

Journal of Scientific & Industrial Research

D. S. I. R.
National Lending Library
for Scientists and
Technologists

A — General

505703A



IN THIS ISSUE

A. GENERAL

Level efficiency organization
Analysis of natural fats by
crystallization

B. PHYSICAL SCIENCES

Application of electrical
analogy for solution of
problems in elasticity

Colouring matters of
Garcinia morella

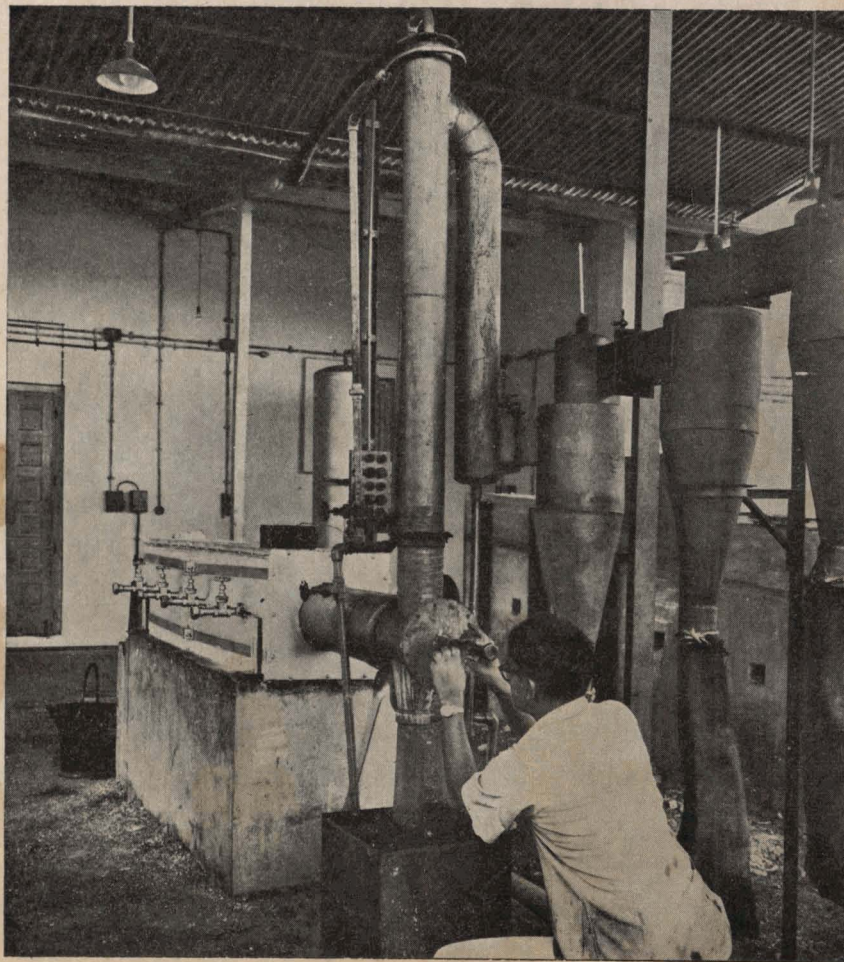
Adherence of vitreous
enamels to aluminium

C. BIOLOGICAL SCIENCES

Composition of shark-ray
collagen

Food value of Indian lichens

Nutritive value of vanaspati
fortified with synthetic
Vitamin A



THE COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, NEW DELHI

J. sci. industr. Res., Vol. 15A, No. 3, Pp. 107-158

MARCH 1956

หนังสือพิมพ์ วิทยาศาสตร์และเทคโนโลยี

ASKANIA

NEW HAND SPHEROMETER



A precision instrument for measuring radii of concave and convex spherical surfaces of lenses, test glasses, mirrors, etc. In addition, the instrument is provided with an attachment for gauging thickness of plates, lenses and optical systems and with another for dioptric gauging of spectacles.

SOLE AGENT

THE SCIENTIFIC INSTRUMENT CO. LTD.

CALCUTTA, ALLAHABAD, NEW DELHI, MADRAS, BOMBAY

Journal of Scientific & Industrial Research

Vol. 15A, No. 3, MARCH 1956

EDITORIAL BOARD

PROF. M. S. THACKER, B.Sc. (Engg.),
M.I.E.E. (Lond.), M.I.M. (Lond.), M.Inst.F.
(Lond.), M.I.E., M.I.R.E., A.M.I.E.S.,
F.Am.I.E.E., F.I.A.Sc., F.N.I., etc., Director,
Scientific & Industrial Research (*ex officio*
Chairman)

H. J. BHABHA, Ph.D., D.Sc., F.R.S.,
Secretary, Department of Atomic Energy,
Bombay

J. C. GHOSH, D.Sc., F.N.I., Member,
Planning Commission, Government of India,
New Delhi

S. KRISHNA, Ph.D., D.Sc., F.R.I.C.,
F.N.I., Scientific Liaison Officer, London

K. S. KRISHNAN, D.Sc., F.R.S., Direc-
tor, National Physical Laboratory, Delhi

JIVRAJ N. MEHTA, M.D., M.R.C.P.,
F.C.P.S., Minister for Finance, Prohibition &
Industries, Bombay State, Bombay

MATA PRASAD, D.Sc., F.R.I.C., F.N.I.,
1841 Krishnanagar, Bhavnagar

D. N. WADIA, F.G.S., F.R.G.S., F.A.S.B.,
Geological Adviser, Ministry of Natural Re-
sources & Scientific Research, New Delhi

B. N. SASTRI, M.Sc., A.R.I.C., A.I.I.Sc.,
Editor & *ex officio*, Secretary

A. KRISHNAMURTHI, M.Sc., Assistant
Editor

S. B. DESHAPRABHU, Liaison Officer
(Production)

CONTENTS

Fuel Efficiency Organization	...	...	107
	J. W. Whitaker		
The International Conference on Peaceful Uses of Atomic Energy	...	...	110
Studies on Natural Fats: Part XII—Some Aspects of Analysis of Natural Fats by Crystallization	...	...	116
	A. R. S. Kartha		
Studies on Rauvolfia	...	...	125
	V. Chandra		
Quality Control in Glass Industry—A Sympo- sium	...	...	134
Reviews	...	...	137
Recent Publications	...	...	140
Notes & News	...	...	141
Progress Reports	...	...	153
Indian Patents	...	...	155

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

COVER PICTURE

The picture on the cover shows the pilot plant designed and erected at the National Chemical Laboratory of India for the production of carbon black from furnace oil. The unit consists of a specially designed furnace for cracking the oil, a chilling chamber and cyclones.

The JOURNAL OF SCIENTIFIC & INDUSTRIAL RESEARCH is issued monthly.

The Council of Scientific & Industrial Research assumes no responsibility for the statements and opinions advanced by contributors.

The Editorial Board in its work of examining papers received for publication is assisted, in an honorary capacity, by a large number of distinguished scientists working in various parts of India.

Communications regarding contributions for publication in the JOURNAL, books for review, subscriptions and advertisements should be addressed to the Editor, JOURNAL OF SCIENTIFIC & INDUSTRIAL RESEARCH, Old Mill Road, New Delhi 2.

ANNUAL SUBSCRIPTION: Rs. 15 (inland); 30 sh. (foreign). SINGLE COPY: Rs. 2 (inland); 4 sh. (foreign)

CONTENTS

SECTION B

Application of Electrical Analogy for the Solution of Problems in Elasticity ...	107
V. Cadambe & S. G. Tewari	
Distribution of Radioactivity in the Rocks of South India: Part II — Khondalites of Andhra State ...	112
A. V. R. Sastry & U. Aswathanarayana	
Ternary Vapour-liquid Equilibria — System: Acetone-chloroform-methyl Ethyl Ketone ...	118
P. Dakshinamurty & C. Venkata Rao	
The Colouring Matters of <i>Garcinia morella</i>: Part II — Infrared & Ultraviolet Absorption Spectra of Morellin & Its Reduction Products ...	128
N. V. Bringi, M. R. Padhye & K. Venkataraman	
The Colouring Matters of Ponderosa Pine Bark: Part I ...	139
E. F. Kurth, V. Ramanathan & K. Venkataraman	
Special Chemical Components of Commercial Woods & Related Plant Materials: Part III — <i>Pterocarpus indicus</i> ...	146
V. N. Gupta & T. R. Seshadri	
A Theory of Adherence of Vitreous Enamels to Aluminium ...	150
E. C. Subbarao	
Beneficiation of Low Grade Graphite from Titilagarh, Orissa ...	154
G. P. Mathur & P. I. A. Narayanan	
Letters to the Editor	
A NOTE ON MOLECULAR WEIGHT DISTRIBUTION & CHAIN TRANSFER IN HIGH POLYMERS ...	157
Santi R. Palit & Kesab Chandra Majumdar	
SEPARATION OF γ -RESORCYLIC ACID FROM A MIXTURE OF β & γ -RESORCYLIC ACIDS ...	159
(Mrs.) L. G. Shah & G. D. Shah	

SECTION C

Combined Therapeutic Action of <i>p</i>-Ethylamino-<i>p</i>'-aminodiphenyl Sulphone (S.N. 44) & Dihydrostreptomycin (DHS) in Experimental Tuberculosis of Guinea-pigs ...	53
S. K. Gupta & B. Mukerji	
Combined Therapeutic Action of <i>p</i>-Ethylamino-<i>p</i>'-aminodiphenyl Sulphone (S.N. 44) & Isoniazid (INH) in Experimental Tuberculosis of Guinea-pigs ...	56
S. K. Gupta & B. Mukerji	
Effect of <i>p</i>-Ethylamino-<i>p</i>'-aminodiphenyl Sulphone (S.N. 44) & <i>p</i>-Isobutylamino-<i>p</i>'-aminodiphenyl Sulphone (S.N. 47) on the Changes in the Serum Protein Composition in Experimental Tuberculosis of Guinea-pigs ...	60
S. K. Gupta, D. C. Dhar & V. C. Vora	
Effect of Prolonged Administration of Melanophore Hormone (Intermedin) on the Adrenal of Normal Rats ...	63
J. N. Karkun, S. K. Roy & N. N. De	
Iodination of Shark-ray Collagen ...	67
N. R. Moudgal, V. Srinivasan & P. S. Sarma	
The Food Value of Some Indian Lichens ...	71
B. M. Lal & K. Ranganatha Rao	
Nutritive Value of Vanaspati Fortified with Synthetic Vitamin A Palmitate: Part I — Stability of Added Vitamin A Palmitate ...	74
R. G. Chitre & D. S. Khale	
Nutritive Value of Vanaspati Fortified with Synthetic Vitamin A Palmitate: Part II — Biological Availability of Added Vitamin A Palmitate ...	77
R. G. Chitre & D. S. Khale	
Letters to the Editor	
POLYPHENOLS IN EDIBLE MATERIALS ...	78
L. V. L. Sastry, M. N. Satyanarayana, M. Srinivasan, N. Subramanian & V. Subrahmanyan	
IDENTITY OF THE CRYSTALLINE GLYCOSIDE OF <i>Urginea indica</i> KUNTH, WITH SCILLAREN A ...	80
S. Rangaswami & S. Sankara Subramanian	
DESTRUCTION OF TIMBER STRUCTURES BY SHIPWORMS IN MADRAS WATERS ...	81
N. Balakrishnan Nair	

Announcing

RESEARCH & INDUSTRY

A new monthly periodical addressed to industry

TECHNICAL DIGESTS

PATENTS & PROCESSES AVAILABLE FOR LICENSING

REVIEW OF PATENTED INVENTIONS IN SELECTED FIELDS

INVITED ARTICLES * NOTES * ENQUIRIES

Vol. I, No. 3, March 1956

CONTENTS

STANDARDIZATION OF RAW COTTON

by A. N. Gulati

MARKET DATA ON FINE CHEMICALS

by A. Rahman

ION-EXCHANGE IN SUGAR INDUSTRY

by S. D. Mahant & K. K. Sarin

BY-PRODUCTS OF SUGAR INDUSTRY — A SURVEY OF
RECENT INVENTIONS

by R. B. Pai

QUALITY CONTROL IN GLASS INDUSTRY

PATENTS & PROCESSES AVAILABLE FOR LICENSING

TECHNICAL DIGEST

NOTES

Annual subscription Rs. 8

★

For particulars, please write to:

**THE ASSISTANT SECRETARY
PUBLICATIONS DIVISION
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
OLD MILL ROAD, NEW DELHI 2**

Bengal Chemical & Pharmaceutical Works Ltd.

The Largest Chemical Works in India

Manufacturers of Pharmaceutical Drugs, Indigenous Medicines, Perfumery, Toilet and Medicinal Soaps, Surgical Dressings, Sera and Vaccines, Disinfectants, Tar Products, Road Dressing Materials, etc.

Ether, Chloroform, Mineral Acids, Ammonia, Alum, Ferro-Alum, Aluminium Sulphate, Sulphate of Magnesium, Ferri Sulph., Potassium Permanganate, Caffeine and various other Pharmaceutical and Research Chemicals.

Surgical Sterilizers, Distilled Water Stills, Operation Tables, Instrument Cabinets and other Hospital Accessories.

Chemical Balance, Scientific Apparatus for Laboratories and Schools and Colleges, Gas and Water Cocks for Laboratory use, Gas Plants, Laboratory Furniture and Fittings.

Fire Extinguishers, Printing Inks, etc.

Office 94 CHITTARANJAN AVENUE, CALCUTTA

Factories CALCUTTA · BOMBAY · KANPUR

ANNOUNCEMENT

We manufacture the following to specification

OBJECT GLASS AND EYEPIECE LENSES

PRISMS FOR PRISMATIC COMPASS

CONDENSERS OF ALL TYPES

PROJECTION LENSES

Enquiries to

INSTRUMENT RESEARCH LABORATORY Ltd.

309 BOWBAZAR STREET

CALCUTTA 12

Phone: 22-7250

Gram: 'INRELABTRY'

SAUTER

ASE PRECISION TORSION-TYPE BALANCE

A NEW CONCEPTION IN RAPID & ACCURATE REPETITION WEIGHING

FIELDS OF USE

CHEMICAL-PHARMACEUTICAL INDUSTRY

Micro-analyses, determination of the weight of tablets, pills and medicine powders

RESEARCH & TESTING INSTITUTES

Investigation of raw materials and finished products

INCANDESCENT LAMP MAKING

Weighing of the incandescent filaments

AGRICULTURAL SCHOOLS

Weighing of seeds of all kinds

PAPER INDUSTRY

Weight determination of paper samples

TEXTILE INDUSTRY

Examination of raw fibres of yarn and fabric samples. Determination of hygroscopy and conditioning



MODEL No. 180

CAPACITY — 1 to 2500 mg.
SENSITIVITY — 0.001 to 2.5 mg.

For further particulars, write to:

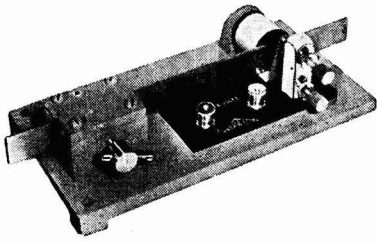
GORDHANDAS DESAI & CO.

SIR PHEROZESHAH MEHTA ROAD

FORT, BOMBAY

P7 MISSION ROW EXTENSION
CALCUTTA 1

22 LINGHI CHETTY STREET
MADRAS 1



**VIBRATING
BAR**

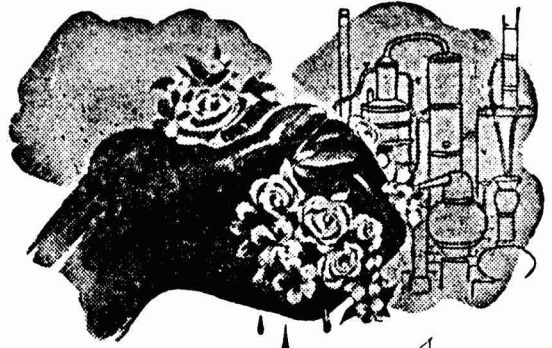
ELECTRICALLY MAINTAINED
50-100 CS./SEC. 4 VOLTS

NEW DESIGN
ENABLES FREQUENCY VARIATION
BETWEEN ABOVE LIMITS

Made by:

**THE STANDARD SCIENTIFIC
INSTRUMENTS CO.**

115 BRODIES ROAD, MADRAS 28



Nirjas
A RAW PERFUME

FOR EVERY PURPOSE
Handkerchiefs, preparing
Hair Oils, Cosmetics, To-
baccos of all descriptions, etc.

