute for corn-steep liquor

SINCE THE OBSERVATION THAT addition of corn-steep liquor to the synthetic culture medium increases the yield of penicillin 5-12-fold, it has been universally used as the most suitable and essential adjunct to the culture medium for the industrial production of the antibiotic. In America, corn-steep liquor is a cheap by-product of the corn-starch factories and is available in plenty. In most other penicillin manufacturing countries it has to be imported, and a search was made for locally available materials which enhance penicillin production.

A number of cheap and locally available materials have been tried as substitutes for corn-steep liquor. Cakes of groundnut, kusum (*Carthamus tinctorius*), cotton and mahua (*Madhuca latifolia*) seeds, wheat bran, mold bran, rice-steep liquor and a few combinations of these were used as nutrient supplement (2 per cent level) to the basal medium consisting of lactose (3 per cent), precipitated chalk (0.5 per cent) and tap water. The yields of penicillin were compared with those obtained by the use of routine medium containing corn-steep liquor supplement (2 per cent).

Cottonseed cake, singly or in combination with mold bran and rice-steep liquor, has been found to be a good substitute for corn-steep liquor in the production of penicillin even without the added precursor (phenyl acetic acid, 0.1 per cent). While in the case of corn-steep liquor, penicillin production falls appreciably when the precursor is not added, in the case of cottonseed cake plus mold bran plus rice-steep liquor solid supplement, the yield is nearly the same with or without the addition of the precursor and almost as high as with corn-steep liquor supplement,

in the presence of the precursor. It is probable that growth factors, as well as some precursors, are present in some form or other in these nutrients [*Ann. Biochem.*, **15** (1955), 155].

Antibiotics in food preservation

RECENT INVESTIGATIONS CARRIED out at the laboratories of the Department of Scientific & Industrial Research, U.K., have shown that the use of antibiotics in preserving food has great advantage in tropical countries, where facilities for refrigeration are not easily obtainable. It has been found that the injection of an antibiotic into an animal just before it is slaughtered also helps to preserve it for several days, instead of one or two days normally possible. Similarly, it has been found that fish like haddock and cod can be kept in good condition for 7-10 days longer than usual by adding a few parts per million of an antibiotic to the ice in which the fish is packed immediately after it is hauled from the sea. So far the best results have been obtained with aureomycin, which possesses the peculiar advantage of being rapidly destroyed when the food is cooked. Although antibiotics are expensive, such small amounts are needed in food preservation that their use would be economical (*B.I.S., BF.*, 518).

Anhydrous formaldehyde

A CONTINUOUS METHOD OF PRODUCTION of anhydrous formaldehyde patented by the Celanese Corporation of America (British Patent No. 725,642) consists in passing a current of hot trioxane vapour into contact with a non-volatile acidic catalyst maintained at an elevated temperature. Trioxane, the crystalline cyclic trimer of formaldehyde, can be produced by distilling aqueous formaldehyde containing a small amount of acidic catalyst followed by solvent extraction of the trioxane.

The trioxane vapour may be passed over a fixed bed of catalyst, or be passed at sufficiently high velocity to maintain the powdered catalyst in a fluidized form. The most suitable temperature range for the decomposition lies between 115° and 240°C.

Suitable catalysts include acidic ion-exchange resins, sulphonated coal or wood, boric and phosphoric

acids, potassium hydrogen sulphate or other alkali metal or alkaline earth metal bisulphate, and aluminium sulphate. The catalyst may be supported on carriers in the form of granules or powder at about 80-350 mesh suitable for fluidized bed operations. The carrier may be of an inert type such as silicon carbide or porous glass, or may be of a surface-active type such as activated silica gel or alpha-alumina.

With phosphoric acid on silicon carbide excellent results are obtained at 210°-30°C., while with potassium hydrogen sulphate supported on active carbon a temperature range of 115°-25°C. is most suitable. Mass velocities of 0.3-2.5 parts by weight of trioxane per weight part of catalyst per hour may be employed. The reaction may be carried out above or below atmospheric pressures, and the trioxane may be depolymerized in the presence of an inert gas diluent such as methane, ethane, nitrogen or carbon dioxide [*Industr. Chem.*, **32** (1956), 48].

Water-displacing compositions

A PROCESS FOR THE MANUFACTURE of 'water-displacing cum corrosion-preventing compositions' has been developed at the Technical Development Establishment Laboratories, Kanpur. The process involves the preparation of nitriles of higher fatty acids, followed by their dissolution along with organic soaps of higher fatty acids and an oil in a suitable solvent. The ingredients, excepting triethanolamine, which is used in very small quantities, are all indigenous.

Such compositions possess the unique property of simultaneously drying and affording temporary protection against corrosion to metal parts. Small quantities are at present imported and used in ordnance factories and for other defence requirements. Due to their essential utility in removing both loose and absorbed water from metallic surfaces, these materials are likely to find increased use in industrial engineering establishments also.

The composition prepared by the above process (Indian Patent No. 46821) possesses all the essential and desirable features of a good water displacing composition. Trials in engineering establishments have shown that its per-

formance is equal to that of imported materials.

New carbon dioxide absorbent

LISASORB, AN ABSORBENT SUITABLE for use in respiratory protective devices, has been developed at the Fuel Research Institute, Jealgora. Practical performance tests of Lisasorb undertaken by the Mines Rescue Station, Jharia, have established that its performance is satisfactory and comparable to standard imported products. Thus, the total carbon dioxide absorption capacity of Lisasorb was found to be 35.01 per cent compared to 30.05 per cent of a standard imported absorbent. The absorption capacity of Lisasorb was higher after use also, the capacity being 27.6 and 27.1 per cent respectively after 2 and 4 hr. use, compared to 22.2 and 22.1 per cent of a standard imported absorbent.

The carbon dioxide absorbents are required in factories, mines, industries and in any circumstances where one is to penetrate into irrespirable atmosphere with self-contained breathing apparatus. The annual requirement of such absorbents is several lakh pounds, and the requirement of the Mines Rescue Stations of the Government of India and the mines are over 200,000 lb. per annum, all of which is imported.

The process for the manufacture of Lisasorb is covered by Indian Patent No. 53,607 and consists essentially of fixing soda lime on a kieselguhr-alumina base under defined and controlled conditions. The main raw materials required are good quality burnt lime, caustic soda and kieselguhr, all of which are easily available in India. The equipment needed for manufacture is simple and can be easily fabricated or procured.

A flexible-tube pump

ROTAFLEX, A FLEXIBLE-TUBE pump manufactured by Gumpoldskirchner Kunststofftechnik Apparate und Leitungsbau G.m.b.H., Vienna, is based on the continuous massaging of a flexible hose by means of two planetary and flexibly interconnected toggle-mounted rollers. The liquids or gases flowing through the hoses have no metal contact. The delivery and suction effort of the pump exerts itself in both directions depending on the direction of

rotation, and the material is delivered without foaming or knocking. All moving parts inside the pump casing run on ball-bearings and are easily accessible.

The pump is designed for hand operation and for power drive. Its delivery rating is dependent upon the speed with a limit of 360 r.p.m. for motor drive. The temperature of the materials to be pumped should not exceed 140°F. The pump can also be used as a syphon. The hourly delivery of the hand-operated model is between 160 and 400 gal. and between 310 and 800 gal. respectively for the power pump [*Chem. Tr. J.*, **138** (1955), 36].

Continuous countercurrent extraction column

A CONTINUOUS, COUNTERCURRENT contact column in which the solids settle down through an upward flow of liquid has been developed by Allis-Chambers (U.S.A.). The column, originally developed for vegetable oil extraction, has been found suitable for many other operations such as ore leaching, ion exchange and absorption. Acting as a continuous sludge-settling device, it yields a clarified liquid overflow that substantially reduces filtration requirements.

Flow of solids through the column is regulated by a series of flow plates with rotating scraper arms, which take a slice of solid material from the bottom of the pile on each plate and move it to the plate opening, so that it gravitates to the top of the pile on the plate below. In effect, each plate supports a quantity of solid which is soaking in the liquid flowing countercurrent to the downward movement of solids. Solids are fed from a top opening with the help of a screw feed and are discharged at the bottom through a liquid-tight conveyor after having drained of liquid. Liquid feed is through an inlet at the bottom, and the liquid overflows through a pipe at the top. Columns are offered with diameters from 12 to 84 in., and with processing capacities up to 1,000 tons per day [*Chem. Tr. J.*, **137** (1955), 1381].

The Arc Welding of Aluminium

THIS NEW INFORMATION BULLETIN No. 19, published by the Aluminium Development Association, London, deals with all the electric

arc welding processes applicable to aluminium. Notes on factors governing the welding arc in general precede a brief description of the characteristics of aluminium in relation to arc welding. The weldability of aluminium alloys by the various arc processes is then discussed.

The first section of the bulletin, on inert-gas shielded-arc welding, deals with the tungsten electrode and the consumable aluminium electrode process. A series of tables giving recommended operating data for stated thicknesses of parent metal includes matters such as edge preparation, pre-heating if necessary, electrode and filler wire diameter, current range, gas consumption and welding arc speeds.

The section on metal-arc welding begins with recommendations on electrical equipment: choice of electrodes and fluxes are accompanied by tables giving recommended data for electrode diameter, current range and plate gap. The process of carbon arc welding is briefly described.

There are shorter statements on the process of working the weld, inspection and testing of arc welds including illustrations of radiographs and photomicrographs, and on the arc cutting of aluminium.

Soldering of aluminium

A NEW METHOD OF SOLDERING aluminium has been devised, which can be worked at a comparatively low temperature—about 250°C. At this temperature, the mechanical properties of cold-worked aluminium and the majority of its heat-treated high density alloys are not affected. The technique involves the use of an electric hot plate to raise the work to the correct temperature; a small pool of solder is deposited on the cleaned surface, which is then lightly scoured with a refractory brush made of glass fibres until the area is effectively 'tinned'. No flux is used. The surfaces to be joined after tinning are placed together and a neat fillet of solder produced by sweeping through the molten solder with the refractory brush [*Chem. Tr. J.*, **137** (1955), 1708].

Processing of uranium ore

URANIUM ORE PROCESSING AT THE Atomic Energy Commission's Feed

Materials Production Centre at Fernald, Ohio, is described. Dried and ground uranium ore and concentrates are dissolved in nitric acid and the crude uranyl nitrate solution is fed into a pulse-type stainless steel sieve tray extraction column where it is extracted in countercurrent by a tributyl phosphate-kerosene solvent. The uranyl nitrate extract is then passed to a scrubbing column where a small amount of water is added to remove soluble impurities. Next, in a stripping column, a large excess of water strips the uranium from the solvent.

The aqueous solution of uranyl nitrate is then concentrated and calcined to produce uranium trioxide. Raffinate from the extraction step is concentrated and spray calcined to recover all the nitric acid values and the various metals as dry oxides.

The trioxide is fed through a four-tier series of horizontal furnaces. In the top furnace, of type 347 stainless steel, reduction is carried out at elevated temperatures by passing hydrogen countercurrent to the material flow. Uranium dioxide is then fed into three successive Inconel furnaces against a countercurrent flow of anhydrous hydrogen fluoride, at elevated temperatures, to produce uranium tetrafluoride. The excess hydrogen fluoride is recovered in two refrigeration systems and part is recycled.

Reduction of the tetrafluoride is carried out by a thermite-type reaction. The uranium tetrafluoride is blended with a reducing agent and charged into a lined metal bomb which is then capped and heated in a furnace. The cooled reaction product takes the shape of a uranium 'biscuit'. The biscuits are heated in a graphite crucible in a vacuum induction furnace and a knock-out plug at the bottom of the crucible is used to discharge the molten metal into a graphite mould [*Industr. Chem.*, **32** (1956), 47].