Details from :—



GHOSE BROS

(Perfumers)

50, EZRA ST, CALCUTTA-1

Estd. 1944

Asha Scientific Company

Lotlikar Mansion, 503, Girgaum Road,
BOMBAY, 2.

Telegrams: ASHACOM.

DIRECT IMPORTERS

OF

**LABORATORY APPARATUS,
INSTRUMENTS & EQUIPMENTS**

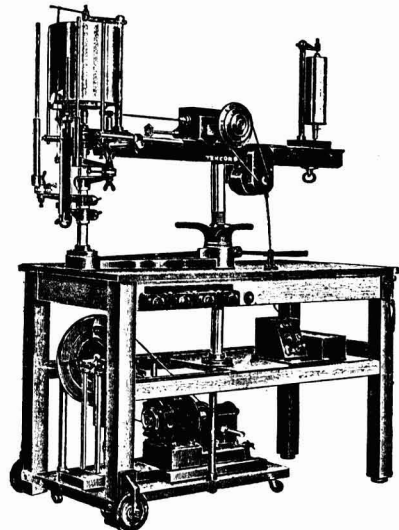
AUTHORIZED DEALERS
OF

"PYREX"

LABORATORY & SCIENTIFIC GLASSWARE

[Made in England]

Your orders and enquiries—Please



Kymograph Assembly

THE TECHNICAL CORPN. LTD.

MAKERS OF HIGH CLASS PHARMACOLOGICAL &
PHYSIOLOGICAL APPARATUS

SAROJINI NAGAR, LUCKNOW

PLATINUM

LABORATORY APPARATUS

PIONEER MANUFACTURERS IN INDIA



TRADE MARK

All items manufactured from
'Special Platinum' guaranteed
99.9% and over

- * WIRES * CRUCIBLES * DISHES
- * FOILS * TIPPED TONGS * J. LAWRENCE SMITH TYPE CRUCIBLES, SPOONS, SPATULAE

ALL ITEMS
AVAILABLE FROM READY STOCKS

Reshaping of damaged platinum apparatus
undertaken at Rs. 3/8/- per gram.

Replacement of damaged platinum apparatus
at Rs. 5/- per gram.

(All prices subject to fluctuation)

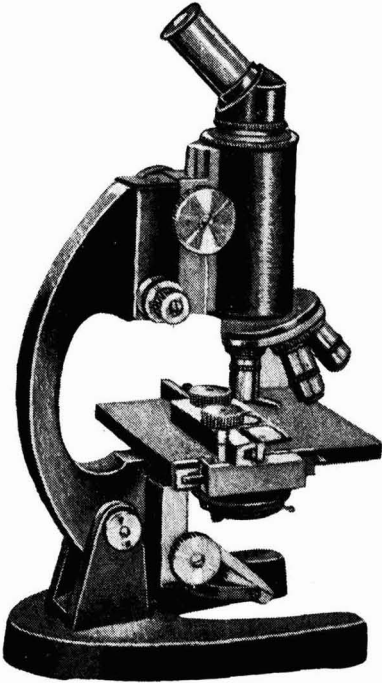
Any article in platinum manufactured and
supplied as per specification.

CATALOGUE ON REQUEST



RAVINDRA & CO. (PLATINUM)

**63, DHANJI STREET,
BOMBAY-3.**



PAUL WAECHTER WETZLAR MICROSCOPE

MODEL FSK/s
(Made in Germany)

Heavy stand, with inclined eyepiece (stand also inclinable). **Tube**, 50 mm. diam. **Coarse adjustment** with rack and pinion. **Fine focusing adjustment** with safety micrometer movement with divided drum (each division 0.002 mm.). **Square stage** with lateral built-in mechanical stage with double vernier. **Abbe illuminating**, adjustable by rack and pinion, 2-lens condensor (N.A. 1.20) with iris diaphragm and adapter for grounded glass. **Concave and plane mirror**, 50 mm. diam. **Wooden case** with lock and key.

- Triple nosepiece
- Three objectives: 10x, 45x, 100x, oil immersion
- Three eyepieces: 6x, 10x, 15x
- Magnification: 60x to 1500x

Importers & Stockists

HOSPITAL SUPPLY Co.

111 CHITTARANJAN AVENUE
CALCUTTA 12

Gram: "HOSPO"

Phone: 33-3322



THERELEK ELECTRIC OVENS

Different Sizes

*

Also Electric Muffle Furnaces, Tube Furnaces, Pot Furnaces, Pyrometers, Temperature Controllers, Recorders, Thermocouples of all types, Incubators, Industrial Heaters, Thermostats and other Electrical Instruments

*

All from Ready Stock

Please contact:

THERMO-ELECTRIC EQUIPMENT Co.

59 COMMERCIAL CHAMBERS, MASJID BUNDER ROAD, BOMBAY 3

T. B. FORD LTD., LONDON

Specialists in

ALL TYPES OF FILTRATION MEDIA

including filter papers for all purposes, asbestos filter sheets
(Sterimats), filter pulps, etc.

★

FORD FILTER PAPERS

include nearly fifty different grades for laboratory purposes and
industrial use

*Write for sample book to
Accredited Agents*

MARTIN & HARRIS Ltd.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

“GOLD SEAL”

MICRO SLIDES AND MICRO COVER GLASSES

Reputed for their non-corrosive and non-fogging qualities

Made by CLAY-ADAMS CO. INC., NEW YORK, U.S.A., “Gold Seal” brand slides are almost colourless, of uniform thickness, edges are bevelled, ground and polished. The slides are factory inspected and selected to eliminate striae, bubbles, scratches and other imperfections.

★

Accredited Agents

MARTIN & HARRIS Ltd.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

LABORATORY EQUIPMENT

For all your requirements of
Laboratory glassware, apparatus, precision instruments,
chemicals, acids, stains, etc.

Please write to :

THE CENTRAL SCIENTIFIC SUPPLIES CO. LTD.

2 AGARAM ROAD, POST BOX No. 2, TAMBARAM (S. Rly.)

Telegram : SYPHON

Telephone : 80751 Extn. 23

We manufacture and supply A.R. sulphuric, hydrochloric and nitric acids (certified by Government Test House, Alipore), items for anthropometry, Perspex museum jars, decerebration apparatus, operation table, etc., at most competitive prices



FILTER PAPER

FOR SPECIAL TESTS
FOR SUGAR INDUSTRY
FOR CHEMICAL LABORATORIES
and all purpose

MANSFIELD OIL GAS CO., LTD.

(INSTRUMENT DEPARTMENT)

16, RADHANATH CHOWDHURY ROAD, CALCUTTA-15

BRANCH OFFICE : 301, LINGHI CHETTY STREET, MADRAS-1

DISTRIBUTORS WANTED



Do you know

SIGCOL INDEX
combines **three in one?**

Behind every **Index** beaker and flask you can see long experience backed by scientific research. **Index** is a symbol of guarantee for laboratory work. It is

- Resistant to **chemical reagents**
- Resistant to **mechanical shocks**
- Resistant to **heat** (coefficient of expansion is only 3.4×10^{-6})

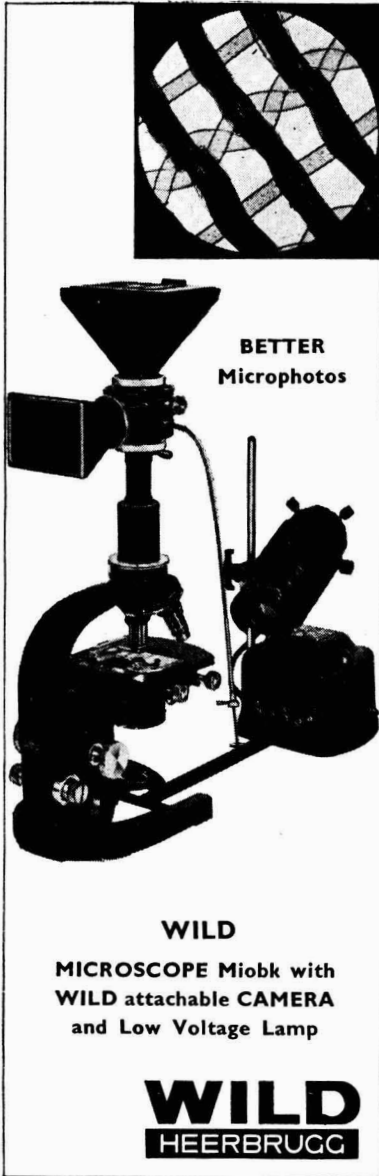
Sole Distributors :

GHPURE & CO.

P-36 Royal Exchange Place Extn., Calcutta I

WILD HEERBRUGG

*The microscope which has proved its
excellent high qualities!*



- * Sturdy Excursion Microscopes
- * Students & Routine Microscopes
- * Medical Microscopes
- * Research Microscopes
- * Microphotographic Equipment
- * Micrometers:
Stage & Eyepiece
- * Microscope Lamps
- * Phase Contrast Equipment

SOLE AGENTS :

RAJ-DER-KAR & Co.

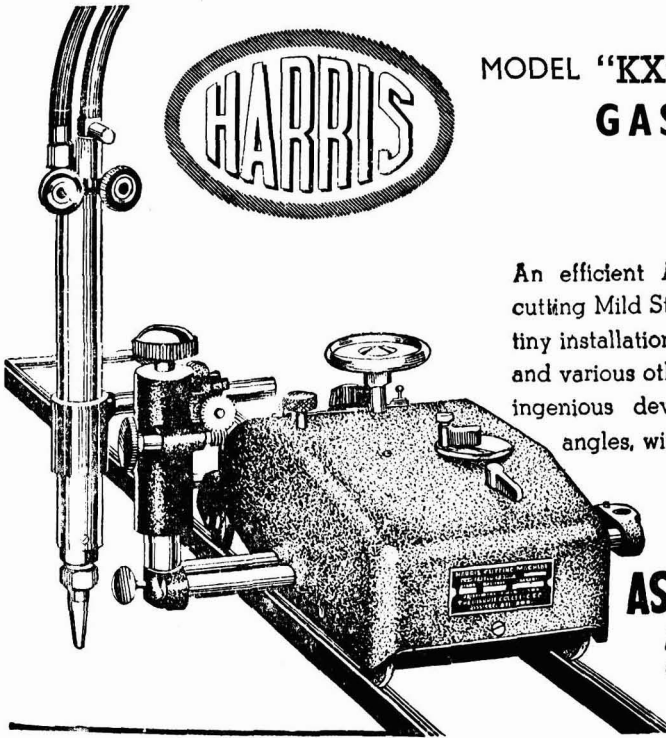
COMMISSARIAT BUILDING
HORNBY ROAD, FORT
BOMBAY

Telephone : 26-2304

Telegram : TECHLAB



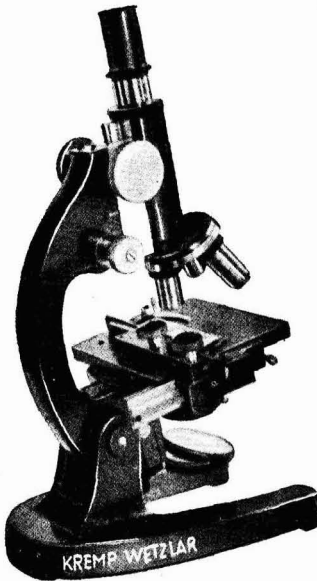
MODEL "KX" PORTABLE
GAS CUTTING
 MACHINE



An efficient AC/DC Motor-driven Unit for cutting Mild Steel upto 12" thick. Though a tiny installation, it can cut straight lines, circles and various other shapes with templates. An ingenious device for cutting corners and angles, with sharp and smooth finish.

ASIATIC  OXYGEN
 AND ACETYLENE CO., LTD.
 8, DALHOUSIE SQUARE, EAST, CALCUTTA-1

AOA-F 1



"KREMP" MEDICAL MICROSCOPE
 (MODEL ECK 2/13)

This model has a special objective 6 L (L=long focus) which is essential for blood corpuscle-counting work. It has an own magnification of 44x.

STAND E—Inclinable up to 90°. Standard draw tube (extension) of 37 mm. with millimeter scale. Coarse adjustment by rack and pinion motion, fine adjustment by micrometer screw with graduated drum (operating knobs on both sides of stand).

FIXED square state 110×110 mm. with mechanical stage III detachable, graduated with scale and vernier reading to 1/10 mm. with two lens condensor, of n.a. 1.4 with iris diaphragm screwed on, and filter bearing movable in a sprung sleeve.

Plane and concave mirror movable to all sides.

OPTICAL EQUIPMENT

- Nose-piece for 3 objectives:
- Achromatic objective No. 3 (10.3x)
- Achromatic objective No. 6L (44x)
- Achromatic oil immersion objective 1/12 (105x)
- Huyghens eyepieces: 6x, 10x, 15x
- Total magnification 1575x

Complete, as described above, in a mahogany cabinet with lock and key

Price on request

UNIQUE TRADING CORPORATION

Grams : UNILAB

51-53 BABU GANU ROAD, BOMBAY 2

Phone : 26983

INTRODUCING
a series of reports on
CHROMATOGRAPHY

A vast amount of material has been published on the use of Chromatography in chemical analysis, and the time seems now appropriate to review the progress made to date.

Compared with instrumentation, Chromatography is both simple and inexpensive, yet its powers of resolution are immense. It enables minute quantities to be separated, the only limitation being the sensitivity of the detecting agent employed; as a result of this, a new term, 'Chromatographically Pure' has come into use.

Among the industrial applications of Chromatography is the evaluation of uranium and thorium from ores; among its triumphs is the first complete illustration of the structure of a protein.

The possibilities of the method are unlimited, both in research and in general use.

To deal with these developments, special types of Whatman Filter Paper and Cellulose Powder have been evolved; and a series of articles entitled 'Progress in Chromatography' will be published in this space month by month.

Progress in Chromatography, No. 1

MULTIPLE SAMPLE ANALYSIS

*This will be the subject of our next advertisement
and will deal with systematic analysis
—both qualitative and quantitative
—by paper chromatography.*

Enquiries to

H. REEVE ANGEL & CO LTD
9 BRIDEWELL PLACE LONDON EC4
Sole Distributors of

WHATMAN FILTER PAPERS

(Manufacturers W. & R. Balston Ltd.)

We offer

**PATHOLOGICAL,
BACTERIOLOGICAL,
PHARMACEUTICAL
& LABORATORY
REQUIREMENTS**

also :

**AUTOCLAVES, INCUBATORS,
DISTILLATION PLANTS,
OVENS, VACUUM STILLs,
FILTERS, BATHS & ALL
SORTS OF GAS, WATER &
VACUUM TAPS,
ANIMAL CAGES,
BOTTLE FEEDING UNITS**

M. RAMCHANDRA & SONS

Estd. 1920

'RAM DOOT' 12B KELEWADI
GIRGAUM, BOMBAY 4

SP/MRS/5

Use SIMCO brand

Scientific Glass Apparatus

for

Accuracy, Quality & Durability

- * All kinds of graduated glassware
- * All glass distillation equipment
- * Gas analysis apparatus—Orsat's, Haldane's, etc.
- * Stopcocks of various types
- * Blood, urine and milk testing apparatus
- * Chromatographic chamber and accessories
- * Any special apparatus according to specifications

Manufactured by

**SCIENTIFIC INSTRUMENT Mfg. Co.
(SIMCO)**

**3 SASTITALA ROAD, NARKELDANGA
CALCUTTA II**

Gram : Meterhome

Direct Importers

for

- * LABORATORY CHEMICALS
- * PHARMACEUTICAL
CHEMICALS
- * FINE CHEMICALS
- * VITAMINS
- * STAINS, etc.

Please refer to:

B. BABULAL & Co.

POST BOX No. 2409, BOMBAY 2

Gram : PETROLIUM

Phone : 28465

Search for ?

The collective wide experience of a team of chemists, biologists, and clinicians helps in evolution of chemotherapeutic agents.