Urea manufacture

THE METHOD FOR UREA MANUFACTURE employed at the Toulouse Works of the Office National Industriel de l'Azote is described. In this plant (production capacity of 30 tons daily) unreacted ammonia and carbon dioxide are used in the contiguous plant for the manufacture of ammonium sulphate from gypsum.

The feed ammonia, which is 99.9 per cent pure, needs no further treatment. The carbon dioxide feed contains 0.6 per cent carbon monoxide, 5.4 per cent nitrogen, 11 per cent hydrogen and traces of organic sulphur and oxygen, the elimination of the latter two being of particular importance if corrosion difficulties are to be avoided. The purification is effected in two phases. The feed gas, after passing through two separators where dust and water are removed, is compressed to 45 kg./sq. cm. and passed through a de-oiler and two heat exchangers cooled respectively by liquid carbon dioxide and liquid ammonia. The incondensable gases are separated from the liquid carbon dioxide and eliminated from the synthesis by a continuous purge.

The liquid is again gasified and compressed to 210 kg./sq.cm., the compressed gas passing through a separator provided with a special filter for the elimination of the final traces of dust and oil. It is now freed from its organic sulphur by passing through two large tubes charged with litharge. The charge is changed when the S content of the exit gases reaches 20 mg./cu. m., the average S content being 5 mg., the charge material is kept out of the exit gas by a special filter. Finally, all oxygen is removed from the carbon dioxide by passage over a copper-nickel base catalyst at 240°C. As it reaches the urea autoclaves, the carbon dioxide is of 98.5 per cent purity, the balance being made up of 15 per cent CO, 46 per cent hydrogen and 39 per cent nitrogen.

The actual urea process is carried out under a pressure of 160 kg./sq. cm. and at a temperature of 160°-70°C. with a practically stoichiometric mixture of ammonia and carbon dioxide. Under these conditions the yield of urea is about 40 per cent of the theoretical. The plant consists of a medium and high pressure section and a low pressure section. In the former, the ammonia received at medium pressure is compressed further to 160 kg./sq. cm. and passed into the autoclave.

The contents of the autoclave first pass through a cylindrical, externally heated vessel where unreacted ammonia and carbon dioxide are evolved for transfer to the gypsum-ammonium sulphate plant. At this stage the solution contains about 600 g.

of urea per litre. The solution is then concentrated under a partial vacuum (500 mm. Hg) and then filtered for the removal of any iron or lead precipitated which would colour the urea red and render it unsuitable for plastic-industry use. It is again concentrated under a pressure of 500 mm. Hg. Concentrated urea solution is then introduced from the top into a pulverizing chamber, where it meets an ascending current of hot air which removes most of the water and causes the solid urea to separate in fine particles. The powder is finally dried in a rotary dryer at 130°C. and then sieved [*Chem. Tr. J.*, **137** (1955), 1706].

Utilization of magnesium limes

DEFECTS IN BUILDING LIKE SPALLING and blistering of plaster coats, disintegration of mortar and general expansion of brickwork have often been noticed, when limes with a high content of magnesium oxide are used. These troubles are due to the presence of unhydrated magnesium oxide, which hydrates and expands after the plasters and mortars are in place. The slowness of magnesium oxide in magnesium or dolomitic limes to hydrate with water under natural conditions is due to an unreactive form of magnesium oxide being produced at the temperature of burning necessary to convert the calcium carbonate of the raw materials to calcium oxide. Autoclaving of magnesium and dolomite limes at high temperatures and pressures to ensure complete hydration, though feasible, is expensive.

Recent investigations have shown that unsoundness of magnesium and dolomitic limes due to unhydrated magnesium oxide can be readily overcome by treating the limes with calcium, magnesium or ammonium chloride. The results are more effective when the salts are added in the water for ganging the limes to mortar rather than in the water for hydrating the limes to powders or putties. The amount of salt needed to correct the unsoundness of magnesium or dolomitic limes is not directly proportional to the actual MgO content. It is more closely related to the original expansion of the untreated lime. For magnesium limes containing 5-15 per cent magnesium oxide the amount of any one of the salts

necessary to remove the trouble entirely is about 2.5-4 per cent.

The physical properties of the treated limes are in no way impaired and may even be improved by the treatment, and the tendency to effloresce, as measured by the hygroscopicity of the samples, is not adversely affected [*Austr. J. appl. Sci.*, **6** (1955), 516].

Bhilai Steel Project

THE GOVERNMENT OF INDIA HAVE accepted the detailed Project Report for the Bhilai Steel Works, furnished by the Soviet authorities. The proposed plant will consist of three blast furnaces for producing iron. By the use of high top pressure and sintering of iron ore, the output of the blast furnaces will be increased significantly. Steel will be produced by the straight basic open-hearth process in six open-hearth furnaces. Ingots produced will be six to seven tons in weight. The large 1,150 m.m. blooming mill will be capable of handling 10-ton ingots. The rolling mills are of modern design and layout, and incorporate technological improvements well proved in the U.S.S.R. The capacity of the plant will be, besides 300,000 tons of pig iron, one million tons of ingots yielding about 770,000 tons of rails, heavy and medium structurals, light structurals, sleeper bars and billets. With slight additions to the plant, such as an additional open hearth and a group of soaking pits, its capacity can be raised at any time to 1.3 million tons of ingots. No further additions of rolling mills will be required to finish the additional ingots. Apart from this, the plant will be so laid out that it can be expanded to produce up to 2.5 million tons of ingots.

The Bhilai Steel Works will use the hitherto unexploited iron-ore resources in the Dalli-Rajhara Pahar area, about 60 miles to the south of Bhilai. Coal will be drawn from Jharia, Bokaro and the nearby Korba fields now being developed. Power for the steel works will be supplied from a thermal station to be established on the coalfields of Korba by the Madhya Pradesh Electricity Board.

The equipment for the plant and the cost of constructing it will together be about Rs. 110 crores. The cost of equipment to be sup-

plied by the U.S.S.R. will be approximately half this amount. The steel works are expected to achieve full production by December 1959, but two coke oven batteries, two blast furnaces, two open-hearth furnaces and the blooming mill will be commissioned about a year earlier (*P.I.B.*).

Polythene manufacture

THE ALKALI & CHEMICAL CORPORATION of India Ltd., an I.C.I. associate, will soon start manufacturing polythene in India. Technical assistance in the design, construction and operation of this plant will be provided by Imperial Chemical Industries Ltd. The process to be used in India will be that developed by I.C.I. and used in the manufacture of their well-known 'Alkathene'. The project will involve a total investment of about Rs. 3 crores.

BEAMA Catalogue

THE THIRD EDITION (1955-56) OF the catalogue published by the British Electrical & Allied Manufacturers' Association Inc., London, describes in a thousand and odd pages the vast range of electrical goods and appliances offered by the British electrical manufacturers. The electric industry in Britain is not only the nation's second largest exporting industry but is also one of the world's two largest exporters of electrical goods.

In presentation and get-up, this edition follows closely the second edition published in 1952-53 and comprises seven divisions including: (1) Electrical Power Plant, containing information on the electrical and allied engineering requirements for a modern electricity supply system from the power house to the substation; (2) Electrical Equipment in Industry, Transport and Communication — illustrating electrical equipment for mines, mills, factories, workshops, railways, transport undertakings, gasworks, waterworks, etc.; (3) Domestic and Commercial Electrical Appliances, Lighting, Accessories and Installation Material — describing space and water heating, lighting, cooking, washing, drying and cleaning appliances. In the fourth division is set out a Five-language Glossary and Indices to Headings used in the Buyer's Guide. The five-language key glossary provides a

handy reference for the equivalent expressions in the German, Spanish, French and Portuguese languages for the English headings in the classified Buyer's Guide which follows. The Buyer's Guide lists alphabetically the range of electrical and allied equipment manufactured by BEAMA firms. The division of Trade Directory contains addresses of the BEAMA Export Organization including the BEAMA committees overseas; principal addresses in the United Kingdom of all BEAMA firms; the names, addresses, etc., of many BEAMA firms' overseas branches, representatives and agents. The last division is the Index to the Illustrated Catalogue Pages.

Unesco Bibliographical Services

THE THIRD ANNUAL REPORT (1953-54) on 'Bibliographical Services throughout the World' published by the Unesco is a valuable source of information both for the research worker in literature-search as well as to bibliographers who need to know on what lines the services are functioning outside their respective countries. Information from 60 countries for the period 1 September 1953 to 1 August 1954 has been compiled in this report. Besides listing principal bibliographical publications, it includes details for each country regarding bibliographies on special subjects, places where lists of periodicals can be consulted and information about bibliographical training.

A notable feature of the report is the rapid growth of such services in countries where, until recently, they were insignificant and where complex problems arising from multiracial population have to be dealt with as in Ceylon. By the starting of new services in some countries of Latin America, readers in other parts of the world are being provided with the extensive resources of hitherto little-known collections (*Unesco*).

New E.R.A. Publications

THE BRITISH ELECTRICAL & Allied Industries Research Association have recently published the following technical reports: *The Effect of Enclosure on the Temperature Rise of Fuses* by H. W. Baxter (*G/T297*, 10s. 6d.); *On the Thermal Excitation of*

Trapped Electrons in Ionic Solids by J. H. Simpson (*L/T317*, 12s. 6d.); *Gas Temperature in Argon Spark Channels* by R. D. Craig (*L/T318*, 6s.); *Stray Losses in Transformer Cores*, *Critical Résumé* (*Q/T124*, 12s.); *Stresses in High-voltage Condenser Bushings* by S. Silbermann (*Q/T125*, 12s.); and *The Application of Electricity to Crop Drying on Farms — A Critical Review* by P. Finn-Kelcey (*W/T25*, 24s.).

Eastern Metals Review

THE ANNUAL NUMBER OF THE *Eastern Metals Review* [9 (1956), No. 1] contains an exhaustive review of the progress recorded in the Indian metal, mineral and metallurgical industries. There are six sections in this number. Section A contains general and review type articles including: The mineral industry of India by P. K. Ghosh; The present and future of Indian metallurgy by Prof. M. S. Thacker; and Role of secondary refineries in India's economy by A. M. Elijah. Section B is devoted to the aluminium industry and contains the following articles: Some aspects of aluminium research in India by E. G. Ramachandran; and Expansion of aluminium industry in India by A. L. Sabharwal. The articles published in Section C, which deals with iron and steel industry, include: Problems of steel industry in India by R. M. Agrawal; and High phosphoric acid steels — their properties and uses by D. P. Chatterjee. Section D deals with minerals and the articles published include: Some recent mineral developments by B. R. Nijhawan; Mineral beneficiation and the Second Five-Year Plan by K. K. Mazumdar; and Indian manganese ore industry and trade by T. K. Uchil. Section E contains articles on miscellaneous topics and Section F gives statistics of production, imports and exports of metals and minerals.

Announcements

■ *The Fourteenth International Dairy Congress* is scheduled to be held at Rome during the last week of September 1956. The topics to be discussed at the Congress are: problems of milk production, manufacture of milk products and consumption of dairy products in various parts of the world, and the developmental programmes

undertaken for milk consumption, particularly in under-developed areas. An International Dairy Index-Book containing particulars about important dairy research and educational centres, official and private dairy organizations, dairy manufacturers and dealers of dairy machinery and equipment in different countries will be published during the Congress.

■ *The Institution of Chemical Engineers* — Application forms for entrance to the 1956 examination, returnable not later than 1 June 1956, may be obtained from the General Secretary, The Institution of Chemical Engineers, 56 Victoria Street, London S.W.1. In applying for forms, applicants should state which parts of the examination they propose to take.