A simple acylation of sulphanilamide widens its activity as manifested in

SULFABENZIDE

(Sulphanilylbenzamide — $\text{NH}_2\text{C}_6\text{H}_4\text{SO}_2\text{NHCOC}_6\text{H}_5$)

Specific for bacillary dysentery

*

OPHTHALMIDE

(Sulphacetamide — $\text{NH}_2\text{C}_6\text{H}_4\text{SO}_2\text{NHCOC}_6\text{H}_3$)

Specially for infection or injuries of the eyes

*

ENTEROCID

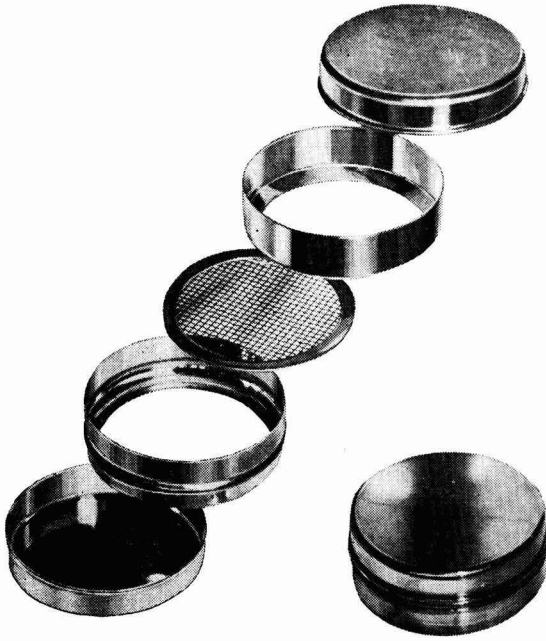
(Phthalyl-Sulphacetamide —
 $\text{COOHC}_6\text{H}_4\text{CONHC}_6\text{H}_4\text{SO}_2\text{NHCOC}_6\text{H}_3$)

Active and potent bactericidal, particularly in gastro-intestinal infections

All available for further research & clinical use from :

BENGAL IMMUNITY Co. Ltd.

CALCUTTA 13



ENDECOTTS FILTERS Ltd.

LABORATORY TEST SIEVES,
METAL GAUZE FILTERS,
SIEVE SHAKING MACHINES

- Laboratory Test Sieves as per B.S.S. & A.S.T.M. Specifications
- 'Pocket Interchanger' Sieves
- 'Endrock' Test Sieve Vibrator

Agents:

UNION SCIENTIFIC SYNDICATE

52-58 Babu Genu Road
P.O. Box 2484
BOMBAY 2

Gram: 'PETROLIUM'

Phone: 28465

SP/UNI/5

For
**Scientific—Medical—Industrial
LABORATORY EQUIPMENT**

Beck Kassel Microscopes & Binoculars
'Nedoptifa' Phase-contrast Microscopes
Refractometers, Spectroscopes, Telescopes
Metrohm pH Meters & Stirrers
Memmert Ovens & Incubators
Palmer's Physiology Apparatus
Bosch Balances, Rotofix Centrifuges
Kahn Shaking Machines, Calculating Machines
Intra Hot-air Sterilizers
etc , etc.

CONTACT

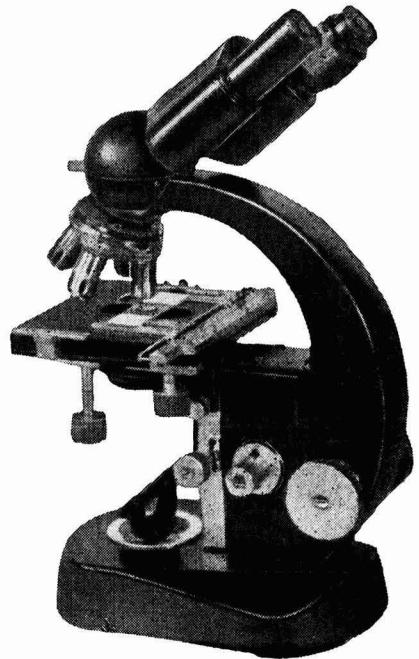
J. T. JAGTIANI

National House, 6 Tulloch Road, Apollo Bunder
BOMBAY I

Post Box 332

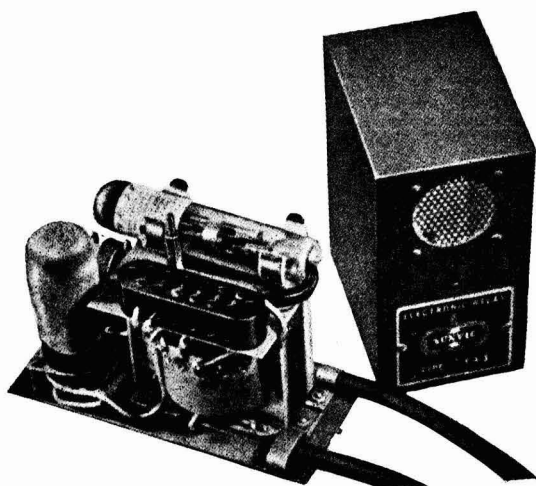
Grams: FACMARE

Phone: 35229



SUNVIC ELECTRONIC RELAY

MODEL EA-3



Sunvic Electronic Relay, Model EA-3, is designed to allow light-contact instruments, such as Toluene Regulators or Contact Thermometers, to achieve in service the precise control of which they are capable.

- * Operates on a few microwatts
- * Controls up to 2 kW. at 230 volts, AC/DC
- * Self-contained with Mains Transformer, Gas-filled Relay and Sunvic Hotwire Vacuum Switch

★

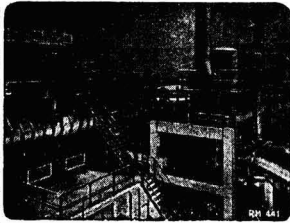
ACCREDITED AGENTS

MARTIN & HARRIS Ltd.

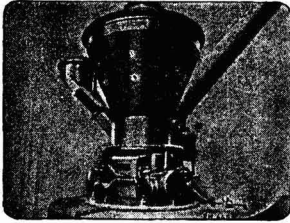
(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY I

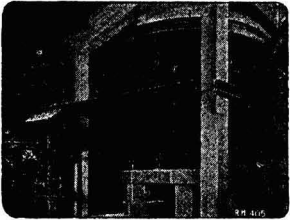
FOR STAR PERFORMANCE



CONTACT SULPHURIC ACID PLANT



CLOSED CIRCUIT GRINDING MILL



CONTINUOUS SUPERPHOSPHATE DEN

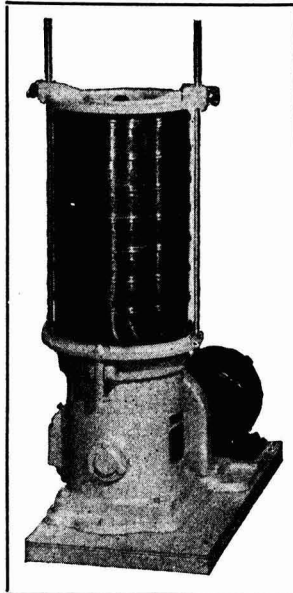
SUNDRY CHEMICAL PLANT

Sulphur & Pyrites Burners
 Electrostatic Dust Precipitators
 Oxyhydrolysis — Electrolytic Cells
 Turbo Colloid Mills — Turbo Stirrers
 Complete Plants and Ancillary
 Equipment for the Chemical Industry

ENQUIRIES TO

MORITZ
 CHEMICAL ENGINEERING CO. LTD.
 204, Earls Court Road London, S.W.5

Telegrams: — MORICHEM LONDON



It is essential to obtain a perfect segregation of the particles. The Inclyno Test Sieve Vibrator is the machine for the purpose.

Screen analysis with the Inclyno is accurate and obviously better than hand sieving. The machine is operated by a fractional h.p. motor and when fitted with an automatic time switch, tests can be carried out over periods up to 60 minutes.

INCLYNO

Test Sieve Vibrator

for

accurate

screen

analysis

GIDVANI & Co.

POST BOX No. 1778, BOMBAY I

SP/GC/6

J.S.I.R.—MARCH 1956

D.C.M
CHEMICALS

for
service
and
dependable
quality

SULPHURIC ACID

HYDROCHLORIC ACID

NITRIC ACID

ALUMINIUM SULPHATE

ALUMINA FERRIC

AMMONIA ALUM

PINK ALUM

CAUSTIC SODA
(LIQUID, SOLID & FLAKES)

CHLORINE

FERRIC CHLORIDE
(LIQUID)

SUPERPHOSPHATE

MIXED FERTILISERS

THE DCM CHEMICAL WORKS

NAJAFGARH ROAD, DELHI.

**Stains &
Staining
Solutions**

for microscopy

B.D.H. stains are issued both in the solid form and in solution. They are produced in large quantities and used regularly and with satisfaction by workers in microscopy in nearly seventy different countries. The histological examination, by specialists, of every batch made guarantees their staining properties and consistently uniform behaviour.

See 'B.D.H. Standard Stains'—a fifty-page booklet on staining methods and the preparation of material. Single copies are free on request.

B.D.H.

THE BRITISH DRUG HOUSES LIMITED

B. D. H. LABORATORY CHEMICALS GROUP, POOLE, ENGLAND

Representatives in India: **BRITISH DRUG HOUSES (INDIA) LIMITED**

P. O. Box 1341, BOMBAY I. Branches at: CALCUTTA - DELHI - MADRAS

E. MERCK'S PURE CHEMICALS, ANALYTICAL
REAGENTS & ACIDS

DR. G. GRUBBLER'S STAINS & INDICATORS

CARL SCHLEICHER & SHULL'S FILTER PAPERS FOR
QUANTITATIVE & QUALITATIVE ANALYSIS

DIFCO'S CULTURE MEDIA

Also

APPARATUS, CHEMICALS, ACIDS, MICROSCOPES, ETC.

for

SCHOOL, COLLEGE, ANALYTICAL &
RESEARCH LABORATORY

BENGAL INDUSTRIAL & SCIENTIFIC WORKS Ltd.

7 JATINDRA MOHAN AVENUE, CALCUTTA 6

Phone: B.B. 2132

Grams: BISWORKS



FOR
RAPID & ACCURATE
CHEMICAL ANALYSIS

use

TINSLEY POLAROGRAPH

with derivative circuit

Here are some advantages:

MICRO ANALYSIS

HIGH SENSITIVITY

QUALITATIVE & QUANTITATIVE ESTIMATION

SIMULTANEOUS ESTIMATION OF SEVERAL CONSTITUENTS
ON ONE POLAROGRAM

ADAPTABILITY: ANALYSIS OF METALS—ORGANIC &
INORGANIC SUBSTANCES

REPEATED ANALYSIS ON THE SAME SAMPLE

SIMPLIFIED OPERATION FOR USE BY SEMI-SKILLED STAFF

ROUTINE ANALYSIS WITH SPEED & ACCURACY



*For further particulars, please contact
Sole Agents in India:*

PIONEER INDUSTRIES

20 BR. INDIAN STREET
CALCUTTA 1

21 FORBES STREET
BOMBAY 1

193 MOUNT ROAD
MADRAS 2

We manufacture

**IONONE 100 PER CENT, IONONE ALPHA &
BETA, GERANIOL & CITRONELLOL PURE,
EUGENOL, CITRAL, GERANYL ACETATE**

and other

**Aromatic Chemicals, Essential Oils, Resinoids
and various perfume compounds useful for soap
and other toilet articles**

S. H. KELKAR & Co. LTD.

**DEVAKARAN MANSION, 36 MANGALDAS ROAD
BOMBAY 2**

Branch :

**Opposite City Post Office
BANGALORE CITY**

Gram :

**'SACHEWORKS'
DADAR**

If you use **Acids**
you will be interested in

KESTNER ACID HANDLING EQUIPMENT

**Pumps, Pipe Lines, Valves,
Tanks, Evaporators,
Filters, Heaters**

Sole Agents in India :

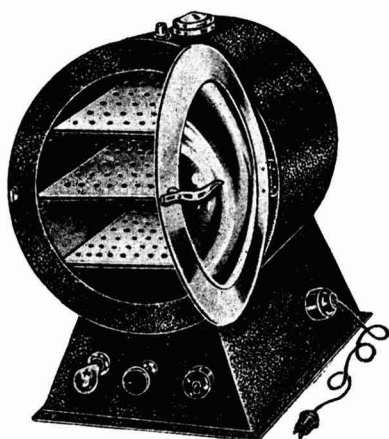
KILBURN & CO. LTD.

CHEMICAL ENGINEERS

4 FAIRLIE PLACE, CALCUTTA I

'ASCO' HOT-AIR DRYING OVENS

These improved models are of modern design and strong construction. They are in great demand in educational institutions, and industrial and clinical laboratories and are now standardized for strength, durability, compactness and efficiency.



A.S. 1930

A.S. 1930 NEW PRECISION HOT-AIR DRYING OVEN

Electrically operated and controlled

The cylindrical form of the oven greatly facilitates uniformity of temperature which is of extreme importance for superior oven operation. It is made of aluminium sheet with sheet iron outer jacket finished in attractive crackle enamel. It is fitted with three perforated sliding shelves and a door well-machined to fit the chamber perfectly. The heating elements are of replaceable type.

Ovens as described above are complete with connecting cord and plug and are useful for working at any temperature up to 150°C. Size: 14" × 10".

ASCO's manufactures are of the most comprehensive range

For all your scientific requirements please write to us

THE ANDHRA SCIENTIFIC CO. LTD.

Head Office & Works:

MASULIPATAM (S. INDIA)

Branches at:

**4 Blacker's Road
Mount Road
MADRAS**

**Asian Building, Nicol Road
Ballard Estate
BOMBAY**

Representatives at:

NEW DELHI — CALCUTTA — HYDERABAD (Dn.) — VIZAGAPATAM — CUTTACK

AVAIL

OF OUR EXPERT SERVICES

In servicing, repairing and designing your Electrical and Electronic equipment such as :

pH Meters, Photometers, Conductivity Bridges,
Cardiographs, H.F. Equipment, Diathermy
Units, Induction Heating Devices, etc., etc.

We have been doing this for various Firms and Government Departments for over 15 years past.

A TRIAL WILL SATISFY YOU

RADIO ELECTRIC LTD.

2C LAMINGTON CHAMBERS, LAMINGTON ROAD, BOMBAY 4

B O R O S I L

LABORATORY GLASSWARE

such as

FLASKS, BEAKERS, CONDENSERS, MEASURING
FLASKS, MEASURING CYLINDERS, PIPETTES &
ANY SPECIAL APPARATUS MADE TO DESIGN

and

PENICILLIN VIALS, VACCINE BULBS—WHITE &
AMBER



**ALL OTHER APPARATUS & EQUIPMENT
MANUFACTURED TO CLIENT'S DESIGN**

**INDUSTRIAL & ENGINEERING
APPARATUS CO. LTD.**

CHOTANI ESTATES, PROCTOR ROAD
GRANT ROAD, BOMBAY 7

Specialists in manufacturing

LAMP BLOWN APPARATUS

from Pyrex, German and other
heat resistant glasses as per
any specification

Makers of

**CHROMATOGRAPHIC CHAMBERS
AND ACCESSORIES**



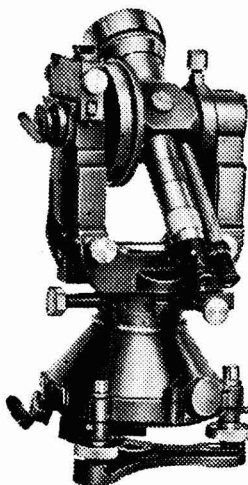
S. K. BISWAS & CO.

137 BOWBAZAR STREET
(KOLAY BUILDINGS)
POST BOX NO. 7885
CALCUTTA 12

Gram : SOXHLET

Phone: 34 : 2019

'WILD' HEERBRUGG (Switzerland)



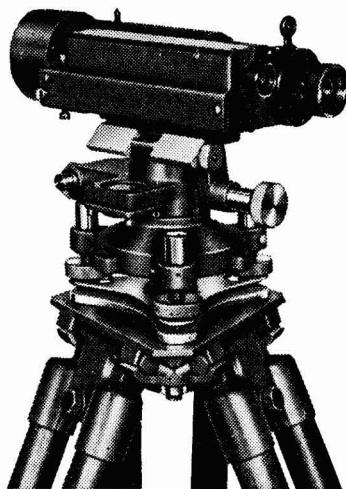
WILD THEODOLITE T3

The manufacturers of
Highest Class Precision Optical
and Mechanical Instruments

for

WORKSHOPS
LABORATORIES &
SURVEY

- * Microscopes for colleges and research
- * Microscopes for angle and thread measuring
- * Testing instruments for plane surfaces
- * Drawing instruments of stainless steel
- * Levels, theodolites and aerial cameras
- * Distance measuring instruments, etc.



WILD LEVEL N2

SOLE AGENTS :

RAJ-DER-KAR & Co.

COMMISSARIAT BUILDING, HORNBY ROAD
FORT, BOMBAY

Telephone : 26-2304

Telegram : "TECHLAB"

LATEST ARRIVALS

PYREX SCIENTIFIC & LABORATORY GLASSWARE

E-MIL GOLD/LINE BURETTES, 50 ml.

WESTGLAS BURETTES & PIPETTES

SUMMIT BRAND MICRO COVER GLASSES

SCP BRAND (Japan) PORCELAIN BASINS & CRUCIBLES

Apply for Price List

LABORATORY FURNISHERS

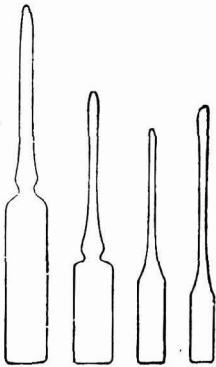
B. PATEL & COMPANY

Direct Importers

27/29 POPATWADI, KALBADEVI ROAD

BOMBAY 2

Telegrams: Glasalsort



MANUFACTURERS OF

**MACHINE MADE AND
HAND MADE**

NEUTRAL GLASS, AMPOULES

For further particulars, write to :

**BOMBAY SCIENTIFIC
GLASS WORKS**

ARAB HOUSE, KHETWADI 13TH LANE
BOMBAY 4

ARVIND

for



QUALITY FABRICS

THE ARVIND MILLS LTD.

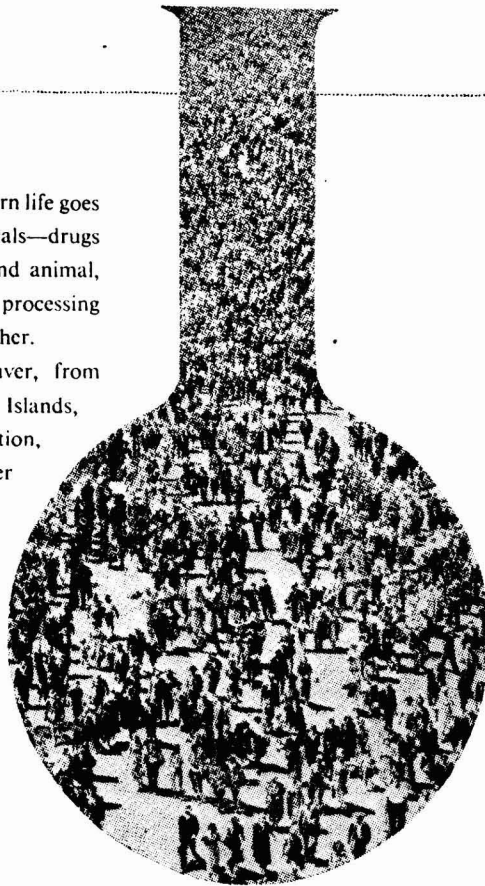
NARODA ROAD, AHMEDABAD 2

They *all* use chemicals

Into the complexity of modern life goes a large number of chemicals—drugs for better health in man and animal, aids to plant welfare, processing materials for the photographer. From London to Vancouver, from Iceland to the Falkland Islands, the May & Baker organization, with resources built up over a century of chemical-manufacturing experience, is geared to present-day needs.

M&B

MAY & BAKER LTD



MANUFACTURERS OF:

M&B BRAND AGRICULTURAL, AROMATIC, HORTICULTURAL, INDUSTRIAL, LABORATORY, MEDICAL, PHARMACEUTICAL, PHOTOGRAPHIC, PLASTIC, POULTRY AND VETERINARY PRODUCTS.

Distributed by:

MAY & BAKER (INDIA) LTD. BOMBAY • CALCUTTA • GAUHATI • MADRAS • NEW DELHI

MA2807-73



T. C. F.

*Standardised and Dependable
Pharmaceuticals, Biologicals,
Vitamins and Hormones
for the Medical Profession*

TEDDINGTON CHEMICAL FACTORY LTD.
(Biological & Pharmaceutical Laboratories)
SURÉN ROAD, ANDHERI, BOMBAY.

Sole Distributors:
W. T. SURÉN & CO. LTD., P.O. Box 229, BOMBAY 1

Branches: CALCUTTA: P.O. Box 672 MADRAS: P.O. Box 1286

WT. 1681-A

Advertise in **ISI BULLETIN!**



The ISI BULLETIN is the only Standards Journal in India and, therefore, an excellent medium for advertising goods of quality. Its pages are at your service. Use them to advertise your goods and services.

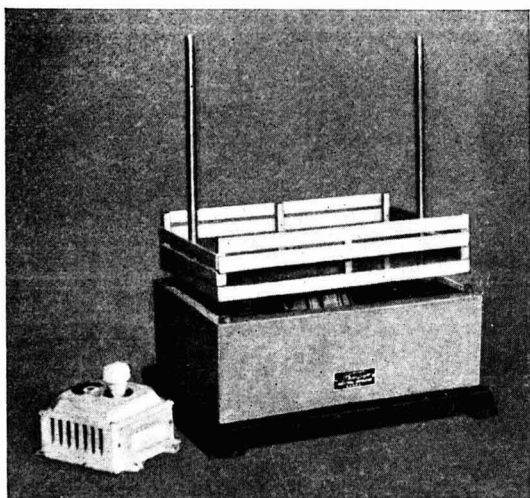
SCHEDULE OF ADVERTISEMENT RATES

	Insertions	Full Page	Half Page	Quarter Page
		254 × 170 mm	170 × 124 mm or 254 × 82 mm	124 × 82 mm or 170 × 60 mm
		Rs	Rs	Rs
Fourth cover page	{ 1	180	105	60
	{ 6	900	525	300
Third cover page and page facing second cover page	{ 1	160	90	50
	{ 6	800	450	250
Other pages	{ 1	140	80	45
	{ 6	700	400	225

For further particulars please write to :

INDIAN STANDARDS INSTITUTION
19 UNIVERSITY ROAD, DELHI 8

TEMPO Laboratory Equipment



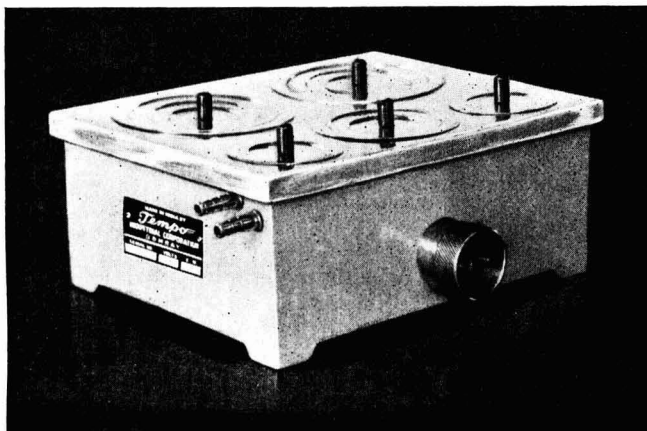
SHAKING MACHINE

Tray size: 15" × 9"

WATER BATH

Electrically heated
Cast in aluminium

Size: 8" × 10" × 4"



Manufactured by:

TEMPO

INDUSTRIAL CORPORATION Ltd.

1ST FLOOR, DEVKARAN MANSION, PRINCESS STREET
BOMBAY 2

For all kinds
of woodwork...
interior or
exterior



SHALIMAR

WOODKOTE

READY MIXED PAINT
is a high-gloss ready-mixed
paint of great durability.

Made to
withstand
all weather
conditions



SHALIMAR

LUSTROL

ALUMINIUM PAINT
has a large covering capacity
and maximum leafing power.

A washable
flat wall
paint



SHALIMAR

MATTKOTE

FLAT WALL PAINT
will cover interior plaster,
concrete, wood. Durable.

THE IMPECCABLE MULTI-PURPOSE ENAMEL

Suitable for a wide variety of industrial and domestic uses
on almost any surface. Can be brush, spray or dip
applied; will stand repeated cleaning.

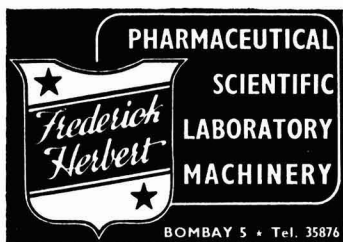
SHALIMAR SUPERLAC



**SHALIMAR PAINT, COLOUR &
VARNISH COMPANY, LIMITED**

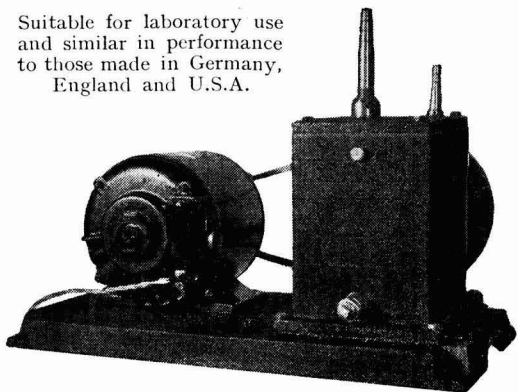
**CALCUTTA • BOMBAY • MADRAS
NEW DELHI • KANPUR**

SPW 26



MADE IN INDIA
HIGH VACUUM
ROTARY PUMP
SINGLE STAGE & TWO STAGE

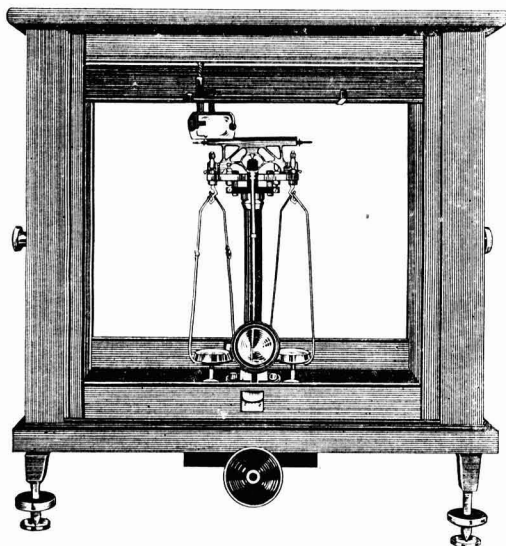
Suitable for laboratory use
and similar in performance
to those made in Germany,
England and U.S.A.



All Indian materials and construction

BASIC & SYNTHETIC CHEMICALS LTD.
P.O. Jadavpur College, Calcutta 32

SP/HF/1



From
A MICRO
to
A PHYSICAL BALANCE
you may depend on
KEROY BALANCES
for their
SENSITIVITY, CONSTANCY &
DURABILITY

Manufactured by

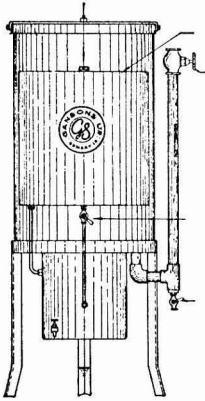
Keroy Limited

Factory
335 NADESHWAR, BANARAS CANTT.

Service Station & Office
32 LATAFAT HUSSAIN LANE, CALCUTTA 10

GANSONS LTD.

BOMBAY 14



GAS for KITCHENS

another development besides uses in
LABORATORIES & INDUSTRIES

Installed in
**RESTAURANTS, HOTELS &
DOMESTIC KITCHENS**

Selling agents :

KILBURN & CO. LTD., CALCUTTA
VIJAY SC. EQUIPTS., VIJAYAWADA
DIKSON BROS., BANGALORE

M. MUKHERJEE & SONS, NEW DELHI
TOSHNIWAL BROS. LTD., MADRAS
UNITED AGENCIES LTD., TRIVANDRUM

KAYCEE SCIENTIFIC & ELECTRICAL INSTRUMENTS

Range of Manufacture:-

VOLTMETERS
AMMETERS
MICROAMMETERS
MULTIMETERS
G.P.O. DETECTORS
PYROMETERS
OHMMETERS
POTENTIOMETERS
WHEATSTONE BRIDGE
RHEOSTATS
SPECTROMETERS
SPHEROMETERS
FILMSTRIP & SLIDE
PROJECTORES

RADIO LAMP WORKS LTD.

BOMBAY . CALCUTTA . DELHI . MADRAS . KANPUR . INDOR

Back issues wanted

SCIENCE & CULTURE

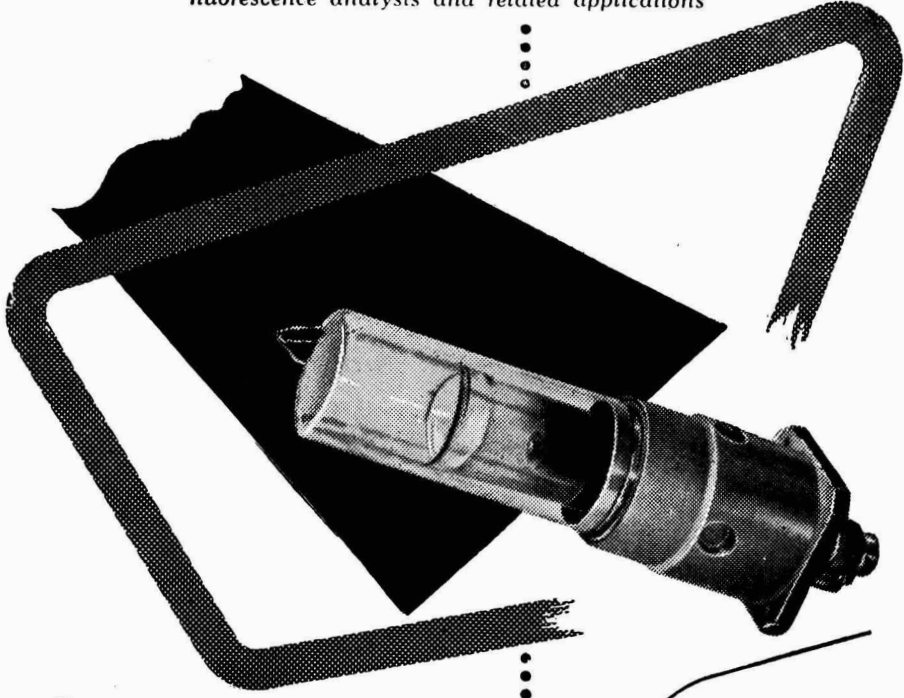
Vol. I	(Complete)
Vol. II	"
Vol. III	"
Vol. IV	"
Vol. V	"
Vol. VIII	"

Please write to:

**THE CHIEF EDITOR
PUBLICATIONS DIVISION
COUNCIL OF SCIENTIFIC &
INDUSTRIAL RESEARCH
OLD MILL ROAD
NEW DELHI 2**

PHILIPS

Suppliers of all
electronic tubes
for X-ray diffraction,
fluorescence analysis and related applications



Sealed-off tubes for X-ray diffraction with line-foci $1 \times 10 \text{ mm}^2$ or $0.3 \times 3 \text{ mm}^2$; anodes of Cr, Fe, Co, Mo, W or Cu; spectral purity better than 10/0

- Special tubes for X-ray fluorescence analysis • Decimal counter tubes • Geiger Müller tubes • H.T. Rectifying valves • Image intensifier tubes

World-wide distribution and service
Unequaled spectral purity



PSPH 75'

N.V. PHILIPS' GLOEILAMPENFABRIEKEN
Scientific Equipment Department,
EINDHOVEN (Holland)

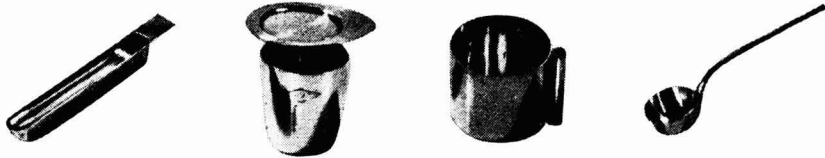
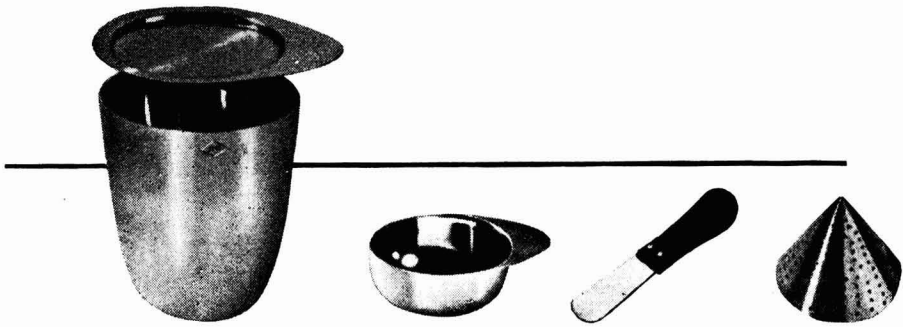
PHILIPS ELECTRICAL LTD.,
X-Ray Department,
Shaftesbury Avenue, LONDON W.C.2.