■ *I.C.A.R. Fellowships* — The Indian Council of Agricultural Research has decided to offer this year a junior (Rs. 100 p.m.) and a senior fellowship (Rs. 150 p.m.) in the following eleven branches of agriculture: agronomy, horticulture, agricultural economics, agricultural botany, agricultural entomology, mycology and plant pathology, soil science, agricultural chemistry, dairying, animal husbandry and agricultural statistics. Tuition and laboratory fees will be paid in addition to the fellowships.

Junior fellowships will be awarded for postgraduate study leading to the M.Sc. and M.Sc. (Agriculture) degrees, and senior research fellowships for the Ph.D. degree. The research fellows will be required to work under teachers at universities or institutions to be selected by the I.C.A.R. The fellowships will be tenable for two years in the first instance, but may be extended in special cases by a period not exceeding one year (*P.I.B.*).

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Progress Reports

NUTRITION RESEARCH IN INDIA

THE ANNUAL REPORT OF THE NUTRITION RESEARCH Laboratories, COONOR, for the year 1954-55 records the results of an interesting analysis of 1,020 published diet surveys undertaken to compare the dietary patterns in different States with regard to the intake of the essential nutrients. The analysis indicates that while in some States like Delhi, Kashmir, Mysore and West Bengal the intake of nutrients is at marginal levels, in most of the other States it is grossly inadequate. From the common correlation matrix many of the nutrients have been found to be closely related to each other, the most significant correlation values being those of caloric value with protein (0.8002), carbohydrate (0.8241) and fat (0.4350).

A brief account of the researches carried out in the laboratory during the year is presented below.

Vitamins — A fluorometric method has been developed for the assay of vitamin A in different materials such as ghee, vegetable oils, vanaspati, etc. The material containing vitamin A is saponified with alcoholic potash under reflux using an all-glass apparatus. The unsaponified fraction is then extracted 3-4 times with low-boiling petroleum ether, washed repeatedly with distilled water to remove alcohol and soap, treated with pure anhydrous sodium sulphate to remove moisture, filtered and made up to volume. The fluorescence values of aliquots of the extract and blank solutions are noted in a photovolt multiplier photometer, model 520M, using ultraviolet light of 365 m μ wavelength from a mercury vapour lamp and combined filter Corning 3389 and 4308. A linear relationship has been observed between fluorescence and the concentration of vitamin A for the range 1-10 I.U./10 cc.

Studies undertaken to determine the effect of vitamin D deficiency on citric acid content and citrogenase activity of rachitic epiphyseal cartilage showed that a single large dose administration of vitamin D to rats with rickets results in a 100 per cent increase in cartilage citrate within 24 hr. of administration and reaching a maximum after 96 hr. The citrogenase activity also showed a 100 per cent increase after 96 hr.

Proteins — The amino acid compositions of some hitherto uninvestigated cereals, legumes and tubers used in Indian dietaries were determined. While legume proteins, in general, were found to have a high lysine content, a species of *Amaranthus* (*A. paniculatus*) was found to compare favourably with whole egg in this respect.

Studies on the biological action and properties of the ovomucoid of duck egg white (DEW), known to possess anti-tryptic and growth-retarding properties, revealed that ingestion of protein in the diet helped to overcome the inhibitory action of the ovomucoid. Physico-chemical studies on purified hen egg (HEW) and duck egg ovomucoid have shown both the ovomucoids to be soluble in water and resistant to precipitation by the common protein

precipitants such as heavy metal salts, trichloroacetic, glyoxalic, phosphomolybdic and tannic acids. Both are non-reducing and give tests for the presence of carbohydrates and negative tests for SH groups.

For studying the effects of protein depletion on the activities of various liver and plasma enzymes, different groups of albino rats were fed diets containing varying proportions of proteins. The results indicate that the effects of calorie restriction superposed as a result of protein depletion are variable in different organs. Whereas in the small intestines and pancreas the effects are not noticeable at all, calorie restriction appears to be beneficial to the liver.

The rate of absorption of wheat gluten has been shown to be quicker than that of wheat flour proteins, the peak of amino nitrogen being reached about 2 hr. earlier in the case of the former. The excretion of urinary nitrogen was also quicker and greater in wheat gluten than in wheat flour test meal, the difference being most marked during the first 4 hr. The minimum protein requirement of Indian subjects was determined from feeding trials on human beings as 3.55 g./sq. m., which works out to 38.2 g. of protein (from cereal and pulse mixed) per day per adult weighing 70 kg.

Fats — A method has been worked out for the quantitative partition chromatographic determination of the octadecanedioic acids of natural fats employing the aqueous and benzene phases of a well-shaken mixture of suitable proportions of water, ethanol, methanol and benzene as the stationary and eluting phases respectively. The eluate is collected in fractions of suitable volumes and titrated against standard alkali. A plot of the volume of alkali consumed against the number of fractions shows that the acids get eluted at well-defined intervals and in the decreasing order of their C-chain lengths. The volume of alkali needed to neutralize each of the bonds is a quantitative measure of the acid comprising it. Free acids can be liberated by acidifying the sodium salts obtained on concentrating the eluate fractions. Using this technique, Δ^8 and Δ^{10} monoethenoid acids have been shown to predominate next to elaidic acid in vanaspati.

Clinical — A large number of biological and physico-chemical investigations were undertaken in connection with the disease kwashiorkor resulting from protein deficiency. A proportion of the fat excreted by the patients has been shown to be of endogenous origin and to be made up of fatty acids and neutral fat. The severity of steatorrhoea (excretion of fats) was found to bear no relationship to the clinical severity of the case. Regarding the efficacy of different protein dietary regimens for curing the disease, Bengal gram (*Cicer arietinum*) was found to be inferior to skim-milk in the matter of regeneration of cell 'solids' fat and minerals. When supplemented with calcium lactate the gain in minerals on Bengal gram was comparable to that obtained on skim-milk diet. Maternal malnutrition has been shown to have no direct relation with the etiology of the disease.

COLONIAL RESEARCH, 1953-54

THE ANNUAL REPORT FOR 1953-54 ISSUED BY THE Colonial Research Council comprises, in addition to the Annual Report of Colonial Research, the annual reports of the Colonial Products Council, the Colonial Social Science Research Council, the Colonial Medical Research Committee, the Committee for Colonial Agricultural, Animal Health and Forestry Research, the Colonial Insecticides, Fungicides and Herbicides Committee, the Colonial Economic Research Committee, the Tsetse Fly and Trypanosomiasis Committee, the Colonial Fisheries Advisory Committee, the Anti-Locust Research Centre, and reports of other specialist advisory bodies.

With effect from 1 January 1954, the Colonial Products Research Council was dissolved and replaced by a new body, the Colonial Products Council. The new Council, in addition to performing the functions assigned to the former Colonial Products Research Council, has assumed responsibility for the general supervision of the work of the Colonial Products Laboratory (formerly the Colonial Products Advisory Bureau).

Grants involving £ 728,510 were allocated for work on 42 schemes and 49 supplementary schemes were made during the year, as compared to £ 1,087,041 in the previous year. The new schemes include establishment of a pool of colonial surveyors; research into insect physiology in the tropics; a scheme for the control of malaria in a hyperendemic area at Taveta-Paro; aircraft insecticide spraying work; a pilot scheme for tsetse reclamation; establishment of a Fungicide Research Unit; investigation into the control of infestation of stored rice; investigations on bilharzia; control of filariasis by insecticidal methods; research into 'unknown' disease of coconuts in Jamaica and Panama disease of bananas; control of insect parts; and investigations on cocoa beetle.

Some of the investigations carried out by the Colonial Products Council during the year are described below.

Vegetable insecticides and drugs — An analytical procedure based upon chromatographic technique has been developed whereby 'pyrethrin I' and 'pyrethrin II' fractions may be readily separated and determined spectrophotometrically. Further work is in progress to obtain a more complete separation of the 'pyrethrin' moieties into the true pyrethrin and cinerin components.

Pyrethrum flowers grown on the Andhali plateau at Aden were examined and found to contain 1.25 per cent total 'pyrethrins'; especially noteworthy was the high ratio (1.98) of 'pyrethrin I' to 'pyrethrin II'.

During the course of work on the constitution of ictrogenin, a jaundice-producing constituent of *Lippia rehmanni* Pears, a new triterpenoid, rehmamic acid, was isolated and its constitution elucidated.

Essential oils — Unlike Dalmation sage oil from *Salvia officinalis*, in which thryone is the principal ketone present, the oil from *Salvia cypria* was found to have camphor as its main ketone. Three species of cinnamomum from Sarawak, *C. parthenoxylon*, *C. iners* and a third unidentified species known locally as 'Medang kerangas', were investigated for the safrole content, a starting material in the synthesis of piperonyl butoxide, which is synergist

for pyrethrum insecticides. The wood of *C. parthenoxylon* and the wood, bark and leaves of 'Medang kerangas' all yielded oils containing safrole. The wood and bark of 'Medang kerangas' are particularly promising sources of safrole, the bark giving a 5.5 per cent yield of oil containing 75.6 per cent of safrole, and the wood a 1 per cent oil containing 94.9 per cent of safrole. It is estimated that distillation of the wood and bark together should give an oil containing 80 per cent safrole.

Paper-making materials — Batai wood (*Albizia fulcata*) from the Federation of Malaya was pulped by the sulphate process. It gives a pulp comparable to coniferous sulphate pulps. A mixed sulphate cook on three species of timbers from Kenya (viz. *Neoboutonia macrocalyx* Pax., *Macaranga kilimandscharica* Pax. and *Croton macrostachys* Hochst) gave a bleached pulp suitable for incorporation in printing or writing papers. Ribbons of *Hibiscus cannabinus*, obtained during the work in Nigeria on the mechanized production of stem fibres, gave a good quality pulp suitable for high-strength papers of all types.

Fibre board — Investigation on the production of hard board from four Malayan timbers, namely kempas (*Koompassia malaccensis*), red meranti (*Shorea leprosula*), keruing (*Dipterocarpus crinitus*) and balau (*Shorea laevis*), have shown that satisfactory boards can be made from the first two. A short chemical treatment of the chips of kempas followed by mechanical defibration in the disc mill gave a high yield of pulp from which boards of more than adequate strength can be made. Tempering treatments involving additions of linseed oil of the order of 2 per cent greatly improve the quality of the boards, somewhat larger additions (about 3.5 per cent of oil) improving it to the level of super-hardboard. The process is similar for red meranti, but in this case a tempering process involving heating only, without any addition of oil, was sufficient to enable the meranti boards to meet the requirements of the British Standard Specification for super-hardboard.

Hides and skins — Examination of the tanned skins of two types of goat in Uganda showed that the short-haired Mubende medium provide better skins for leather manufacture. Trials of dry-salting and straight-drying of sheep and goat skins in the Sudan indicated that there was a ceiling temperature for drying skins in the sun, above which serious damage resulted.

Carbohydrates — A range of dextrans has been isolated by growing various bacteria and moulds on cane sugar. Dextran-like products and amino sugar-containing polysaccharides have been obtained from various wood-rot fungi.

The dextran-synthesizing enzyme 'dextran-sucrase' (a complex of the enzyme with dextran) has been isolated from cultures of *Betacoccus arabinosaceus*. It has been shown that certain simple sugars (mainly glucose derivatives) increase the rate of conversion of sucrose by the enzyme and enter into the synthesis to produce oligosaccharides and finally dextran. The dextran produced by this bacterium has been shown to be a mixture of branched and unbranched components. The size and shape of dextran molecules could be controlled by altering growth conditions and the 'priming' receptor molecules.

(Continued on page 256)

INDIAN PATENTS

[A few of the Patent Applications notified as accepted in the *Gazette of India*, Part III, Section 2, 25 February to 24 March 1956, are listed below.]