NORTH AMERICAN PHILIPS CO. INC.,
Research and Control Instruments Division,
750, South Fulton Ave. MOUNT VERNON N.Y.

Sole Concessionaires in India

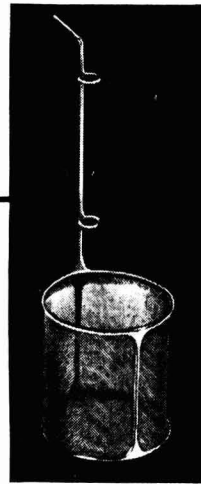
PHILIPS ELECTRICAL CO., (INDIA) LTD.,

Branches: CALCUTTA, MADRAS, BOMBAY, NEW DELHI, KANPUR, LUCKNOW,
PATNA, BANGALORE



Platinum for chemical analysis

The century-long experience of Johnson Matthey in both the manufacture and use of platinum apparatus, coupled with craftsmanship of the highest order, provides a guarantee of quality in all JMC platinum ware. Good design, close attention to dimensional accuracy and the highest standards of finish are combined to produce units excellently matched to their duties and of robust construction for long, trouble-free service.



Johnson 
Matthey

AVAILABLE EX-STOCK IN INDIA FROM

RAM LABHAYA ARORA & SONS

161/1 HARRISON ROAD, CALCUTTA

Telegram: "METCHEMIKO", CALCUTTA

Telephone : 33-3256

Indian skill can make



**ANALYTICAL REAGENT CHEMICALS OF THE SAME
HIGH STANDARDS OF PURITY AS THOSE MADE BY
GERMAN, BRITISH & AMERICAN TECHNICAL SKILL**



VERY RELIABLE INDIGENOUS SUBSTITUTES OF
GUARANTEED ANALYTICAL REAGENTS
MAY BE FOUND IN

B A S Y N T H B R A N D

ACID SULPHURIC	sp. gr.	1.84
ACID HYDROCHLORIC, FUMING	"	1.19
ACID HYDROCHLORIC	"	1.18
ACID NITRIC	"	1.42
AMMONIUM HYDROXIDE	"	0.90

AND MANY OTHER ITEMS ALL MADE IN INDIA BY

BASIC & SYNTHETIC CHEMICALS Ltd.

P.O. JADAVPUR COLLEGE, CALCUTTA 32

USE SWADESHI AND HELP TO KEEP EMPLOYED INDIAN TECHNICAL SKILL IN INDUSTRIES

INDEX TO ADVERTISERS

	PAGE		PAGE
ANDHRA SCIENTIFIC CO. LTD., MASULIPATAM	... A25	J. T. JAGTIANI, BOMBAY	... A18
ARVIND MILLS LTD., AHMEDABAD	... A28	KEROY LTD., CALCUTTA	... A33
ASHA SCIENTIFIC CO., BOMBAY	... A8	KILBURN & CO. LTD., CALCUTTA	... A24
ASIATIC OXYGEN & ACETYLENE CO. LTD., CALCUTTA	... A14	LABORATORY FURNISHERS, BOMBAY	... A41
ASSOCIATED INSTRUMENT MANUFACTURERS (INDIA) LTD., CALCUTTA	... A39	MANSFIELD OIL GAS CO. LTD., CALCUTTA	... A12
BASIC & SYNTHETIC CHEMICALS LTD., CALCUTTA	A33, 37	MARTIN & HARRIS LTD., BOMBAY	... A11, 19, 42, 44
B. BABULAL & CO., BOMBAY	... A16	MAY & BAKER (INDIA) LTD., BOMBAY	... A29
BENGAL CHEMICAL & PHARMACEUTICAL WORKS LTD., CALCUTTA	... A6	MORITZ CHEMICAL ENGINEERING CO. LTD., LONDON	... A20
BENGAL IMMUNITY CO. LTD., CALCUTTA	... A17	M. RAMCHANDRA & SONS, BOMBAY	... A16
BENGAL INDUSTRIAL & SCIENTIFIC WORKS LTD., CALCUTTA	... A22	PHILIPS ELECTRICAL CO. (INDIA) LTD., CALCUTTA	... A35
BOMBAY SCIENTIFIC GLASS WORKS, BOMBAY	... A28	PIONEER INDUSTRIES, BOMBAY	... A23
B. PATEL & CO., BOMBAY	... A28	PUBLICATIONS DIVISION, C.S.I.R., NEW DELHI	... A5, 34
BRITISH DRUG HOUSES (INDIA) LTD., BOMBAY	... A22	RADIO ELECTRIC LTD., BOMBAY	... A26
CENTRAL SCIENTIFIC SUPPLIES CO. LTD., TAMBARAM	... A12	RADIO LAMP WORKS LTD., BOMBAY	... A34
CRAFTSMAN ELECTRONIC CORPORATION LTD., BOMBAY	... A43	RAJ-DER-KAR & CO., BOMBAY	... A13, 27
D.C.M. CHEMICAL WORKS, DELHI	... A21	RAM LABHAYA ARORA & SONS, CALCUTTA	... A36
FREDERICK HERBERT, BOMBAY	... A33	RAVINDRA & CO. (PLATINUM), BOMBAY	... A9
GANSONS LTD., BOMBAY	... A34	SCIENTIFIC INSTRUMENT CO. LTD., CALCUTTA	... A2
GHARPURE & CO., CALCUTTA	... A12	SCIENTIFIC INSTRUMENT MFG. CO., CALCUTTA	... A16
GHOSE BROTHERS (PERFUMERS), CALCUTTA	... A8	SHALIMAR PAINT, COLOUR & VARNISH CO. LTD., CALCUTTA	... A32
GIDVANI & CO., BOMBAY	... A20	S. H. KELKAR & CO. LTD., BOMBAY	... A24
GORDHANDAS DESAI & CO., BOMBAY	... A7	S. K. BISWAS & CO., CALCUTTA	... A26
GRIFFIN & GEORGE (INDIA) LTD., CALCUTTA	... A38	S. MATHURADAS & CO., BOMBAY	... A41
HOSPITAL SUPPLY CO., CALCUTTA	... A10	S. SIRCAR & CO. LTD., CALCUTTA	... A41
H. REEVE ANGEL & CO. LTD., LONDON	... A15	STANDARD SCIENTIFIC INSTRUMENTS CO., MADRAS	... A8
INDUSTRIAL & ENGINEERING APPARATUS CO. LTD., BOMBAY	... A26	TATA IRON & STEEL CO. LTD., CALCUTTA	... A40
INSTRUMENT RESEARCH LABORATORY LTD., CALCUTTA	... A6	TECHNICAL CORPORATION LTD., LUCKNOW	... A8
INDIAN STANDARDS INSTITUTION, DELHI	... A30	TEMPO INDUSTRIAL CORPN. LTD., BOMBAY	... A31
		THERMO-ELECTRIC EQUIPMENT CO., BOMBAY	... A10
		UNION SCIENTIFIC SYNDICATE, BOMBAY	... A18
		UNIQUE TRADING CORPORATION, BOMBAY	... A14
		W. T. SUREN & CO. LTD., BOMBAY	... A30

THE G & T THERMOSTATIC OVEN

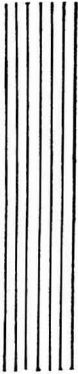
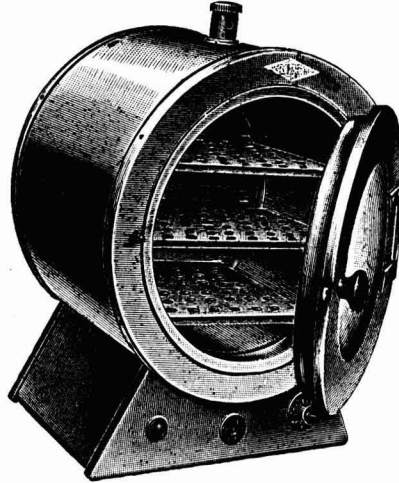
FOR

ALL

ROUND

THERMAL

EFFICIENCY



*Thermostatically controlled from 35° to 220°C.
Operable on all voltages of 100-110 and 200-250 A.C. and D.C.*

Stocked by

GRIFFIN & GEORGE (India) Ltd.

B-5 CLIVE BUILDINGS
P.O. BOX 2136
CALCUTTA

INDIA HOUSE
FORT STREET
BOMBAY 1

17 MOUNT ROAD
MADRAS

SUNLIGHT INSURANCE BUILDING
MINTO ROAD EXTENSION
NEW DELHI

Fuel Efficiency Organization

J. W. WHITAKER

Fuel Research Institute, Jealgora, Bihar

COAL and oil, the chief world fuels, are 'wasting assets', and are consumed at a rate which increases automatically with the growth in population and with the general development of a country. More especially with development in industrialization have we periodically to take stock of the supply of fuels and to explore by boring and prospecting such areas as are likely to yield deposits of value. If supplies are scarce, it is essential to ensure that the fuel when found shall be utilized in an efficient and proper manner. Coking coal, for instance, should not be consumed indiscriminately in processes other than carbonization, unless there is a veritable super-abundance of such coal. Petroleum oil fractions being of high value both technically and monetarily, the utilization of petrol, kerosene, diesel oil and fuel oil is

normally directed into the right and proper channels, and faulty practice and wastage are rare. But in the consumption of solid fuels, and especially of coal, the fuel is not used with the same discrimination, economy and intelligence, particularly if the fuel cost is not high, as compared with the value of the products of the industry concerned.

Table 1 shows the *relative* costs of fuel and electrical energy in different industries in India. It will be seen from the last column in the table that the cost of fuel in most industries is very low in comparison with the value of the products made. This low fuel charge on the manufacture of products exerts practically no financial pressure on the industry, with the result that there is no financial stimulus towards fuel economy: the average fuel charge is only about $3\frac{1}{2}$ per cent and this includes electrical energy consumed.

TABLE 1 — INDUSTRIES AND THEIR FUEL COSTS*

INDUSTRY	EX-FACTORY VALUE OF PRODUCTS AND BYPRODUCTS (Rs. in crores)	EXPENDITURE INCURRED ON COAL AND COKE (Rs. in crores)	EXPENDITURE ON FUEL AND ELECTRICITY (Rs. in crores)	COST EXPRESSED AS PERCENTAGE OF THE GROSS EX-FACTORY VALUE OF PRODUCTS AND BYPRODUCTS	
				Coal and coke	Fuel and electricity
Cotton textiles	412.8	4.75	13.06	1.15	3.16
Jute textiles	160.3	1.19	2.36	0.70	1.40
Iron and steel	69.9	7.86	8.87	11.25	12.70
Vegetable oils	125.0	0.61	1.84	0.49	1.47
Cement	23.9	3.42	4.37	14.32	18.28
Chemicals	41.0	1.28	2.16	3.13	5.26
Aluminium, copper and brass	21.6	0.27	0.67	1.27	3.08
General engineering and electrical engineering	67.9	0.69	1.66	1.02	2.45
Paper and paper board	18.0	1.12	1.42	6.21	7.88
Sugar	84.5	0.31	0.99	0.37	1.18
Glass and glasswares	4.5	0.37	0.96	8.17	21.20
Ceramics	3.9	0.49	0.62	12.56	15.98
Rice milling	45.2	0.15	0.35	0.34	0.77
Total for 28 manufacturing industries	1180.0	23.12	40.81	1.96	3.45

*Source: Census of Indian Manufacturing Industries, Ministry of Commerce and Industry, 1952.

Exceptions to this generalization are the iron and steel works, the cement industry, the glass and ceramics industries, and the railways.

The Fuel Research Institute has been engaged for some time in assessing the physical and chemical properties of the coals of the country, and good progress has been made in the main coalfields. For the chief Indian coals, there now exists a collection of knowledge and information available both at the Central Institute in the Jharia Coalfield, and at the various Coal Survey Laboratories at Ranchi (Bihar), Ranigunj (Bengal), and Bilaspur (Madhya Pradesh). In the coming years similar technical knowledge will be available for the coals of Assam, as a Coal Survey Laboratory is being established at Jorhat. The information already gathered is being utilized increasingly by Central and State Governments and by the Coal Board, iron and steel works, the railways, and other large consumers; and it is being increasingly recognized that the Fuel Research Institute is in a position to state categorically which of the main coals of India are most suited for different purposes, i.e. which are best allocated for steam-raising, carbonization, gasification, domestic coke manufacture, or conversion to synthetic oil, etc. The amenability of coals to purification has also been studied extensively, and the limitations and economics of coal-washing of many coals are known. This is important: popular but ill-informed opinion is inclined to regard coal-washing as a panacea for all ills.

To state the best uses of a coal, however, does not by any means necessarily ensure that the coal will be used in that manner *efficiently*. For example, much of the coal of the country is satisfactory for steam-raising and is used for that purpose, but the efficiency with which such coal is consumed and the heat utilized for steam generation is quite another matter. To use two tons of coal where one ton will suffice must be regarded as extravagance. By no stretch of imagination can we say in such cases that economy in fuel (or coal conservation) is being achieved: yet fuel economy is important today and may become vital in the next 5 or 10 years. The demand for coal in India by the year 1960 will be about 60 million tons per annum. This coal has to be transported from the coalfields and collieries

to the actual centres of consumption. Do we take measures to ensure that the coal is then *consumed* with economy and efficiency? Are we transporting (and shall we continue to transport) unnecessary coal? Can the efficiency of utilization be so raised that, with the industrial growth and development now foreshadowed, the coal-transport problems will not be unduly increased? These are the issues.

Fuel research can be visualized as extending into three main fields: First, the assessment in quantity and in quality of the coals and other fuels available; secondly, the additional testing of the fuel to assess purification potentialities and suitability for (or amenability to) particular technical processes; and thirdly, the *ensuring of efficiency in utilization*. Clearly the first field is essential and the second is also of great importance; but it is by *economy in utilization* that we can expect the most immediate and direct benefits. India has a record of 'cheap coal'. Not many years ago the price was only a few rupees per ton, and even today it is not high. The pit-head price of roughly Rs. 13 or 14 per ton for moderately good grade coal is equivalent to £1 (sterling) per ton, against prices of £4-6 per ton now common in Europe and America. This implies essentially that Indian coal is still 'cheap'. Low price of such a basic commodity is of course of no small benefit to industry and to (railway) transport; but, unfortunately, low price does not promote or encourage economy: waste and extravagance naturally follow, if the cost of fuel forms only a negligible charge on the value of the commodity produced.

Perhaps the main offender in coal utilization is the 'average' steam-raising plant and the 'average' steam locomotive. The steam locomotive, it is well known, has a total efficiency of only 4 or 5 per cent. In other words, 95 per cent of the energy in the coal is not utilized for the actual traction. The furnace and boiler of the locomotive may have a joint efficiency of 60 or 70 per cent, and in this respect steam generation in such a boiler is satisfactory. It is in the utilization of the steam where most of the losses occur. These losses arise largely from limitations and restrictions in size and design, and in practice it has proved difficult to increase the overall efficiency beyond 10 per cent. Certain locomotives, however, in

Europe, notably in France, have achieved this efficiency, and the fuel consumption of such locomotives is thus halved — as against Indian practice. However, railway electrification and dieselization are now receiving much attention in all countries, and the railway authorities in India are alive to the position. There is a further point of importance. Steam locomotives require large size high grade coal whereas thermal power stations can use low grade (slack) coal of which India has abundant supplies. This gives a further reason for the change-over.

Turning to what is termed 'stationary plant', the efficiency of a modern boiler may be as high as 90 per cent while the efficiency of a neglected boiler may be as low as 45 per cent or even less. It is generally the *smaller* plants which are run extravagantly, whether in India or elsewhere, and their usual efficiencies can often be increased considerably, i.e. from a value of say 44 to 66 per cent, if the necessary care and attention to details are given. For example, treatment of the water supply may be of primary importance, or it may be necessary to attend to heat-insulation, or to the reduction of standby losses, or to the general mode of plant operation, e.g. staggering the load. Unfortunately, the men operating small boiler plant are often untrained and illiterate and possess but little understanding of combustion, heat transfer, and so forth. In such circumstances, the plant is naturally not operated with high efficiency. More energy and more work from the stokers are *not* called for: more training and more technical knowledge and understanding definitely *are*. Knowledge, if applied, will lighten the labour of stoking. The senior engineering staff and those in charge should pay attention to training the boiler house staff — and indeed to fuel economy in general, e.g. steam consumption.

The above observations are confined largely to steam-raising plant. In respect of carbonization and gasification, the efficiency of the plant and its operation are not neglected to the same degree: coke-oven managers, for instance, are usually well aware of the technical and economic issues involved, as are the managers of gas works and of gasification plant, e.g. producer plant and the

like. But in other fields of utilization where *combustion* is the main process, notably in furnaces for foundries, glass making, brick burning, lime kilns and the like, there is again usually room for improvement. Nor can we exclude authorities responsible for installing large thermal plant utilizing coal for the generation of electric energy. Modern practice indicates that the highest thermal efficiencies are obtained by employing powdered coal, i.e. 'pulverized fuel'. Coals are burnt most efficiently in this condition, especially low grade coals with their high content of foreign matter. Yet in recent years some large power plant have been installed in India which operate on less efficient principles. As a matter of national policy, when the installation of thermal power plant (in which the fuel consumption will be high) is under consideration, arrangements should be made for burning low grade coal, having up to 35 per cent of ash.

To advise upon these matters and to assess the efficiency of plant with a view to its improvement or alteration, the Fuel Research Institute is establishing a Fuel Efficiency Section. Similar steps have been taken in other countries, perhaps under the pressure of war. In U.K., for instance, great economy in coal was effected in the last war, simply by insisting upon increased efficiency of consumption. In spite of all the growth of industry that has taken place in the past 20 or 30 years in that country, the annual consumption of coal in U.K. has barely increased. The output from the mines has fallen from 300 million tons per annum in 1913 to 220 million tons today. It is agreed that about 100 million tons were exported in 1913; but, even so, the residual 200 million tons remains substantially the same, and this after a period of over 40 years. If similar attention were paid to efficiency of coal utilization in India, similar economy would no doubt be also achieved. Such economy will reduce fuel costs to the industries, and save the 'transport coal' required by the railways — and thus largely offset the higher charges likely to arise from the increased price of coal in the forthcoming years. In this work the help and co-operation of the Coal Board and of the chief coal consumers are being sought.

The International Conference on Peaceful Uses of Atomic Energy

PHYSICS SESSION*

INTERESTING and comprehensive information was presented on the values of the total neutron cross-sections at various energies for different elements. This information is of basic interest in the study of nuclear structure and also in the design of nuclear reactors. Ever since the preliminary work of Rainwater and Havens, data have been accumulating in this branch and most of the results compiled together previously were from the work done in the U.S.A. This is the first time that all the measurements of total neutron cross-sections obtained from various choppers and crystal spectrometers in different parts of the world, including the U.S.S.R., have become available. Except for a few small variations, the agreement among these various measurements is most striking. There are, however, some substances which must be studied in greater detail as the results quoted in the publications are from the very early measurements. For example, the results for beryllium oxide are from the work of Fermi *et al.* published in 1947. No work seems to have been done since then. There are also certain interesting elements on which information has been released by only one country, for example by the U.S.S.R. on Am²⁴¹. The errors in the various measurements are still of the order of 5 per cent or more. It would be of great value to have these reduced. In order to obtain these results various types of choppers have been used. A comparative survey of these was given at the conference. The results include values obtained from neutron sources other than reactors, of particular interest being the electron linear accelerator at Harwell.

The other important set of constants released at the conference was that of the fission of U²³⁵, U²³³ and Pu²³⁹. Here again the values from the different countries are in reasonable agreement (Table 1). Of particular interest is the number of neutrons

*Contributed by Dr. R. Ramanna, Atomic Energy Establishment, Bombay.

emitted per fission in U²³³. This clearly shows that U²³³ is a better fuel for breeding than U²³⁵ and emphasizes the great future for thorium in reactors to come. Preliminary to this there was a session to discuss the latest theories of fission in view of the new facts of fission phenomena that have been observed, particularly the angular distribution of fission fragments with respect to the incident particles and the asymmetric mass distribution of fission fragments. The interpretation of these results on the new hydrodynamic model of the nucleus was also discussed.

The information released on sub-critical experiments covered a wide range. Exponential experiments, first suggested by Fermi, are used to obtain reactor parameters directly, since theoretical calculations become very complicated. For this reason the results of these experiments form a set of empirical observations basic to reactor design. Several papers were presented in which the effect of the variation in lattice spacing, rod dimensions, types of cooling used, and moderator properties on reactivity have been discussed. Of particular interest were the exponential experiments with fast neutrons. The measurements have yielded bucklings of systems of various mixtures of fuel and diluent materials with isotopic ratio of U²³⁸ and U²³⁵ in the range 3:1 to 7:1. The reflector savings of Pb, Fe, U and Al have been calculated. Agreement with the theory is discussed and differences are attributed to the energy spectrum of the neutrons in the system.

TABLE 1 — FISSION CONSTANTS FOR U²³³, U²³⁵ AND Pu²³⁹

	COUNTRY	U ²³³	U ²³⁵	Pu ²³⁹
σ_T	U.S.S.R.	615 ± 30b	710 ± 20b	1040 ± 30b
	U.K.	580 ± 20	720 ± 15	1050 ± 50
	U.S.A.	610 ± 9	687 ± 7	—
	France	—	—	1065
σ_f	U.K.	515 ± 15	638 ± 20	702 ± 20
	U.S.A.	—	580 ± 8	—
	France	518	580	750
η	U.S.S.R.	2.4	2.12	2.05
	U.S.A.	2.31	2.08	2.03

In another session, the diffusion of neutrons from pulsed fast neutron sources in moderating and multiplying media was discussed. The application of these methods to determine slowing down constants at various temperatures is of particular interest in the regions where the neutron energy is of the same order as the crystal vibration energies. A method of determining the diffusion constants of moderators by using a time modulated pile neutron beam was also described. The pulsed neutron beam method can be used to measure the delayed neutron periods in a multiplying medium.

There was also a survey on accelerators which was not in the official proceedings of the conference. This was given by two well-known authorities on the subject, Prof. Lawrence of the U.S.A. and Prof. Veksler of the U.S.S.R. The former discussed the importance of increasing the current output of accelerators now being built, and the latter described the future accelerator programme of the U.S.S.R. It is interesting to note that the highest energy synchrocyclotron (650 Mev.) was built near Moscow in 1949 and that in 1956 a synchrotron of 10 Bev. will be in operation in the Soviet Union.

REACTOR SESSION*

THE reactor sessions can be broadly classified under two headings, viz. research reactors and power reactors.

About 16 papers were presented on research reactors describing various types of reactors in operation in different countries. Although many of these reactors were earlier described in scientific journals, construction features and additional details were made available at the conference. While a detailed description of some research reactors was quite useful, a general survey of different types of research reactors and the reactor as a research tool was of considerable interest. The types of research reactors that are at present in operation may be classified according to the fuel and moderator used and the type of coolant employed. The natural uranium reactors may have graphite or heavy water as moderators and cooling may

be by a gas such as air or CO_2 as in BEPO at Harwell and the Saclay Pile or by heavy water as in the proposed N.R.U. reactor in Canada or by light water as in the N.R.X. The other class of research reactors use enriched uranium as fuel and either light water or heavy water as both moderator and coolant.

With the necessity for extensive testing of materials under radiation which a power development programme involves, neutron sources in which both fast and slow fluxes are maximal are required. To meet this need, enriched uranium research reactors were developed. The materials testing reactor at Arco, Idaho, which has a maximum thermal flux of 4×10^{14} neutron/sq. cm./sec., is of this type. The core of enriched uranium reactors is small; consequently volume specific power can be high. Further, for the same power level a higher neutron flux can be obtained. The N.R.U. reactor, a natural uranium heavy water moderated reactor being built in Canada, would operate at a power level of 200,000 kW., and produce a maximum flux of 3×10^{14} neutrons/sq. cm./sec., as against the slightly higher flux of Arco M.T.R. reactor at a power of only 30,000 kW. However, the production of plutonium from uranium 238 atoms would be comparatively small in the case of the enriched reactor because of the decreased ratio of U238 to U235 isotopes and a higher fast fission effect.

Increasing attention is also being paid to provision of facilities for so-called loop experiments for technological studies concerning effects of irradiation on materials, corrosion properties, heat transfer coefficients, stability of coolant materials and new fuel systems. These consist of large channels in the reactor core lattice where prototype fuel elements with individual cooling system may be studied under simulated conditions.

The sessions on power reactors consisted mainly of prototype reactors in operation and under construction in different countries. In the three countries which have most vigorously pursued reactor technology, i.e. U.K., U.S.A. and U.S.S.R., there is surprisingly little overlapping in the power reactor development programme envisaged. In the United Kingdom two reactor types, one the natural or slightly enriched uranium, gas cooled, graphite-moderated thermal reactor

*Contributed by Dr. N. B. Prasad, Atomic Energy Establishment, Bombay.

at Calder Hall and the other the sodium cooled fast breeder reactor at Dounreay, are under construction. The Calder Hall reactor station is scheduled to go on stream during 1956 and will have an electrical capacity of 92,000 kW. In the U.S.A., five reactor types are being considered as being most promising. Of these, two are light water cooled, light water-moderated reactors using enriched uranium as fuel. In the pressurized water reactor the steam is generated in a heat exchanger by circulation of the moderator at high pressures whereas in the boiling water reactor the steam is generated in the reactor core itself. The third is the homogeneous reactor where the fuel (90 per cent enriched) in the form of uranyl sulphate is dissolved in heavy water which acts as both coolant and moderator. The advantage here is that costly metallurgical processing of fuel elements is eliminated and continuous processing for separation of fission products from the fuel solution can be accomplished. However, the system has to operate under high pressure and the active fuel solution flows through heat exchangers and auxiliary equipment which leads to serious corrosion problems. The other two will use liquid sodium as the coolant. In one, the sodium-graphite reactor, sodium flows in annular channels around the fuel elements and graphite canned in zirconium will be used as moderator. In the other one, the experimental breeder reactor, the fuel will be plutonium with no moderator and with sodium as coolant. It is expected that in this type of fast breeder reactor, every atom of plutonium burnt out will produce 1.6 atoms of plutonium thereby leading to a net breeding gain of 60 per cent and doubling of the fuel investment in 5-6 years.

The atomic power station in operation in U.S.S.R. since 2 July 1954 was described in detail. This is a pressurized water-cooled enriched uranium-graphite reactor with a rated heat capacity of 30,000 kW. and an electric power output of 5,000 kW. It was announced that a second atomic power station with an electrical capacity of 100,000 kW. is under construction. The reactors would be similar to the one in operation except that a higher conversion ratio of plutonium will be obtained by the use of zirconium instead of stainless steel in the core. It will be seen that with the exception of the fast breeder

reactors in the U.K. and U.S.A. there is very little duplication in the programme of the three countries. In addition to the above prototype reactors it was announced that Canada was considering a heavy water moderated, heavy water cooled power reactor with an electrical capacity of 20,000 kW.

In addition to the above prototype reactors other types are under active design consideration. Mention must be made of the liquid metal fuel reactor where a dilute solution of uranium, magnesium and zirconium in liquid bismuth is used as fuel. With efficient fission product removal in a closed loop, high conversion factors are obtained.

Some of the most interesting papers presented to the conference were on fuel cycles and the economic aspects of nuclear power. Most of the prototype power reactors described above use enriched uranium as a fuel. However, for countries without diffusion plants to produce enriched uranium, there is no option but to start with natural uranium-plutonium converters. The plutonium obtained from such converters would be later used to fuel either plutonium fast breeder reactors or thermal converters where more plutonium or uranium 233 from thorium may be produced. For countries with adequate resources of thorium this would be the starting point for thorium U_{233} breeder reactors. While only fast breeder reactors are possible with plutonium, fast and thermal breeders are possible with the thorium U_{233} cycle. While it is premature to say which cycle would be more economic, the higher material efficiency and burn up obtainable with thorium thermal breeders may considerably offset the possible advantage of the higher net breeding gain that may be obtained in the plutonium fast breeder. However, availability of necessary raw materials would also affect the choice of one or the other cycle.

Cost estimates of the prototype reactors described indicate that with present technological advance, the capital investment for the nuclear power plants may be of the order of \$ 200-400 per installed kW. capacity and the cost of generation will be in the range of 4-10 mills/kWh. The capital cost per kW. of installed capacity may be expected to come down rapidly within the next few years.

CHEMISTRY, METALLURGY & TECHNOLOGY SESSIONS*

THE sessions on chemistry, metallurgy and technology, which were eighteen in number, covered a wide range of problems concerning reactor materials. Discussions centred on the occurrence of uranium and thorium, prospecting for radioactive minerals, treatment of uranium and thorium ores and concentrates, production of high-purity uranium and thorium, physical metallurgy of uranium and thorium alloys, fabrication of fuel elements, production technology of special materials, facilities for handling highly radioactive materials, chemistry of transuranic elements and fission products, chemical processing of irradiated fuel elements, radiation effects on fissile and non-fissile materials, liquid metal technology, and waste treatment and disposal.

Seventeen nations had submitted papers on the natural occurrence of uranium and thorium which were summarized, for the benefit of the non-geological members of the conference, in a masterly survey by Paul Kerr¹ of the Columbia University. Thereafter, delegates from Argentina, Australia, Belgium, Brazil, Canada, France, India, Italy, Japan, Portugal, United Kingdom and United States participated in a panel discussion on the salient characteristics of uranium and thorium deposits in the different regions of the earth. The paper presented by Wadia² (India) made special mention of a new mineral Cheralite (composition: $\text{ThO}_2 = 31.4$ per cent, $\text{U}_3\text{O}_8 = 4.48$ per cent, $\text{P}_2\text{O}_5 = 24.55$ per cent, and $\text{SiO}_2 = 3.12$ per cent) and other thorium-rich variants of monazite which have been recently discovered in India.

In the session on prospecting for radioactive minerals, geological, geochemical, geophysical and geobotanical methods were discussed and new developments in instrumentation for location of active minerals were specially emphasized. Vohra³ (India) described an elegant method for 'remote location of uranium and thorium deposits' based on the determination of the 'age' of the air from measurements of radioactive composition with respect to thoron and radon decay products.

*Contributed by Dr. Brahm Prakash, Department of Metallurgy, Indian Institute of Science, Bangalore.

Pre-concentration of low grade ores of uranium, acid and alkali leaching processes of extraction, and concentration of lean uranium-bearing solutions by ion exchange, solvent extraction and chemical precipitation formed the subject of discussion for one of the sessions. Shankar⁴ (India) described an ion-exchange process for the recovery of uranium from carbonate leach solutions which is specially adapted to separation of uranium from anions such as vanadates, phosphates and aluminates. Krumholz⁵ (Brazil) in his communication has described the Brazilian practice for the extraction of thorium and uranium from monazite. It was obvious from the discussions that as the nations of the world become more and more atom power-conscious, the high grade ores of uranium and thorium would rapidly run out and, at a not very distant future, it would be necessary to extract uranium and thorium from materials in which these elements occur in extremely low concentrations. In this context, Harrison-Brown's⁶ (U.S.A.) paper on 'the possibilities of securing long-range supplies of U and Th from granitic rocks (containing 4 p.p.m. U, and 12 p.p.m. Th)' was of considerable interest.