Chemicals, plastics, rubber, paints and allied products

52528. Production of new pyrazolone derivatives: *Condensing reactive derivative of a cyclopropane carboxyl acetic acid with an aryl hydrazine* — J. R. GEIGY A.-G.
52873. Manufacture of new piperidines: *A phenyl alkyl pyridine is hydrogenated, or a 5-oxo-pentanoic-1-acid nitrile phenyl-*

$$\begin{array}{c} \text{CH}-\text{CO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CN} \\ | \\ \text{R}^1 \end{array}$$
R¹ representing an alkyl radical, is treated with hydrogen in the presence of a catalyst — CIBA LTD.
55074. Manufacture of a pyridine sulphonic acid: *Reacting 3 pyridine sulphonyl halide with a hydrazide and treating the hydrazide with a carbonyl compound* — F. HOFFMANN-LA-ROCHE & Co. AKTIENGESELLSCHAFT
55101. Epoxidation of water-insoluble unsaturated esters: *Reacting with aq. H₂O₂ acetic acid and for acetic anhydride and ionizable acidic agent at 10°C. to b.p. of mixture* — ROHM & HAAS Co.
55407. Production of flexible cellular material: *Forming a liquid reaction mixture comprising an active hydrogen containing polymeric material, a polyisocyanate and water and setting the mixture in an atmosphere containing ammonia* — THE GOODYEAR TYRE & RUBBER Co.
52802. New compositions comprising sulphur containing compounds: *Composition contains 1, 2-dichloro-1: 2-di-(phenylthio) ethylene together with a diluent or carrier* — BOOTS PURE DRUG Co. LTD.
53660. N-Aralkyl-N-hydrocarboxyalkyl-halogenated alkanamides and preparation thereof: *The amides are prepared by reacting an amine of the formula Ar-X-NH-Y-OR with an acylating agent, X, Y and R standing for hydrocarbon radicals* — STERLING DRUG INC.
55933. Production of chlorine and an aqueous solution of lithium hydroxide: *Electrolysing lithium chloride containing alkali metal chlorides as impurities and decomposing lithium amalgam thus obtained by contacting with water in two or more stages* — OLIN MATHIESON CHEMICAL CORPORATION
52079. 2-Substituted imidazolines and their preparation: *Containing carboxylic acid with ethylenediamine* — CHAS, PFIZER & Co. INC.
52699. Aminoalkyl phenyl ethers and their salts: *Reacting a substituted phenol or its alkali-metal derivative or ester with a dialkylamine halide or secondary amine or tertiary amine* — THE UNIVERSITY OF LEEDS
53716. Manufacture of polymeric quaternary ammonium compounds: *Polymerizing a quaternary ammonium compound* — I.C.I. LTD.
53786. Preparation of a halogenated pent-yne-ene-ol: *Reacting alkyl β-halogenated vinyl ketone with lithium acetylide in presence of liquid ammonia* — CHAS, PFIZER & Co. INC.
54123. Process for the manufacture of pyridazone compounds: *A compound of the formula*

$$\begin{array}{c} (\text{R}_2\text{R}_3) \text{CH}-\text{CO}-\text{CH}_2-\text{CH}-\text{CO}-\text{OR} \\ | \\ \text{R}_1 \end{array}$$
wherein R, R₁, R₂ and R₃ stand for hydrogen or hydrocarbon radical, is condensed with phenyl hydrazine and the product is cyclized and dehydrogenated to the pyridazone — F. HOFFMANN-LA-ROCHE & Co. AKTIENGESELLSCHAFT

Chemical processes, engineering and equipment

53201. A method for carrying out chemical reactions in the gaseous phase: *By introducing the initial materials into a vortex tube under conditions such that temperatures are attained for reaction to occur* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ
53435. Process and apparatus for the production of gases: *By injecting simultaneously two mixtures of carbonaceous fuel and a free oxygen containing gas into a reaction chamber and contacting the combustion products with an endothermic gasifying agent* — HEINRICH KOPPERS G.M.B.H.
54857. Methods of and means for the estimation of small quantities of gaseous impurities in rare gases: *Apparatus comprises an electrical discharge tube, means for passing the impure rare gas at low pressure and photoelectric means for measuring the variation in colour of the discharge* — THE INDIAN OXYGEN & ACETYLENE Co. LTD.
55225. Filtering device: *Supply roller bears under pressure on intermediate roller devices and is driven by the drum body* — SULZER FRERES
52916. Improvements in or relating to froth flotation: *The frother agent is 2-ethyl hexanol, polyoxyethylene ether alcohol or ether, the frothing agent forming a molecular association with the collector at the air/water, and solid/liquid interfaces* — ANZIN LTD.

Physics, general

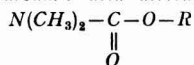
55934. Acoustic well logging method and apparatus: *Comprising generating acoustic impulses at one point, generating electric signals corresponding with the arrival of acoustic energy at a second point spaced apart from first point a predetermined distance and recording the peak value of signals generated prior to the arrival at second point of acoustic energy* — SOCONY MOBIL OIL Co. INC. (formerly SOCONY-VACUUM OIL Co. INC.)
52368. Band driving arrangements for driving magnetic storage devices: *Driving means com-*

INDIAN PATENTS

prises means for directing a flow of gas against the surface of the member to be driven — STANDARD TELEPHONES & CABLES LTD.

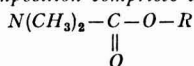
Drugs and pharmaceuticals

52534. Synthesis of steroids: *A 2- α -acetonyl-4- β -oxy-polyhydrophenanthrene-1-one containing a bridge consisting of two carbon atoms and connecting the 2-carbon atom with the 4 β -oxy group is cyclized* — CIBA LTD.
52580. Improvements in or relating to preparation of terpene thiocyanates for use as insecticides: *Comprising reacting terpene chloro-esters with an alkali thiocyanate dissolved in a lower alcohol or ketone at 55°-80°C.* — DIRECTOR, INDIAN AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI
52052. Substances having insecticidal properties: *Reacting phenol having at most three chlorine atoms with dimethyl carbamic acid chloride and using mixed with usual carriers and diluents* — N. V. PHILIPS' GLOEILAMPENFABRIEKEN
52053. Manufacture of a substance having insecticide activity: *Carbamic acid derivatives are prepared by reacting a phenol or naphthol with dimethyl carbamic acid* — N. V. PHILIPS' GLOEILAMPENFABRIEKEN
52578. New acaricidal compositions: *Comprises a compound of the general formula R_2S_2 together with a diluent or carrier* — BOOTS PURE DRUG CO. LTD.
54266. Improvements in or relating to therapeutic antibiotic compositions and the preparation thereof: *Comprising tetracycline, oxytetracycline or chlorotetracycline suspended in mineral oil* — CHAS. PFIZER & Co. INC.
54997. New acetanilide derivatives and the manufacture thereof: *Dichloro-acetyl chloride is reacted with a substituted aminophenol* — BOOTS PURE DRUG CO. LTD.
55064. Vaccine products and method for preparing the same: *Poliomyelitis virus antigen is absorbed from a killed aqueous poliomyelitis vaccine on to aluminium phosphate, the phosphate with the antigen is separated and resuspended in an aqueous medium* — PARKE, DAVIS & Co.
55313. Process for preparing therapeutically active amines: *β -Ionone or 4-(2, 6, 6-trimethyl-1-cyclohexen-1-yl)-2-methyl-2-buten-1-ol is reacted with a diamine, $H_2N-(alkylene)-R_1$, R_1 representing a tertiary amino group, in the presence of a reducing agent* — F. HOFFMANN-LA-ROCHE & Co. AKTIENGESELLSCHAFT
- 56660 and 56661. New insecticidal compositions: *Contains carbamic acid derivative of formula*



where R represents a phenyl or naphthyl group, and a carrier.

The composition comprises a compound



wherein R stands for a phenyl group containing 1-3 chlorine atoms, and a carrier — N. V. PHILIPS' GLOEILAMPENFABRIEKEN

55183. Process of producing tetracycline: *Streptomyces sp. ATCC No. 11834 is grown under*

aerobic conditions in nutrient medium to produce tetracycline — OLIN MATHIESON CHEMICAL CORPORATION

54391. Production of tetracycline by the hydrogenolysis of chlortetracycline: *Reacting chlortetracycline with hydrogen in presence of palladium hydroxide catalyst* — AMERICAN CYANAMID Co.

Fuels and lubricants

53475. Process and apparatus for coking heavy hydrocarbon oils: *Wherein the mass, number and size distribution of coke particles is maintained constant by constantly withdrawing large coke particle and replacing them by equal number of smaller particles* — ESSO RESEARCH & ENGINEERING Co.
55499. Mixer tube for a gas burner: *Gas inlet end of the tube bore is wholly confronted by a reflector* — THE INDIAN OXYGEN & ACETYLENE Co. LTD.

Metals and metal products

55691. Process for recovering purified mercury from impure mercury containing alloying metal impurities: *Agitating impure mercury with aqueous solution of mineral acid and an ammonium salt of the mineral acid* — OLIN MATHIESON CHEMICAL CORPORATION
54036. New and improved delay fuse compositions and articles comprising same: *Comprising titanium having a particle size not greater than about 60 and at least one oxidizing agent* — I.C.I. LTD.
52622. Apparatus for electromagnetic detection of ores and conductive bodies and formations: *In which imaginary disturbances created by the masses of metal situated near the transmitting coil, interfering with the precise measurement of the imaginary and phase difference anomalies caused by ores, may be eliminated by means of a compensating auxiliary coil* — CANADIAN AIRBORNE GEOPHYSICS LTD.

Glass and ceramics

52935. Improvements in or relating to a method for forming fused bifocal lens blanks: *Flowing molten glass of predetermined index of refraction into the counter-sink within major element of a bifocal lens blank, to form and fuse minor element in situ in one operation* — PITTSBURGH PLATE GLASS Co.

Building materials and methods

52654. Prefabricated structural member: *Comprising a sheet curved in an arc having at least two longitudinal sinuous corrugations and an intermediate corrugation having a number of sinuously continuous transverse corrugations, the ratio of their width to depth being 5:1 or more* — MARTIN, PEDERSEN & PEDERSEN (Jr.)
53985. Building structures: *A beam member has a groove in its face which receives a connecting device, the device and the member have at least one aperture engaged by a bolt* — HARRISON
54411. Sheet cladding for use in construction of walls and roofs: *Wherein the cladding sheets are formed with an initial set so that they are bowed*

in an inward direction transversely to the corrugation — ARCON (PROPRIETARY) LTD.

52745. Process for producing pre-stressed reinforced concrete structural components: *Reinforcing irons bent to hair pin shape and inserted into moulds with bent ends supported against anchor plate at one end by wedge-shaped guiding members and the free ends supported by bearing members against another anchor plate; pre-stressing effected after hardening of concrete by local displacement of wedge-shaped members* — BOCK

Miscellaneous

55126. Improved cowdung gas plant: *Entire portion of sides and practically whole portion of digester tank cover kept immersed in slurry in tank* — SWAMI VIMUKTANANDA
52949. Improvements relating to the control of air-conditioning apparatus: *A wheatstone bridge device is provided having balancing means, sensing means and ratio means* — J. STONE & CO. (DEPTFORD) LTD.
53998. Photo-sensitive material and a process of making same: *A photographic carrier and light sensitive stabilized diphenyl amine compound having at least one diazo group in its molecule* — CINETECHNIK A.G.
52677. Improvements in and relating to colour photographic processes and materials: *Developing primary negative material, then applying a take-off material including a metallic sulphide whereby an image is formed of the uppermost image of said negative material, obliterating uppermost image of primary negative and printing from the image in the remaining layer or from layers of said primary material* — H. V. FRAUNHOFER & H. E. COOTE
52695. Process for the manufacture of pulp: *Fibrous material is impregnated with caustic soda lye and treated in a screwpress after which the material is subjected to milling treatment* — ASCHAFFENBURGER ZELLSTOFFWERKE AKTIENGESELLSCHAFT
52894. Improvements in or relating to the production of thermosetting adhesive composition: *Treating gluten in alcohol and cashew-nut oil with formaldehyde* — PRESIDENT, FOREST RESEARCH INSTITUTE & COLLEGES, DEHRA DUN

PROGRESS REPORTS — *Continued from page 253*

The use of Meyer's dinitrosalicylate reagent for reducing-end-group assay was investigated under anaerobic conditions. It was found that (a) greatly increased sensitivity in the estimation of glucose, maltose, etc., was obtained in the absence of oxygen; (b) the reagent did not randomly degrade polysaccharides in the absence of oxygen as does an alkaline ferricyanide reagent; and (c) the oxidation proceeded far beyond the terminal glucose unit in a polyglucosan or oligosaccharide, i.e. a magnification procedure was discovered whereby it should be possible to estimate the molecular weight of very large polysaccharides.