The highlight of the technology sessions was the extensive declassification of information concerning the metallurgy of reactor fuels and the fabrication of fuel elements. There were contributions from the U.S.A., U.S.S.R., U.K. and France on refinements in the production technology of metallic uranium and thorium. In a classic summary of reactor fuels, Howe⁷ (U.S.A.) detailed the different types of fuel systems that have been employed in research and power reactors in the United States including metallic uranium-base elements, dispersion of fissile materials in metallic matrices, ceramic systems, liquid metal fuels, and aqueous solutions. The fuel elements of the swimming-pool reactor, which was on display at Geneva, were of the dispersion type developed at the Oakridge National Laboratory. In this system, individual fuel plates consisted of a three-layer sandwich with a central core of a 25 per cent alloy of enriched uranium and aluminium (or a powder-metallurgical compact of enriched UO_2 and aluminium) completely jacketed on all sides with aluminium cladding, by what is popularly known as the 'picture-frame technique'.

The plates were subsequently brazed on to aluminium side plates to give a concertina arrangement which has a high surface/volume ratio for enhanced heat transfer. From the simple, sealed, aluminium-canned slugs which produced the first significant amounts of nuclear heat in 1943 to the highly elegant 'MTR-type elements' described above is an interesting study in technological advancement.

It is essential that prolonged life should be ensured for the fuel elements when they are exposed to intense reactor radiations during operation. In this connection, the papers presented by Konobeevsky⁸ (U.S.S.R.), Billington⁹ (U.S.A.) and Pugh¹⁰ (U.K.) gave very valuable information on thermal cycling and irradiation effects on α -uranium. Changes in the dimensions and other properties of uranium during burn-up were described and tentative mechanisms to interpret these changes were discussed. As the phenomenon is of great importance in the design of fuel elements, means were suggested for counteracting this dimensional instability. It was disclosed that alloying uranium with metals such as chromium, niobium, molybdenum and zirconium tends to stabilize uranium in the radiation damage-resistant gamma phase.

Radiation damage to structural materials and moderators figured prominently in the discussions and the conference brought to light the extensive investigations that have been carried out to devise ways and means of minimizing the damage.

Unlike with the fossil fuels, it is not possible to achieve completeness of burn-up in nuclear fuels because of the build-up of fission products of high capture cross-section, and of physical damage to the fuel elements on account of continued exposure to reactor radiations. It, therefore, becomes necessary to reprocess the fuel elements at regular intervals. Chemical processing of irradiated fissile elements occupied two sessions, during which the versatility and efficacy of solvent extraction and ion-exchange processes for this purpose were specially emphasized. A significant contribution on pyrometallurgical processing of irradiated fuel was from the Ames Laboratory¹¹ (U.S.A.) which described a vacuum melting and partitioning process based on equilibrating the molten uranium fuel with molten metals such as silver which are immiscible with uranium.

During equilibration, plutonium and most of the fission products get transferred from the liquid uranium to the second phase. The principal advantage of this method for reprocessing the atomic fuel consists in its retaining the fuel in its original metallic state.

The technology of the separation processes has been backed by extensive chemical studies on transuranic elements and fission products. Three sessions were devoted to these problems. Many countries made notable contributions to the chemistry of the fission process, the solution chemistry of gross fission products, the chemistry of the actinides and of individual elements such as polonium, ruthenium, technetium, neptunium, americium, curium and their compounds. Two of the nine transuranic elements were given names in honour of Albert Einstein and Enrico Fermi, two of the founding fathers of atomic energy. Element 99 was christened Einsteinium, symbol E, and element 100 was christened Fermium, symbol Fm. Earlier this year, the element 101 had been named Mendeleevium by the United States scientists in honour of the 19th century Russian scientist Mendeleev.

Detailed descriptions of the 'hot' laboratories, as those handling highly radioactive substances are called, were provided by U.K., U.S.A. and U.S.S.R.

The chemical problems encountered in nuclear reactors formed the subject of discussion at one of the sessions. The behaviour of heavy water in piles, and of aluminium, zirconium and their alloys at normal and at elevated temperatures when exposed to different corrosive media, received special attention. In aqueous corrosion of aluminium¹² and zirconium¹³, it was reported that small additions of nickel (0.5-1.0 per cent) to aluminium, and of tin (1.2 per cent) to zirconium greatly improved their corrosion resistance.

Two sessions were devoted to the production technology of special materials such as graphite, heavy water, zirconium and beryllium which have to be processed to a high degree of purity to meet the exacting specifications of the nuclear engineers. Comprehensive summaries were presented by Currie¹⁴ (U.S.A.) on graphite, by Benedict¹⁵ (U.S.A.) on heavy water, by Shelton¹⁶ (U.S.A.) on zirconium, and by Kaufmann¹⁷ (U.S.A.) and Meyerson¹⁸ (U.S.S.R.) on the present status of beryllium metallurgy.

The separation of hafnium from zirconium attracted special attention. Among the practical methods of effecting the separation which were disclosed at the conference, mention may be made of solvent extraction as reported by Shelton¹⁶, and Hure¹⁹ (France); of fractional crystallization as reported by Sajin²⁰ (U.S.S.R.); and of vapour-phase dechlorination as reported by Prakash²¹ (India).

Liquid metal technology was discussed at one session. The advantage of using liquid metals as heat-transfer media arises from their ability to convey the nuclear heat at high temperatures. The comparative value of liquid sodium, sodium-potassium alloys, and of liquid bismuth, their production technology, special handling techniques, and corrosion characteristics were discussed in papers from U.K., U.S.A., U.S.S.R. and Sweden.

The problems of waste treatment and disposal were discussed at the concluding session. Canada, U.K. and U.S.A. presented papers on the disposal of wastes in the ground and in the sea. In the end, Silvermann²² (U.S.A.) dealt with the problems of air and gas cleaning for nuclear energy processes.

References

1. KERR, P. F., *The natural occurrence of uranium and thorium*, P/1114.
2. WADIA, D. N., *Natural occurrence of uranium and thorium in India*, P/875.
3. VOHRA, K. G., *Remote location of uranium and thorium deposits*, P/869.
4. SHANKAR, J. et al., *An ion-exchange process for the recovery of uranium from carbonate leach solutions*, P/871.
5. KRUMHOLZ, P., *Extraction of thorium and uranium from Brazilian monazite*, P/133.
6. BROWN, H. S., *The possibilities of securing long range supplies of uranium, thorium and other substances from igneous rocks*, P/851.
7. HOWE, J. P., *The metallurgy of reactor fuels*, P/825.
8. KONOBEEVSKY, S. T. et al., *Effects of irradiation on structure and properties of fissionable materials*, P/681.
9. BILLINGTON, D. S., *Radiation damage in reactor materials*, P/744.
10. PUGH, S. F., *Damage occurring in uranium during burn-up*, P/443.
11. VOIGT, A. F., *The purification of uranium reactor fuel by liquid metal extraction*, P/545.
12. DRALEY, J. E. & RUTHER, W. E., *Aqueous corrosion of aluminium alloys at elevated temperatures*, P/535.
13. THOMAS, D. E., *Aqueous corrosion of zirconium and its alloys at elevated temperatures*, P/537.
14. CURRIE, L. M. et al., *The production and properties of graphite for reactors*, P/534.
15. BENEDICT, M., *Survey of heavy water production processes*, P/819.
16. SHELTON, S. M. et al., *Zirconium metal production*, P/533.
17. KAUFMANN, A. R. & KJELLGREN, B. R. F., *Status of beryllium technology in the U.S.A.*, P/820.
18. MEYERSON, G. A., *Techniques for manufacturing items of pure beryllium oxide for use in nuclear reactors*, P/633.
19. HURE, J. & SAINT-JAMES, R., *Separation of zirconium from hafnium*, P/347.
20. SAJIN, N. P. & PEPELYAEVA, E. A., *Separation of hafnium from zirconium and production of pure zirconium dioxide*, P/634.
21. PRAKASH, B. & SUNDARAM, C. V., *Separation of hafnium from zirconium by vapour phase dechlorination*, P/876.
22. SILVERMANN, L., *Air and gas cleaning for nuclear energy processes*, P/571.

Studies on Natural Fats: Part XII— Some Aspects of Analysis of Natural Fats by Crystallization

A. R. S. KARTHA

Maharaja's College, Ernakulam*

RECENT studies on the glyceride structure of natural fats using new methods¹⁻⁷ have indicated that some of the earlier results obtained on the basis of crystallization and GS_3 estimation by the Hilditch and Lea method⁸ require modification in many instances. In view of a recent paper by Cama *et al.*⁹, the possible sources of error in the earlier procedures have now been discussed and some of the points which had not been fully clarified in the earlier publications have now been fully dealt with.

In the determination of glyceride types in natural fats, GS_3 can be almost quantitatively separated by crystallization from small volumes of acetone at 25°C. when the saturated acids present are limited to palmitic and higher acids⁷. With fats of the palmitic-stearic-oleic-linoleic type fatty acid composition, crystalline fractions obtained above 20°C. from acetone consist entirely of GS_3 and GS_2U ¹⁰. When S contains myristic and lower acids, GS_3 determination by crystallization becomes less accurate, and in such cases oxidation methods of determining GS_3 are advantageous.

That appreciable hydrolysis of azelaoglycerides may take place during acetone-permanganate oxidation of fats and separation of azelaoglycerides with excess of aqueous potassium or sodium carbonate⁸ has been indicated earlier^{1,2,4,11}. Neutral hydrolysis products originate from GS_2A and GSA_2 , and separate with GS_3 and unoxidized fat. When larger amounts of fats (more than 25 g.) are oxidized, neutral products isolated after the first oxidation may have iodine values of the order of 10-30, and to reduce this to about 1-2, one or more repeat oxidations are necessary. The ester linkage between the fatty acid carboxyl and the hydroxyl of the glycerol is quite stable

and is not affected by the alkaline conditions developed during the acetone permanganate oxidation and this has been confirmed recently¹². Hence only the azelaic acid radicals and free hydroxyls in the partly hydrolysed azelaoglycerides will be affected during the repeat oxidations. When one of the free hydroxyls in these products is primary, as in the monostearins and unsymmetrical distearins, the products of further oxidation will be acidic and will be separated from the GS_3 in the subsequent working up. Hydrolysis products of symmetrical monoazelains will be the symmetrical distearins and these will be oxidized to a neutral ketonic body which cannot be readily separated further from the GS_3 . Thus the error in the Hilditch and Lea method⁸ will be dependent on the GS_2U content of the fat and in cases where repeat oxidations are not done, the error tends to be higher. Crystallization of the fat and applying the Hilditch and Lea method to the less soluble fractions cannot eliminate this error; perhaps the error may be enhanced by this procedure since GA_3 and GSA_2 , which being more acidic tend to lower the hydrolysis of GS_2A during oxidation and working up, are to a great extent absent when fractions in which GS_3 and GS_2U are concentrated and are used for oxidation.

To demonstrate that the above sources of error in the Hilditch and Lea method do not produce any significant differences in GS_3 values in practice, Cama *et al.*⁹ have compared the GS_3 contents of a few fats obtained by the above technique with the GS_3 contents of fats of the same source, but of slightly different S contents, obtained by *physical crystallization*. In most cases the figures quoted by Cama *et al.*² as obtained by *physical crystallization* were actually obtained

*Present address: Indian Agricultural Research Institute, New Delhi.

by applying the Hilditch and Lea method to the less soluble fractions obtained by crystallization of the fats, and are hence liable to error of the same order as when the fat is directly subjected to the above technique. The correct GS_3 contents, as obtained by crystallization, have now been calculated from the original crystallization data from published literature, on the assumption that only fractions containing appreciably above 66.6 per cent of S contain any GS_3 . The results are given in Table 1.

Recent evidence shows that the proportions of different glyceride types in any natural fat are simply related to those required by chance distribution^{1,2,5}. Hence, when different samples show different S contents, the GS_3 present is to be compared with the GS_3 possible according to chance. If the methods are of the same accuracy, the ratio of GS_3 present to GS_3 required according to chance distribution should be the same by both methods for the different samples¹³, but for a comparison it is enough if the difference between the above two values is the same for different samples when the variation in the S contents of the samples is not very large. The difference in the values of GS_3 found by crystallization and of GS_3 required according to chance distribution, when subtracted from the difference in values of GS_3 found by oxidation and of GS_3 required according to chance distribution, gives the relative difference in GS_3 contents by the two methods. This value should be zero when the methods are of equal accuracy. This relative difference in the GS_3 contents of the different fats (Table 1) has an appreciable positive value in most

cases. This further supports the view that the Hilditch and Lea method⁸ is liable to positive error.

A critical study of the specificities and mode of action of the lipases which convert the fatty acids into glycerides in fat depots shows that the glyceride structure of natural fats could be based only on simple chance distribution or some modification thereof where the extent of alteration from chance distribution is dependent on the difference between the GS_3 present and that possible according to chance^{11,34-36}. Hence in fats with very small GS_3 contents, the variation of other glyceride types with increase in S should show some definite pattern and in fats with the same S and GS_3 contents the proportions of other glyceride types should be the same. Crystallization analysis of glyceride types has generally been limited to fats containing mainly C_{16} and higher acids because of the ready solubility of glycerides of the lower acids. These fats may conveniently be divided into two groups for the present discussion: (1) fats containing 30-70 per cent mols of S and (2) fats containing below 30 per cent mols of S.

Data reported by Hilditch and collaborators prior to 1948 on the analysis of fats of group (1) are presented in Table 2. The method followed was crystallization from acetone at 0°C. or above, followed by component acid analysis and GS_3 estimations of fractions by the Hilditch and Lea method. Re-investigation of these fats using lower temperatures has not been attempted so far, presumably because the workers consider that for these fats crystallization at 0°C. is as accurate as lower temperature crystalliza-

TABLE 1— GS_3 CONTENTS OF SOME NATURAL FATS

FAT	BY OXIDATION (HILDITCH AND LEA) METHOD					BY CRYSTALLIZATION METHOD					RELATIVE DIFFERENCE (% mol)
	Ref.	S ₁ (% mol)	GS ₃ chance %	GS ₃ found %	GS ₃ found-GS ₃ chance	Ref.	S ₁ (% mol)	GS ₃ chance %	GS ₃ found %	GS ₃ found-GS ₃ chance	
Coconut oil	14	93	80	84	+4	9	94	83	82	-1	+5
Palm kernel oil	14	85	61	66	+5	9	87	66	62	-4	+9
Stillingia tallow	15	68	31	24	-7	16	73	39	21	-18	+11
Borneo tallow	17	63	25	5	-20	18	63	25	0	-25	+5
Cacao butter	8	60	22	3	-19	19	61	23	0	-23	+4
Kokum butter	20	59	21	4	-17	21	59	21	0	-21	+4
Palm oil, Cameroons	22	49	12	8	-4	23	53	15	7	-8	+4
Palm oil, Belgian Congo	22	50	13	6	-7	24	50	13	6	-7	0
Sheep tallow	25	61	23	27	+4	26	61	23	18	-5	+9
Cow, English	27	58	20	18	-2	28	59	21	13	-8	+6
Pig perinephric	29	51	13	11	-2	30	51	13	7	-6	+4
Pig back	29	43	8	7	-1	30	44	9	3	-6	+5
Buffalo butter, Indian	31	75	42	42	0	32	72	37	25	-12	+12
Cow butter, Indian	33	68	31	34	+3	32	69	33	21	-12	+15

TABLE 2—GS₂ AND GU₃ CONTENTS OF SOME NATURAL FATS

FAT	S (% mol)	GS ₂ (% mol)		GU ₃ (% mol)	
		Found by oxida- tion	Required by chance distrib- ution	Found by crystal- lization	Required by chance distrib- ution
Neem oil ³⁷	32	0.2	3	19	32
Baku fat ³⁸	41	0.2	7	10	21
Mowhra oil ³⁹	43	0.2	8	0	19
Pig external ⁴⁰	44	5	9	3	18
Palm oil, Bassa ²⁸	44	6	9	12	18
Shea butter ⁴⁰	46	4	10	5	16
<i>Lophira alata</i> fat ⁴¹	46	0.2	10	0	16
Hodgsonia fat ⁴²	48	3	11	13	14
<i>Garcinia morella</i> fat ²¹	49	0.2	12	1	13
Pig perinephric ³⁰	51	9	13	3	12
Ewe external ⁴³	51	5	13	0	12
Palm oil, Came- roons ²³	53	8	15	6	10
<i>Shorea robusta</i> fat ⁴⁴	55	0.2	17	1	9
<i>Allanblackia stuhl-</i> <i>mannii</i> fat ⁴⁵	55	0.2	17	0	9
<i>A. parviflora</i> fat ⁴⁶	56	0.2	18	0	9
Ewe perinephric ⁴³	57	14	19	0	8
<i>Garcinia indica</i> fat ²¹	59	0.2	21	2	7
<i>Garcinia indica</i> fat ²⁰	59	4	21	0	7
Cow, English ²⁸	59	17	21	0	7
<i>A. floribunda</i> fat ⁴⁶	60	0.2	22	0	6
Cacao butter ⁴⁷	60	0.2	22	0	6
Phulwara butter ⁴⁸	62	8	24	0	5
Borneo tallow ¹⁸	63	5	25	0	5
Ox Calicut ⁴⁹	67	28	30	0	4
Ox, Bombay ⁴⁹	73	36	39	0	2

tions possibly can be. The results show that in fats with 1-2 per cent GS₃, there is irregular variation of GU₃ (and hence of GS₂U and GSU₂ also) as S increases, and that in fats with approximately the same S and GS₃ contents, proportions of GU₃ indicated (and hence of GS₂U and GSU₂ as well) can be widely different. In view of the characteristic mode of action of the lipases these irregular variations in glyceride types could possibly be attributed to lack of accuracy in methods of analysis.