The conditions have been found in which molasses may be converted into laevulinic acid and the product isolated. The process involves only small quantities of the reagents.

Microbiological research — Methods have been developed for the quantitative estimation of each

polyphenolic component both of the fresh and of the cured cocoa beans. The biochemical changes in cacao beans during fermentation have been studied, and considerable evidence has been obtained to show that the purple colour remaining in the beans after an unsatisfactory fermentation is not due to the anthocyanin pigments of the fresh bean remaining unattached. Further investigations on the loss of purple colour in fermenting cacao beans indicate that the process might be non-enzymic. This view, however, does not explain the failure of boiled beans to lose their colour on fermentation.

Pilot plant scale production of comirin, a new antifungal antibiotic discovered and developed at the Colonial Research Institute, has been undertaken. The use of comirin in the suppression of fungus and yeast infection in human and plant tissues is being investigated.

PSORALEA & OTHER INDIGENOUS DRUGS USED IN LEUCODERMA

B. MUKERJI

Central Drug Research Institute, Lucknow

THE genus 'Psoralea' belongs to the Family Leguminosae comprising of 100-115 species^{1,2} of strongly scented herbs, shrubs and under-shrubs distributed in the tropical and subtropical regions. Of these, the tubers of *Psoralea esculenta* Parsh. were employed by the American Indians and the settlers as articles of food. *Psoralea glandulosa* Linn. and *P. pentaphylla* Linn. are used medicinally in West Indies and in Mexico. The leaves of *P. glandulosa* Linn. are used as a tonic or anthelmintic and the roots are used as an emetic. *P. butiminosa* Linn. (containing 0.028 per cent essential oil) growing in Arabia and *P. physodes* Dougl. of California are popularly considered as a tonic and an emmenagogue. *P. psoralioides* (Walt.) Cory. [*P. pedunculata* (Mill) Vail, *P. melilotoides* Michx. (Congo root, Bob's root, Samson's snake root)] of Virginia has been recommended as an aromatic bitter tonic, especially useful in chronic diarrhoea. The root yields a bitter principle and about 2 per cent of a volatile oil having a pungent and bitter taste. *P. pinnata* Linn. and *P. polysticta* Benth. are used medicinally in South Africa.

The most important among the species of psoralea is *Psoralea corylifolia* Linn., also known as 'Malay tea' or 'Bawchang seed'. It is indigenous to India and is a common herbaceous weed growing throughout the plains. Its vernacular names are: Bengali—*Latakasturi*; Hindi—*Babchi*; Gujarati—*Bavachi*; Marathi—*Babchi*; Oriya—*Vakuchi*; Punjabi—*Babchi*; Sanskrit—*Sugandha-*

kantak; Tamil—*Karop-karishi*; Telugu—*Kalagiuja*. The seeds of this plant have been in use in the Ayurvedic system of medicine. Mention of its uses has been made by ancient Hindu physicians and according to some they are laxative, stimulant and aphrodisiac. The seeds have been specially recommended in the treatment of leprosy, internally and also applied externally in the form of a paste or ointment. The drug was considered so efficacious in leprosy that it was known as *Kusthanashini*, meaning 'leprosy destroyer'. In inflammatory diseases of the skin such as psoriasis and in leucoderma, it is prescribed both as a local application and by the mouth. The seeds are also used as an anthelmintic, diuretic and diaphoretic in febrile conditions³.

The data relating to botany, pharmacology and chemistry of the different species of psoralea, excepting *Psoralea corylifolia*, are extremely meagre. In the case of *Psoralea corylifolia* also very little work was done till 1923 when a careful examination of the seeds was made in the Calcutta School of Tropical Medicine and an oleo-resin fraction was prepared for clinical trials. This gave a fresh impetus to the modern physicians and the results of its local application in leucoderma being fairly satisfactory, considerable amount of interest in the further study of this drug was aroused. Since then it is occupying an important place in the treatment of leucoderma, though its use in leprosy has been more or less abandoned.

Another important drug, but not of Indian origin, which has recently been given a prominent position in the treatment of leucoderma is *Ammi majus* Linn. growing in Egypt. Its efficacy in the treatment of leucoderma was first observed in 1948 in Egypt⁴ and later in France. Its active constituents, either in the form of tablets or extracts, were tried and encouraging results have been reported. Further, the isolation of its active constituents and the subsequent establishment of their similarities with 'xanthotoxin' and 'imperatorin' opened up a new line of investigation on the therapeutic efficacy of the above-named compounds in leucoderma.

New interest has since been aroused in India on the possible pigment-stimulating properties of similar chemical compounds in the treatment of leucoderma. Several Indian indigenous drugs such as *Ficus carica*, *Aegle marmelos*, *Luvanga scandens* and *Angelica archangelica* contain these principles. Attempts are now being made to undertake detailed studies of these drugs with regard to their uses in the treatment of leucoderma.

A brief survey of the available present-day knowledge about the chemistry, pharmacology, therapeutic uses, etc., of these drugs has been made in the present review.

Psoralea corylifolia Linn.

Description — It is an erect annual herbaceous plant, 0.6-1.2 m. high. Branches are firm and conspicuously gland-dotted. Leaves are simple, distinctly petioled, roundish, 3.8-7.5 cm. long, inciso-dentate, firm in texture, both sides conspicuously dotted with black dots, nearly glabrous. Flowers close, in dense axillary 10-30-flowered racemes; peduncles 2.5-5 cm. long, hairy; pedicels very short. Calyx 3.4 mm. long, hairy outside, the upper teeth linear-lanceolate, the lower ovate, twice as long as the upper. Corolla bluish purple, nearly twice as long as the calyx. Pod small, black, sub-globose, glabrous, one-seeded indehiscent, the pericarp adhering to the seed.

Pharmacognosy: **Macroscopic** — *Psoralea* seeds are really fruits with pericarp adhering to the seed coat, 3.5-4.5 mm. long, 2-3 mm. broad. Pods one-seeded, ovoid-oblong, somewhat compressed, glabrous, mucronate, closely pitted, giving the appearance of a bath sponge under a magnifying lens. Colour dark chocolate to almost black. Cotyledons



FIG. 1 — *Psoralea corylifolia* LINN.

do not contain any starch. Odourless, but when chewed, the smell of a pungent essential oil is observed; taste bitter, unpleasant and acid.

Microscopic — The pericarp consists of small thin-walled parenchymatous cells in the early stage. At maturity the pericarp gets reduced and the parenchymatous cells composing it collapse a good deal. The testa of the seed is represented by 4-5 layers of cells, a layer of prismatic cells in the outermost side, a layer of parenchyma below it and then a layer of thick-walled cells and a layer or two of parenchymatous cells on the inner side. The seed is attached to the pericarp by a small fan-shaped funicle.

Chemistry — *Psoralea* seeds contain a colourless oil, 13.2 per cent of extractive matter, albumin, sugar, 7.4 per cent ash and

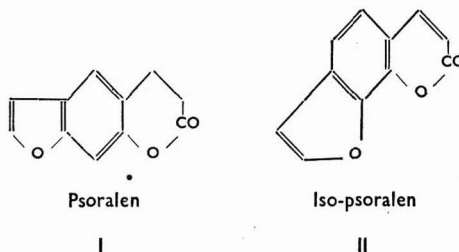
traces of manganese⁶. Menon⁷ obtained a fatty oil from the seeds and determined some of its physical and chemical constants.

Sen *et al.*⁸ have carried out a thorough examination of the seeds and found that they contained (1) an unsaponifiable oil having the formula $C_{17}H_{24}O$, boiling between 180° and 190°, at 11-15 mm. Hg pressure; (2) a yellow acid substance, $C_{40}H_{45}O_{10}$; and (3) a methyl glucoside, m.p. 105°-7°. According to them, the unsaponified oil is pharmacologically active and was, therefore, tried in cases of leucoderma and psoriasis. Later Chopra and Chatterjee⁹ studied the chemistry of the seeds. They observed that the chief active principle is an essential oil. Besides the essential oil, the seeds contain a fixed oil, a resin and traces of a substance of alkaloidal nature. The essential oil was obtained in 0.05 per cent yield and had the following constants: sp. gr. at 25°, 0.9072; refractive index, 1.5025; and solubility in water at 25°, *c.* 0.0197 per cent. The essential oil on keeping deposited needle-shaped crystals.

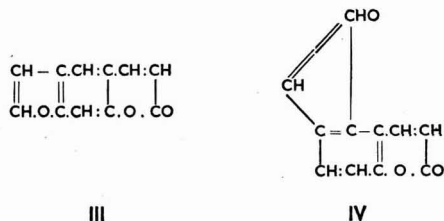
Jois *et al.*¹⁰ have observed that the petroleum ether extract of the seeds yielded a dark reddish brown oil and a crystalline solid, $C_{11}H_6O_3$, m.p. 162°, which they named 'Psoralen'. Chopra and Chatterjee (*loc. cit.*) have also pointed out that the oil obtained from psoralea deposited on keeping a crystalline solid, melting at 135°. These crystals were probably of psoralen in an impure state, since, the crystalline solid obtained by Jois *et al.* (*loc. cit.*) at first had a m.p. of 135°; on repeated crystallization it melted at 162°. Further, the oil was found to contain a considerable quantity of resin. The fatty acids obtained from the oil were found to be principally palmitic, oleic and linolic acids together with small amounts of stearic, lignoceric and linolenic acids. Psoralen is sparingly soluble in cold petroleum ether and ether but dissolves readily in alcohol and chloroform. It crystallizes from boiling water in long silky needles. Preliminary investigations have indicated that it is possibly a coumaron-coumarin.

On further investigation, Jois and Manjunath¹¹ observed that two furocoumarins consisting of not only psoralen but also iso-psoralen were present in the crystalline precipitate (0.25 per cent of seeds) obtained from the fatty oil of the seeds. The identity of psoralen and iso-psoralen as indicated by the similarity of their properties and of those

of some of their derivatives has been confirmed by mixed m.p. determinations¹². The structures (I) and (II) were assigned to psoralen and iso-psoralen respectively.



Spath and co-workers¹³ isolated from the roots of *Angelica archangelica* a furocoumarin 'angelicin' and established its structure by synthesis. Iso-psoralen was found to be identical with angelicin¹². Seshadri and Venkatarao¹⁴ obtained from the pericarp, by extracting the entire seeds with ether, an alkali-soluble resin, volatile essential oil and non-volatile terpenoid oil, and from the crushed kernel, by extraction with light petroleum, a mixture of psoralen and iso-psoralen and a fixed oil from which a sterol (probably phytosterol), m.p. 126°-28°, was isolated as acetate. Rao *et al.*¹⁵ observed that psoralen separated from a mixture containing iso-psoralen was converted into trans-psoralic acid (m.p. 225°-27°) by treating the substance in 5 per cent sodium hydroxide solution with mercuric oxide. In a similar manner iso-psoralen was converted into trans-iso-psoralen; m.p. 173°-75°. Spath *et al.*¹⁶ synthesized an isomer of angelicin and obtained a furocoumarin, m.p. 171°, which had the structure (III) or (IV). Its properties indicated that it might be identical with psoralen. Okahara¹⁷ isolated from the leaves of *Ficus carica* Moraceae a furocoumarin, ficusin, m.p. 161.5°-162°, which he showed by degradation to be fur-2, 3-dicarboxylic acid. He also showed α -resodicar-



boxylic acid to have the structure (III). The m.p. of a sample of ficusin did not depress the m.p. of freshly sublimed psoralen or synthetic furocoumarin. Psoralen and ficusin are, therefore, identical.

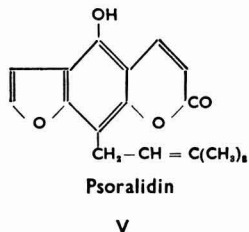
Jois and Manjunath¹⁸ have shown psoralen to be identical with ficusin. With fuming nitric acid (sp. gr. 1.52) psoralen in cold acetic acid gives nitro-psoralen, a brownish yellow product, m.p. 278°-79° (decomp.). Okahara¹⁹ repeated the synthesis of psoralen by the method of Spath and co-workers and obtained a product melting at 161°-62° instead of 171°. Ficusin purified by sublimation in high vacuum and recrystallized from methyl alcohol gave m.p. 161°-62°, which agrees with that reported by Jois and Manjunath for psoralen and iso-psoralen. Bose and Finlayson²⁰ found that when the coumarin derivative isolated from the essential oil of *Phebalium argenteum* Smith²¹ was purified by sublimation at 120°-30° under 0.05 mm. Hg pressure and crystallized from methyl alcohol, it yielded a crystalline product (m.p. 166°-67°) identical with psoralen.

Spath and Hiller²² observed that of the two furocoumarins isolated from the leaves of *Ficus carica* Linn. by Okahara¹⁷, one was considered to be bergapten²³, C₁₂H₈O₄, m.p. 188°, and the other 'ficusin', C₁₁H₆O₃, m.p. 162°. Okahara assigned to it the same structure established by Spath and co-workers for psoralen. Rangaswami and Seshadri²⁴ determined the solubility of psoralen and iso-psoralen mixture prepared from *Psoralea corylifolia*. The solubilities at 27° in 100 cc. of oil are: (i) coconut, 2.7 g.; (ii) arachis, 1.71 g.; and (iii) sesame, 1.71 g. They found that the solubility at 100° was three times that at 27°. Chakravarti *et al.*²⁵ isolated from the pericarp of the seeds of *Psoralea corylifolia* a new crystalline substance and named it 'psoralidin' (m.p. 315°; decomp.) in a yield of 0.05 per cent of the weight of the seeds. They also obtained psoralen and iso-psoralen apart from the essential and turpenoid oils and resin acids. The kernel yielded psoralen and iso-psoralen and the fixed oil as reported by the earlier workers but no psoralidin. The isolation of psoralidin was based on its comparatively sparing solubility in a mixture of ether and petroleum ether in which psoralen and iso-psoralen and other constituents are readily soluble. The resin from the mother liquors of crude psoralidin yielded psoralen (m.p. 169°) and iso-psoralen (m.p.

142°) through its alkali-soluble fraction in a total yield of 0.33 per cent.

On the basis of chemical analysis, psoralidin has been assigned the formula C₁₆H₁₄O₄²⁶. Its methyl and acetyl derivatives show the presence of one hydroxyl group and its behaviour towards alcoholic alkali indicates the presence of a lactonic group. Coumarins containing an alkoxy group, e.g. Me₂C = CH-CH₂-O, get readily hydrolysed by concentrated sulphuric acid and acetic acid into the phenolic compounds. The methyl derivative of psoralidin under similar experimental conditions, however, does not get hydrolysed into the corresponding phenolic derivatives. Such a grouping, therefore, which could have accounted for its fourth oxygen atom did not appear to be present in psoralidin. In the absence of any direct proof of the function of this oxygen atom, it has been assumed to be present in an inner ether linkage. On the basis of the experimental findings noted above and the possible genetic relationship of psoralidin with psoralen it appeared likely that psoralidin should be derived from psoralen through the attachment of a phenolic hydroxyl group and an isoprene chain to the benzene ring as in the case of a number of naturally occurring coumarins and furocoumarins.

This view has subsequently received additional support through a study of the oxidation of methyl psoralidin with chromic acid in glacial acetic acid. The acetone resulting from the oxidation of the isoprene units in methyl psoralidin as in the case of other furocoumarins containing the isoprene chain was identified through condensation with benzaldehyde in the presence of alkali giving dibenzal acetone, m.p. 111°. In view of the above, the structure (V) has been provisionally assigned to psoralidin.



The difference in the melting point of the synthetic psoralen prepared by Horning and Reisner²⁷ and that reported by Spath *et al.*¹⁶

makes it necessary to review the work on naturally occurring psoralen. Jois *et al.*¹⁰ gave the m.p. of psoralen as 162° which was supported by Okahara¹⁷, who extracted ficusin, from the leaves of *Ficus carica*, and which was later shown to be identical with psoralen and had a m.p. of 161°-62°. Later, Spath *et al.*¹⁶ reported the synthesis of psoralen and recorded a m.p. of 171° for it. The same author obtained a sample of ficusin from Okahara and after repeated purification of the sample found that the m.p. rose to 166°-67° (evacuated tube). He also obtained from Jois *et al.* (loc. cit.) natural psoralen with a m.p. of 162° and after purification found that its m.p. also rose to 169°-70°. A mixed m.p. of natural psoralen (m.p. 171°) was found to be 170°-71°. Later, Okahara¹⁹ synthesized psoralen according to Spath's^{28,29} method but obtained a product which melted at 161°-62° and not at 171°. He, however, found that further purification of natural 'ficusin' did not change its m.p. Spath *et al.*²² isolated psoralen from air-dried fig leaves from Italy and reported that it had a m.p. of 160° and on recrystallization obtained a product with a m.p. of 166°-67° (evacuated tube). The m.p. of synthetic psoralen was then accepted as 171°. Synthetic psoralen obtained by Horning *et al.* (loc. cit.), however, melted at 162°-162.5° which is in good agreement with independent reports of Okahara *et al.* (loc. cit.) for natural psoralen. The melting point in an evacuated tube was unchanged. Thus there is a lot of disagreement between the m.p. of synthetic and natural products and further work is needed to solve this discrepancy.

Preparation of the active constituents of P. corylifolia — Rangaswami and Seshadri²⁶ suggested a method for preparing the active principles of *Psoralea corylifolia*. The psoralen-iso-psoralen mixture, to which is ascribed the curative action of psoralea in the treatment of leucoderma, is prepared by initial soaking and percolation of the whole drug with methylated spirit to dissolve the pericarp and continuous extraction of the powdered kernel with 'solvent spirit' to dissolve out the fixed oil and the active crystalline principles and which are then separated mechanically.

The method for the isolation of psoralen-iso-psoralen mixture reported by Chakravarti *et al.*²⁵ is as follows: The whole seeds are first

extracted with ether to dissolve out the sticky pericarp. The seed coat is then removed and the powdered kernels extracted with hot alcohol. On concentration of the alcoholic extract, a mixture of psoralen-iso-psoralen usually crystallizes out (1 per cent in weight of seeds). A further quantity (0.33 per cent) of the mixture is obtained from the ethereal extract of the pericarp, by first crystallizing out psoralidin from the ethereal concentrate and then extracting psoralen and iso-psoralen with dilute caustic soda. Acidification of the alkaline solution followed by extraction with ether and removal of the ether yields psoralen and iso-psoralen.

In some cases it was found that the alcoholic extract of the kernels did not deposit psoralen and iso-psoralen on concentration and the process had to be modified. The alcohol was completely removed, the residue taken up in ether and the ethereal solution extracted with dilute sodium hydroxide. The alkaline solution was acidified and the psoralen-iso-psoralen mixture taken up in ether from which it was obtained by removal of ether and crystallization of the residue from alcohol.

Seshadri and Venkatarao's¹⁴ process also involves the preliminary extraction of the whole seeds with ether, but the ethereal extract is not worked up for psoralen and iso-psoralen. The ether-extracted seeds are then powdered and extracted with petroleum ether in a Soxhlet apparatus, the psoralen and iso-psoralen crystallizing out in the receiver.

Pharmacology — The essential oil has an irritant effect on the skin and mucous membrane. In 1 in 50,000 dilution of the oil, the paramoecia remained alive and active for 15 min. but some died in 40-45 min. In a stronger solution (1 in 10,000 dilution), these organisms died in 10 min. The essential oil shows a selective activity against the skin streptococci^{3,9} which are killed in 10 min. in a dilution of 1 in 10,000.

It has a distinct stimulatory action on voluntary muscle in high dilutions (1 in 50,000 to 1 in 100,000). The tone of the isolated uterus of the guinea-pig or cat is decidedly increased and the uterus may also show a tonic contraction. Perfused, isolated pieces of intestine are affected in a similar way while the peristaltic movements are found to increase. Intravenous injections of the saturated solutions of the oil have no

effect on blood pressure or on respiration. The isolated mammalian heart was neither stimulated nor depressed. There was a well-marked contraction of the arterioles in a frog when perfused with a 1 in 5,000 solution of the oil^{3,9}.

Therapeutic uses — *Psoralea corylifolia* has been used extensively in the treatment of leucoderma since early times both in India and in Western countries. Dey³⁰, while strongly recommending an oleo-resinous extract, describes the effects as follows: "After application for some days, the white patches appear to become red or vascular; sometimes a slightly painful sensation is felt. Occasionally, small vesicles or pimples appear and if these be allowed to remain undisturbed, they dry up, leaving a dark spot of pigmentary matter, which forms, as it were, a nucleus. From this point as well as from the margin of the patch, pigmentary matters gradually develop, which ultimately coalesce with each other and thus the whole patch disappears. It is also remarkable that the appearance of fresh patches is arrested by its application." So good results have, however, not been reported by any other worker. Panja³¹ has recently reported the efficacy of *P. corylifolia* oil in the treatment of leucoderma.

Different preparations of the drug have been tried at the Calcutta School of Tropical Medicine in a variety of skin affections since 1926. Acton³ tried solution of the pure essential oil, 1 in 10,000 to 1 in 20,000 dilutions, in some cases of acute streptococcal dermatitis, but unfortunately due to much irritation, conditions became worse. A 20 per cent solution of the purified resin in alcohol and a 1.0 per cent alcoholic solution of the essential oil were found to be ineffective in leucoderma. The most effective preparation was the oleo-resinous extract of the seeds which contains most of the essential oils. This preparation was gently rubbed on the leucodermic patches once or twice daily. It has been tried in a very large number of cases of leucoderma both in syphilitic and non-syphilitic groups but it was found to be ineffective in the former, because in such cases, in all probability, the melanoblasts are killed, as they are not visible in the histological preparations. It was suggested that the beneficial effects may be due to (i) absorption and excretion of the oil through the skin where it produces its specific action; (ii) increased absorption of amino acids concerned

in pigment formation due to the stimulation of the intestinal mucosa; or (iii) antiseptic action in the gastro-intestinal tract. The effect of the essential oil is purely local and, consequently, if any concurrent affections of the gut such as infection with *E. histolytica* exists, they should be treated simultaneously. The action of the oil on the skin appears to be specific, which might be readily demonstrated under a microscope on the frog's skin. The melanoblastic cells in leucoderma cease to function properly and their stimulation by the oil helps them to form and exude pigment which gradually diffuses into the decolourized areas.

The Hindu physicians, however, used to administer the powdered seeds of the drug orally while treating the cases of leucoderma but such trials were not made in the investigations mentioned above.

Clinical trials on leucoderma patients with orally administered powdered seeds of *Psoralea corylifolia* have been undertaken in several centres and by Ayurvedic physicians. In the majority of cases, undesirable side reactions such as nausea, vomiting, malaise, headache and sometimes purging have been recorded. The writer's own experience also corroborated the above facts. Presumably, the oleo-resinous fraction and the essential oil contained therein causes, on repeated administration, too much gastric irritation and this prevents either an increase in the dosage, which is often necessary to bring about pigmentagenic stimulation of the skin, or prevents absorption of the effective active ingredient in the drug. At the Central Drug Research Institute it was, therefore, thought that it would be best to treat the leucoderma cases with a psoralen-iso-psoralen mixture isolated from crude seed powder of psoralea on more or less the same principle as recommended by Rangaswamy and Seshadri²⁶. A quantity of psoralen-iso-psoralen mixture was also sent over to the Officer-in-Charge of the Dermatology and Venereology Department of the Vellore Medical College. An analysis of the results obtained at both these centres indicate that in patients below the age of 20 years and where the leucoderma is of comparatively recent origin, encouraging results can be obtained with this mixture in doses of 10-30 mg. per day after meals over a period of 7-10 days at a time, the treatment continuing for 4 months. A liquid preparation can also be made from this psoralen-iso-psoralen mix-

ture which can also be applied locally on white patches simultaneously with oral administration, daily for 3 weeks. Several patients have responded well with this treatment, the leucoderma patches in all cases showing a tendency to be covered up gradually. The initial time of response varied between 10 and 30 days. Generally, there is first a slaty hue assumed on the depigmented patches and then follicular eruptions start which go on coalescing. The borders of the depigmented patches which were, in most cases, not smaller than 3 in. in diameter, appear to get hyperpigmented comparatively early in the course of treatment, and there is also a tendency for these hyperpigmented patches to close up the depigmented patches from the side. With this treatment no systemic disorders were met with. In a few extremely sensitive patients eruptions of erythema appeared on the skin particularly after exposure to sunlight. However, these disappeared on the stoppage of the treatment. No fresh leucoderma patches appeared during the course of the treatment and relapses were also few and far between. If this treatment is supplemented with ultraviolet exposure from a mercury-vapour lamp, for 2 to 2½ min., the recovery process appears to get hastened.

While many cases have not been treated with this psoralen-iso-psoralen mixture given by the mouth, there is clear indication that oral treatment with this furocoumarin has some value which is not obtainable by external application of the crude psoralea oil alone.

Ammi majus Linn.

The dried fruit or the extract of this plant has been known to the Egyptians for their value in the treatment of depigmented areas for many centuries. Ibn El-Bitar³² and Dawood El-Antaki³³ supported this view in their writings as early as 1923. The crude material was found to be very efficacious but side effects like nausea, vomiting, malaise, pain in abdomen, faintness and even coma prevented its use among patients³⁴.

Description of the plant—*Ammi majus* Linn. belongs to the family Umbelliferae. It is a common annual herbaceous plant widely distributed throughout the Mediterranean region and grows freely in the Nile Delta region. The plant attains a height of about one and a half metres and possesses a whitish

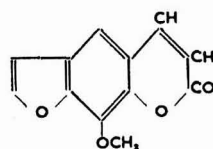
tap root with few more or less horizontal, lateral branches.

The flowers are whitish, actinomorphic or zygomorphic, hermaphrodite, pentamerous. The petals are deeply emarginate, bilobed. The plant flowers in March and April and fruits in May and June.

The fruit is a brownish, cylindrical schizocarp (cremocarp), but the colour depends greatly upon the degree of maturity. Fully ripe fruits are reddish brown, while unripe fruits vary in colour from greenish to greenish brown.

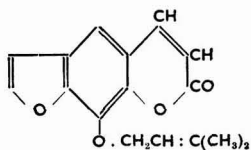
Chemistry—Fahmy and El-Keiy³⁵ analysed the fruits of *Ammi majus* and reported the following values: amorphous glucosidal principle, 1.0; tannin, 0.45; oleo-resin, 4.76; oily liquid, 3.2; fixed oil, 12.94; glucose, 0.2; protein, 13.825; and cellulose, 22.43 per cent calculated on the air-dried material. The fruits contained in addition, calcium oxalate, brown colouring matter, hemicellulose, traces of volatile oil, gummy and mucilaginous matter, etc.; moisture, 6.17; and ash, 7.09 per cent. They were unable to isolate any substance in the crystalline form. Later Fahmy and Hameed³⁶ were able to isolate from the petroleum ether extract of the powdered fruits, a crystalline principle to which they gave the name ammoidin. Two more crystalline compounds, ammudin and majudin, were isolated from the fruits of the drug later. The percentage of the three crystalline compounds, ammoidin, ammudin and majudin, obtained from the drug were 0.5, 0.3 and 0.4 respectively. Ammoidin, C₁₂H₈O₄, m.p. 148°, was found to be identical with xanthotoxin (8-methoxy psoralen), ammudin, C₁₆H₁₄O₄, m.p. 102°, with imperatorin (8-amylenoxy psoralen), and majudin, C₁₂H₈O₄, m.p. 189°, with bergapten (5-methoxy psoralen)³⁷.

Isolation of xanthotoxin and imperatorin from the fruits of the drug was also reported by Sochonberg and Sina³⁸. These have the following structures^{39,40}:



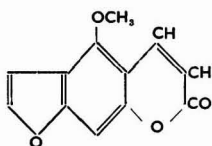
Xanthotoxin or ammoidin
(8-methoxy psoralen)

VI



Imperatorin or ammudin
(8-amylenoxy psoralen)

VII



Bergapten or majudin
(5-methoxy psoralen)

VIII

Pharmacology — Fahmy and Shady³⁷ found xanthotoxin to be non-toxic in therapeutically effective doses. The question is left open whether the activity of xanthotoxin is due to stimulation of dopase or coenzyme in functionally depressed melanoblasts or due to removal or neutralization of the cause of depression of the activity of the melanoblasts. Recent researches have revealed that ammoidin and ammudin accelerate the formation of melanin⁴¹. Elwi⁴² found that xanthotoxin or imperatorin caused pathological lesions in guinea-pigs. A single dose of 400 mg./kg. has been found to be lethal and in single doses of 200-300 mg./kg. cloudy swellings, fatty degenerations and acute haemorrhagic necrosis of the liver and severe congestion of the kidneys resulting in haematuria occurred. Continued doses of 1-2 mg./kg. for five months resulted in liver necrosis in young animals without affecting growth.

Therapeutic uses — El Mofty⁴, Hafnaoui⁴³ and Malek⁴⁴ were the first to publish encouraging results about the treatment of leucoderma with the plant extract from Egypt in 1948-50. Later Sidi and Burgeois-Gavardin^{45,46} confirmed their findings from France. The activity of ammoidin in the treatment of leucoderma, either administered orally in 0.05 g. doses three times daily or applied externally in 1 per cent liniment, was also reported in 1948. The activity of ammudin and majudin was found to be lesser than ammoidin³⁷. Lerner *et al.*⁴⁷ have also shown

that the therapeutic activity of the extract is due to ammoidin which, as already stated, is analogous to xanthotoxin and has been proved to have a photo-sensitizing action.

The drug used in the trials was available in the form of a paint for external application and tablets for oral administration. The paint contains 7.5 mg. ammoidin and 2.5 mg. ammudin per cc. and each tablet contains 10 mg. of ammoidin and 5 mg. of ammudin⁴⁸.

Behl³⁴ quite recently studied the effect of the drug on 165 cases of established primary leucoderma. Tablets, paint and in few cases intradermal injections were tried. Patients were given one tablet of *Ammi majus* thrice daily after meals and the dosage was correspondingly reduced in the case of children. Some patients complained of side effects like headache, giddiness, and sensation of heat in the body, particularly in summer, which, however, disappeared after reducing the dosage and taking plenty of butter milk or lemon juice with water. The paint was applied on the patches followed by irradiation in the sun for some minutes. Intradermal injections were given once a week at about 15-20 places at one sitting. In some cases the reaction was very severe when they were subjected to local paint and irradiation. The intradermal injections were definitely useful, particularly when there was poor response with the paint. Local reaction to oral medicine was never encountered. Improvement was usually noticed within 4-8 weeks of the commencement of the treatment. The majority of cases treated with tablets and paint improved satisfactorily while a few slightly. In the opinion of Behl, *Ammi majus* is a definite improvement in the treatment of leucoderma and although the complete-cure rate was small, there was a substantial improvement in over 66 per cent of the cases in contrast to other photo-sensitizing agents like psoralea.

Venkateswaran⁴⁸ treated 9 cases of vitiligo with the extract of *Ammi majus* Linn. Although nine cases are not sufficient to draw any definite conclusion, still it can be observed that isolated patches of short duration can be cured with the external application followed by irradiation in the sun. Better results were obtained with younger patients with vitiligo of short duration. In the case of dark-skinned patients the drug was tolerated without any skin reactions.

It is curious to note that while xanthotoxin and imperatorin were previously isolated

from a number of other plants like *Fagara xanthoxyloids* Lam. (xanthotoxin, 2 per cent cent)^{49,50}, *Ruta chalapensis* Linn.⁵¹, *Angelica glabra*, *Peucedanum officinalis* (peucedanin, 2 per cent, identical with imperatorin)⁵²⁻⁵⁴ and *P. ostruthum*⁵², the pharmacology or the clinical use of these compounds was neither known nor attempts were made to investigate them earlier and our present knowledge is derived from studies undertaken with *Ammi majus*. The plants mentioned above are, however, exotic.

Indian medicinal plants containing psoralens

The Indian sources for xanthotoxin and imperatorin are *Luvanga scandens*⁵⁵ and *Aegle marmelos*⁵⁶ respectively. *Angelica archangelica*⁵⁷ also contains imperatorin and xanthotoxin besides bergapten and is found to grow in India (Kashmir). *Ficus carica* growing in India contains an active principle which is identical with psoralen¹⁷. It also contains a small amount of bergapten²².

Luvanga scandens Ham. (Fig. 2)

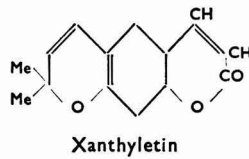
Luvanga scandens Ham. (Sanskrit—*Jivanti*, *Lavangalata*, *Kakoli*; Bengali—*Kakla*) belongs to the family Rutaceae. It is found in Assam (Khasia Hills), in Eastern Pakistan, Burma, Malaya Peninsula and Sumatra.

Description of the plant — It is a powerful scandent shrub, armed with axillary solitary strong sharp and more or less recurved thorns, all parts glabrous. Leaves 3-foliolate, long-petioled, glabrous; leaflets lanceolate or oblong lanceolate, shortly petioled, more or less acuminate, entire, coriaceous, 7.5-25 cm. long. Flowers conspicuous, white, shortly pedicelled, forming glabrous cymose racemes in the axils of the leaves and above the scars of the fallen ones. Petals about 10-12 mm. long. The berries oval, obscurely 3-lobed, the size of pigeon's egg, rather smooth, 1-3 seeded, glabrous.

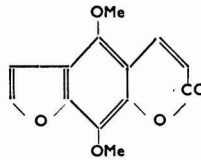
The berries are sweet, oily and aphrodisiac and the matured ones are used for preparing medicinal oils⁵⁸.

Chemistry — The crushed berries of the matured fruits of *Luvanga scandens* Ham. on extraction with petroleum ether gives an oil which yields xanthotoxin (0.1-0.4 per cent), xanthyletin (0.05 per cent), isopimpinellin and luvangetin (0.08-0.5 per cent). All these compounds are coumarins, and the structures of the latter three compounds are given below (IX, X and XI).

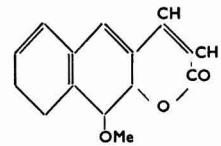
It is interesting to note that in unripe samples all these compounds are absent⁵⁵.



IX



X



XI

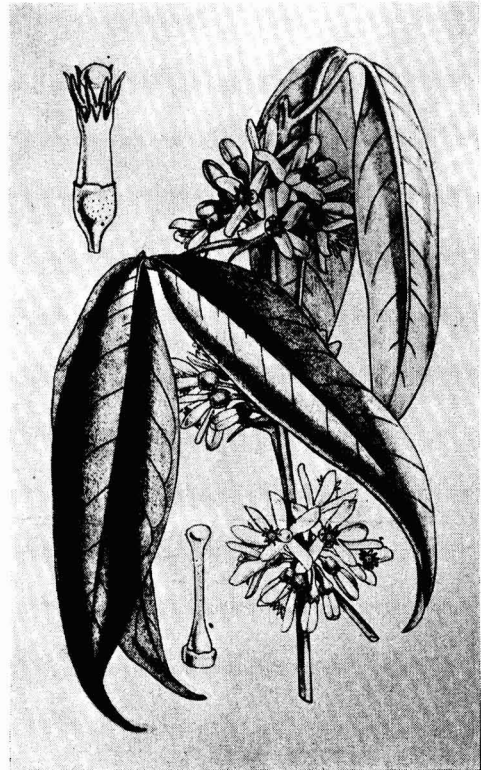


FIG. 2 — *Luvanga scandens* HAM.

***Aegle marmelos* Corr. (Fig. 3)**

Aegle marmelos or the common Indian *bel* belongs to the family Rutaceae. It grows wild in the sub-Himalayan tract up to an altitude of 4,000 ft. in the western Himalayas, in central and southern India and in Burma. It is often cultivated all over India.

Pharmacognosy—Fruit a sub-globose berry, 7.5-20 cm. diam., greenish when young, yellowish brown when ripe, with smooth surface. Epicarp forms a woody hard rind, about 3 mm. thick, reddish in colour, inner portion fibrous. Mesocarp and endocarp adherent to the rind form the pulp, pale reddish in colour; carpels 10-15, central, each containing several seeds, with oblong flat multicellular woolly white hairs; seeds surrounded by colourless sticky mucilage. Odour faintly aromatic; taste mucilaginous.

Chemistry — The fruit contains total sugar, 4.6; reducing sugar, 3.7; pectin, 8 per cent; ash, 8.6 per cent consisting of Ca, Mg and Fe⁵⁹; tannin, 9 per cent in pulp and 20 per cent in rind; a large amount of mucilage, essential oil⁶⁰ and ascorbic acid⁶¹. The most important

constituent is marmelosin (a furocoumarin), C₁₃H₁₂O₃, m.p. 103.5°, which crystallizes in needles. The furocoumarin has been found to be identical with imperatorin obtained from *Imperatoria ostruthium* Linn.⁵⁶. The quantity of marmelosin (imperatorin) is maximum in the inner layer of the sweet aromatic pulp and almost negligible in the outer rind, seed and the gum. The cultivated fruits from Bengal, Assam, Uttar Pradesh and the Punjab have a higher percentage of furocoumarin than the wild varieties⁶².

***Angelica archangelica* Linn.**

The plant *Angelica archangelica* Linn. (Punjab—*Chora, Chura*) belongs to the family Umbelliferae. It is a native of Europe and Asia, and is generally found at high altitudes in the mountains. In India it is found in Kashmir. It also grows throughout the eastern United States.

Pharmacognosy — Fruits, cernocarps, oval, externally pale yellowish brown, 4-8 mm. long, 3-6 mm. broad, 1-2 mm. thick; base faintly notched; apex bearing 5 minute calyx teeth and remains of style; mericarps joined or separate; each mericarp nearly flat on one surface, the latter bearing a central longitudinal groove, margins sharp, slightly upturned, convex on the other surface and with 3 strong longitudinal ribs, the latter separated from one another by narrow grooves and from the margin by broader grooves; pericarp soft, tough and spongy; single-seeded.

Chemistry — The fruits contain several coumarins consisting of imperatorin, 0.5; bergapten, 0.1; umbelliprenin, 0.04; and xanthotoxin, 0.25 per cent⁵⁷.

Spath *et al.*¹³ isolated from the roots a furocoumarin, 'angelicin', which was found to be identical with iso-psoralen¹².

Pharmacology — In sublethal dose, given intraperitoneally, the essential oil produces depression of central nervous system of guinea-pigs and white rats. The animals become dull, apathetic, listless in about 10-15 min. and show a tendency to lie on one side. Motor functions are slowed but perception to touch and pain is not lost. The animals become deeply unconscious in about an hour. Eye reflex becomes sluggish and pain sensation is lost altogether. The respirations are slow and difficult. Lethal doses produce deep narcosis leading to death within a few hours.

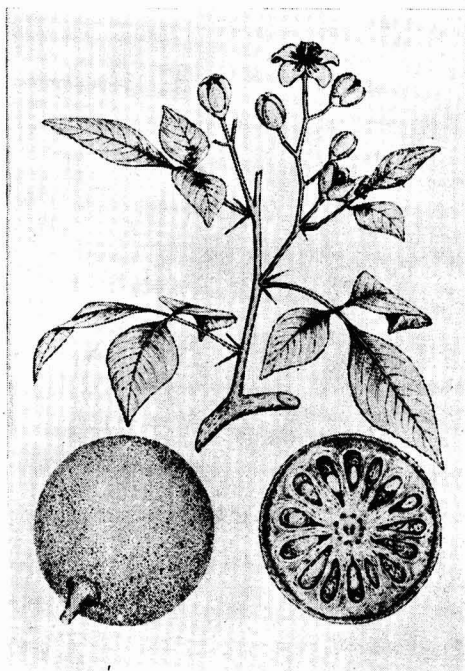


FIG. 3 — *Aegle marmelos* CORR.

***Ficus carica* Linn. (Fig. 4)**

Description of the plant—*Ficus carica* Linn. belongs to the family Urticaceae found in Baluchistan, Afghanistan, western Asia and east Mediterranean region. In India it is cultivated in north-western India and in Deccan. It is a shrub or small deciduous tree, branchlets and underside of leaves pubescent or tomentose. Leaves cordate, more or less deeply lobed, lobes obtuse, blade 10-20, petiole 5-7.5 cm. long, upperside rough. The tree is dioecious, that is some trees have elongated receptacles with male and gall flowers while others have shortly pyriform, nearly globose receptacles, containing only female flowers. The leaves in both sexes are the same but the difference in the shape of receptacles and flowers is so great that at one time they were regarded a distinct species, the male tree being called *caprificus*. The receptacles of both sexes lengthen out into a stalk, at the base of which are membranous bracts.

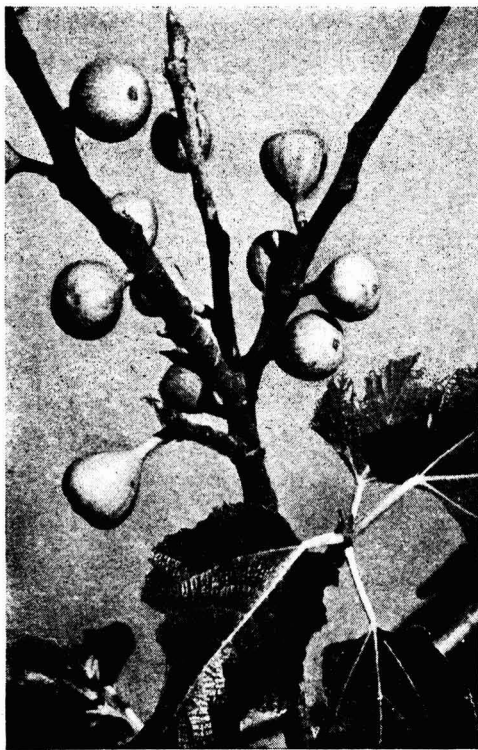


FIG. 4—*Ficus carica* LINN.

Chemistry—The leaves yield 0.06 per cent of ficusin, $C_{11}H_6O_3$, m.p. $161^{\circ}-62^{\circ}$. The yield was higher in July and August than in October. Its properties resemble those of angelicin, and isomer of similar structure. Acetone extract of the leaves yielded small amounts of bergapten, $C_{12}H_8O_4$, m.p. $188^{\circ}-89^{\circ}$ ¹⁷.

Conclusion

The investigations carried out on *Ammi majus* mentioned above have a very important bearing on the possible therapeutic value of furocoumarins in general and in the treatment of leucoderma. The manner in which xanthotoxin and imperatorin are metabolized in the body is not known so far. Nevertheless, when one takes into consideration the facts that xanthotoxin is the 8-methoxy and imperatorin the 8-amylenoxy derivative of the simplest furocoumarin, psoralen, as shown in the structure above, the empirical basis of the age-old use in India of *Psoralea corylifolia* (containing psoralen, iso-psoralen and psoralidin) in the treatment of leucoderma assumes a new aspect and a scientific background. It was in this particular perspective that a clinical investigation of a mixture of psoralen and iso-psoralen on leucoderma patients was considered desirable and it is gratifying to note that successful results have already been obtained in certain cases. This shows that pigmentogenic stimulation of the melanoblastic cells of the skin need not necessarily occur through only 8-methoxy psoralen (xanthotoxin or ammoidin) but possibly through some other common metabolite of 8-methoxy psoralen and psoralen. Further studies would probably reveal a comparatively simple furocoumarin as the most important active agent in this process.

None of the indigenous drugs of Egypt or India, described in this paper, appears to possess the specific curative properties in the treatment of leucoderma. Clinical evidence so far available are not comparable but appears to indicate that the Egyptian drug ('meladionine' from *Ammi majus* containing 8-methoxy psoralen, etc.) is probably more potent in its pigment-stimulating properties than the Indian drug *Psoralea corylifolia*. Most of the recorded data on the Indian drug, however, are obtained from only *local application* of an oleo-resinous extract from *Psoralea corylifolia*. Oral treatment

with its active photo-sensitive ingredients has not been done on a large number of individuals. Recent experience with this type of oral treatment with a mixture of psoralen-iso-psoralen from *Psoralea corylifolia* appears to be very encouraging. Probably a simple furocoumarin available in both the Egyptian and the Indian plant is the important active ingredient. Attempts to identify this are under progress.

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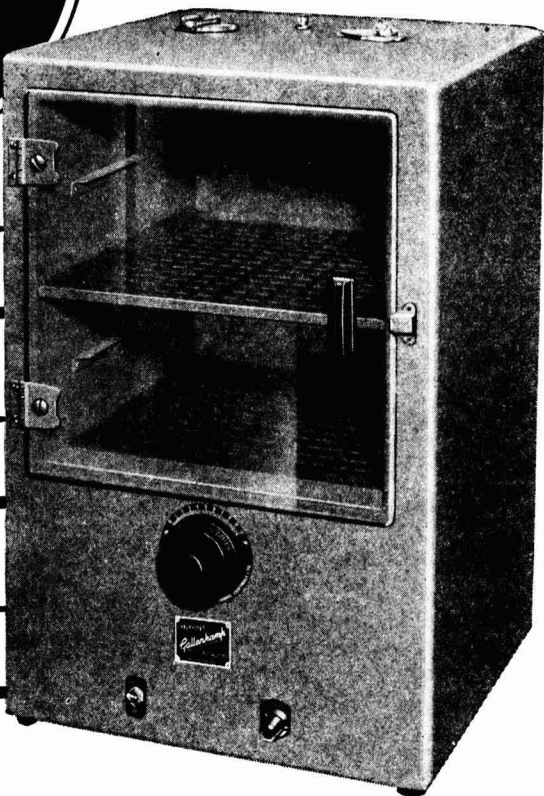
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