In the above reports (Table 2) many of the soluble fractions obtained at 0°C. contained above 33.3 per cent of S, showing that GS₂U is soluble in acetone mother liquors at 0°C. But when the S content was below 33.3 per cent, the fractions were computed as made up of GSU₂ and GU₃ alone in spite of the evident solubility of GS₂U at 0°C. without verifying whether GS₂U could remain behind in these fractions. It was also never examined whether the solubility of the GS₂U in acetone mother liquors at 0°C. was due to the normal solubility of the former in the solvent or due to intersolubility effects exerted by the dissolved GSU₂ or GU₃. In case the dissolved GSU₂ or GU₃ exerted no intersolubility effect, they will not interfere with crystallization of

GS₂U and by proper selection of conditions where GS₂U is comparatively insoluble, better separation of this could be obtained. If due to solubility in acetone or due to intersolubility effect of dissolved GSU₂ and GU₃ or both, appreciable amounts of distearo-olein, which has the highest melting and is also the most sparingly soluble GS₂U met with in ordinary fats, can remain in solution in acetone at 0°C., then the explanation for the irregular glyceride type values recorded in Table 2 is obvious.

It was to elucidate these points that the solubility of distearo-olein in acetone at 0°C. in the presence of added GU₃ was determined^{1,2}. Pure GU₃ can be easily prepared by synthetic methods but the preparation of pure GSU₂ is by no means so easy. Further, intersolubility effects exerted by GSU₂ in the absence of any GU₃ cannot interfere with the estimation of GS₂U by this method. Distearo-olein is insoluble in acetone at 0°C., but in the presence of GU₃ appreciable amounts remain in solution showing intersolubility effect. GS₂U from lower melting acids would be more soluble in acetone at all temperatures. It is also likely that intersolubility effect exerted by GU₃ will also increase as the solubility of GS₂U increases. Dissolved GSU₂ can also produce similar intersolubility effect at 0°C. These results support the view that crystallization from acetone at 0°C. was liable to appreciable error, the extent of error varying with component acid composition of fat, and that quantitative separation of GS₂U from GU₃ could not be obtained under the simplest possible conditions when the disturbing effect of GSU₂ is eliminated^{1,2}. The simplest possible conditions produced here are: (1) established insolubility of the GS₂U in acetone at 0°C.; (2) low m.p. of GU₃, below 0°C., which ensured that none of it can crystallize out along with GS₂U; and (3) complete elimination of GSU₂. That the last mentioned is one of the most important factors concerned in the efficient separation of GS₂U is illustrated by the following example: A groundnut oil with 20 per cent S will contain GS₂U, 10; GSU₂, 40; and GU₃, 50 per cent respectively by mols^{1,2,5}. The S contains a small amount of palmitic acid but at the same time contains appreciable amounts of acids higher than stearic, so that the GS₂U, like distearo-olein, will be practically

insoluble in acetone at 0°C. in spite of the presence of a certain amount of linoleic acid in the oil. A mixture of 17 per cent distearolein and 83 per cent GU_3 when crystallized from acetone at 0°C. at a solvent ratio of 1:20 precipitates 14 per cent of the former^{1,2}. Groundnut oil contains the same relative proportions of GS_2U and GU_3 as the above mixture along with GSU_2 to the extent of two-thirds the weight of GSU_2 and GU_3 combined. A solution of groundnut oil in acetone at a solvent ratio of 1:20 should precipitate 7-8 per cent of GS_2U on the weight of the oil at 0°C., if the GSU_2 exerted no influence. However, in practice, such a groundnut oil solution does not precipitate any glycerides at 0°C. showing the influence exerted by GSU_2 .

The above conclusions recorded in 1949¹ naturally referred to the accuracy of the crystallization analyses recorded in the literature prior to 1948 (Table 2) most of which were done at 0°C. at lowest, and relates only to factors which may possibly arise in connection with the analysis of natural fats. Most of the fats listed in Table 2 contain oleic acid as the predominant constituent of the U and contain appreciable amounts of triolein, m.p. 5°C. If the temperature of crystallization is lowered much further, then triolein can start crystallizing causing error in the computations. This is illustrated by the fact that whereas vegetable oils with 20 per cent S content show about 10 per cent GS_2U content by

azelaoglyceride estimations^{2,5}, low temperature crystallization of an olive oil of similar S content using the maximum possible precautions did not reveal the presence of any GS_2U ⁴⁹. By selecting a sufficiently high melting GS_2U (oleo-dibehenin or oleo-dilignocerin) more or less quantitative separation from triolein may be possible in a single crystallization at 0°-5°C. Similarly, by carefully preparing a sufficiently low melting GU_3 and lowering the temperature of crystallization similar separation of distearo or dipalmito-olein may be obtained in one single crystallization. But these are only of academic interest, whereas the practical problem involved in this group of fats is the separation of oleo-disaturated glycerides derived from mixtures of stearic, palmitic and small amounts of myristic acids from GU_3 consisting predominantly of triolein, in the presence of large amounts of GSU_2 built up from the same mixture of fatty acids.

Fats with less than 30 per cent S require less than 2-2.5 per cent of GS_3 according to chance distribution, and in view of the characteristic mode of action of the lipases (loc. cit.), the other three glyceride types should be present virtually in accordance with chance requirements. A few oils of this group have been subjected to elaborate low temperature crystallization, and the results are given in Table 3. For comparison the values required according to the rule of glyceride type distribution are also

TABLE 3 — LOW TEMPERATURE CRYSTALLIZATION OF SOME OILS

OIL	S (% mol)	GLYCERIDE TYPES (% mol) FOUND BY CRYSTALLIZATION			GLYCERIDE TYPES (% mol) CALCULATED ACCORDING TO RULE OF GLYCERIDE TYPE DISTRIBUTION ⁵		
		GS_2U	GSU_2	GU_3	GS_2U	GSU_2	GU_3
Poppy seed oil ⁵¹	11	1	31	68	4	25	71
Tobacco seed oil ⁵²	11	3	27	70	4	25	71
Sesame oil ⁵³	17	5	41	54	8	35	57
Gray seal oil ⁵⁴	17	0	51	49	8	25	57
Olive oil, Turkish ⁵⁰	14	0	42	68	6	30	64
Olive oil, Italian ⁵⁰	19	0	57	43	10	37	53
Groundnut oil ⁵⁴	20	7	47	46	11	38	51
Groundnut oil ⁵⁴	23	9	50	41	15	41	44
Groundnut oil ⁵⁴	25	10	54	36	18	42	40
Herring oil ⁵⁴	23	4	61	35	15	41	44
Neats' foot oil ⁵⁷	22	7	51	42	14	39	47
Chrosophera oil ⁵⁹	24	13	47	40	17	41	42
Whale oil ⁵⁵	31	9	75	16	26	44	30
Okra seed oil ⁵⁶	33	23	52	25	28	44	27
Cottonseed oil ⁶⁰	28	13	59	28	22	43	35
Cottonseed oil ⁶²	31	19	56	25	26	44	30
<i>Pentaclethra macrophylla</i> ⁶³	24	8	56	36	17	41	42
<i>Pentaclethra macrophylla</i> ⁶³	30	11	68	21	24	44	32
<i>Pentaclethra etulelana</i> ⁶³	29	9	68	23	22	44	34
Sacred baboon fat ⁶⁴	29	6	74	20	22	44	34

included^{1,2,5}. In this group also there is no regular variation of GS_2U and GU_3 with increase in S. However, it may be said that oils with a large number of component acids, for example the fish oils and the *Pentaclethra* fats, show lower GS_2U values than fats of similar S content containing only two or three major component acids. The oils of this group contain large proportions of GU_3 along with smaller proportions of GSU_2 and comparatively small amounts only of GS_2U and the temperatures used for crystallization are much below the melting points of many of the possible components of the GU_3 . In such cases more sparingly soluble components of GU_3 can crystallize out along with GSU_2 and GS_2U in earlier stages and thus cause error and this has been experimentally illustrated¹⁰ by analysis of fractions obtained by crystallizing groundnut oil from acetic acid-acetone mixtures at -15° to $-20^\circ C$. For fats containing palmitic, stearic, oleic and linoleic acids this phenomenon can happen approximately in the temperature range of 0° to about $-40^\circ C$. when acetone is used as the solvent.

The source of error in the crystallization studies recorded in Table 3 hence depends mainly on the presence of large proportions of GSU_2 and GU_3 along with comparatively small proportions only of GS_2U : the error will become smaller and finally vanish when the amount of GU_3 is progressively lowered. The result of analysis of fat mixture C by Cama *et al.*⁹, where, in spite of careful low temperature crystallization, only 1 out of 5 per cent of added GS_2U could be detected supports the above arguments. However, in the above crystallization studies⁹ a number of special factors are present which would favour the more efficient separation of GS_2U which will normally be absent in the crystallization of natural fats of similar S contents. These are: (1) fats containing more than 50 per cent linoleic acid, as in the GU_3 concentrate used, will have not less than half the GS_2U and GSU_2 as linoleoglycerides which will be more soluble than the oleo-disaturated glycerides used in the experiment; (2) the GU_3 concentrate prepared by low temperature crystallization of sunflower seed oil contains about 8 per cent of S and is likely to be saturated with GS_2U and GSU_2 under the conditions of its separation from the oil. Hence, the added GS_2U would separate more completely than if only

pure GSU_2 and GU_3 were present; and (3) all the higher melting components of the GU_3 which would crystallize out with GS_2U and GSU_2 at higher temperatures and thus produce error have been separated from the GU_3 concentrate and hence error from this source would be reduced if not eliminated. If a GU_3 concentrate is prepared by crystallizing out the GS_2U and GSU_2 from a natural fat then any added GS_2U can possibly be quantitatively precipitated, perhaps in a single stage, by conducting the crystallization under the same conditions as used for the preparation of the GU_3 concentrate. The phenomenon involved is the same as that on which the approximate estimation of stearic acid in mixed fatty acids by using a solution of alcohol saturated with stearic acid at $0^\circ C$. is based. It is likely that if a synthetic GU_3 free from S is used, less efficient separation would have resulted in all cases studied. It is also likely that the GSU_2 employed, which appears to have been obtained by crystallization below $0^\circ C$., would contain more of GS_2U and GU_3 and less of GSU_2 than assumed, and this also would tend to produce greater separation of GS_2U than would be possible normally.

There is another simple method of testing the accuracy of the low temperature crystallization techniques. Determination of glyceride types by azelaoglyceride estimation methods have established that fats with less than about 20 per cent S obey chance distribution law^{1,2,5}. The actual proportions of any glyceride in these fats will hence be the same as the values required according to simple chance distribution. The proportions of various simple tri-unsaturated glycerides in different oils of this type have been reported by different workers using elaborate low temperature crystallization techniques and these are given in Table 4. It is seen from these values that when the proportions of other glycerides present increase relatively to the simple GU_3 in the fat, the accuracy of estimation of the latter falls rapidly and by the time a chance distribution value of about 15 per cent is reached, they pass out of the range of detection by the method.

Deterioration of fats during fractional crystallization

The results of analysis of fat mixture A by Cama *et al.*⁹ draw attention to another source of error in the detailed fractionation

TABLE 4—PROPORTIONS OF SOME SIMPLE TRIGLYCERIDES IN SOME OILS

OIL	FATTY ACID	FATTY ACID (% mol) IN MIXED ACIDS	SPECIFIC SIMPLE TRIGLYCERIDE (% mol)	
			Found by crystallization	Required by chance distribution
Castor oil ⁴⁵	Ricinoic acid	92	75	78
Tung oil ⁴⁶	Eleaostearic acid	84	56	59
Tung oil ⁴⁶	do	79	45	49
Tung oil ⁴⁶	do	71	23	36
Safflower seed oil ⁴⁷	Linoleic acid	77	31	46
Poppy seed oil ⁴¹	do	73	27	39
Tobacco seed oil ⁴²	do	71	19	36
Sunflower seed oil ⁴⁷	do	73	24	39
Sunflower seed oil ⁴⁷	do	67	8	30
Sunflower seed oil ⁴⁷	do	63	7	25
Sunflower seed oil ⁴⁷	do	51	1	13
Chrosophera oil ⁴⁸	do	53	3	15
Maize oil ⁴⁸	do	61	1	23
Sesame oil ⁴³	do	47	1	10
Olive oil ⁴⁹	Oleic acid	77	29	46
Olive oil ⁵⁰	do	67	5	30
Groundnut oil ⁴⁴	do	59	6	21
Groundnut oil ⁴⁴	do	41	nil	7
Chonopher oil ⁴⁹	Linolenic acid	66	10	29
Linseed oil ⁴⁹	do	56	5	18

technique. This mixture had S content 47.0 per cent, iodine absorption 53.8 per cent and a glyceride structure of GS_3 , 5; GS_2U , 34; GSU_2 , 59; and GU_3 , 2 per cent mols respectively. The detailed analysis of Cama *et al.* indicated a composition of GS_3 , 5; GS_2U , 41; GSU_2 , 52; and GU_3 , 1 per cent mols respectively with an S content of 49.6 per cent which is 2.6 per cent higher than the S content of the starting material. Summation of the iodine absorptions of the different fractions from the crystallization data gives a value of 53.8 per cent for the whole fat which is identical with that of the original fat in spite of the total S content of the latter being 2.6 per cent lower than that of the former. This is a clear pointer to the fact that iodine absorption is only an approximate value and that much reliance should not be placed on this value by itself, particularly in analysis of this type, excepting perhaps when it is established that only mono-ethenoid acids are present. This demonstrates also that analytical methods for estimation of saturated acids by difference wherein the iodine value is used in the calculations cannot be very accurate in general. The apparent increase in saturated acids in the present case might be due to autoxidation of part of the unsaturated acids during fractional crystallization with the result that some of the peroxidized acids are ultimately calculated as saturated acids. An

instance of very high peroxidation and polymerization of C_{20} - C_{22} unsaturated acids has been recorded by Hilditch and Maddison⁵¹ where fractions consisting predominantly of these acids had peroxidized to such an extent that their methyl esters could not be distilled *in vacuo*.

The rate of this deterioration depends on the degree of unsaturation of the U and is normally inhibited to some extent by the antioxidants present in the oil. The antioxidants are highly soluble and will be removed in the most soluble fraction in the very first fractionation, and recrystallization of precipitates will be particularly susceptible to danger of deterioration. Addition of antioxidants in every crystallization has not been attempted in any case.

In the earlier investigations prior to about 1945, where component acids were estimated by lead salt separation and ester fractionation, deterioration of fats during crystallization always resulted in an apparent increase in S content. But in some of the more recent analyses where the S is determined by difference techniques or other methods, the error appears to be sometimes positive (up to 3.0 per cent) and sometimes negative (up to -4.8 per cent) as seen from Table 5. The range of total error thus adds up to some 8 units per cent when using such techniques. If the total S content obtained by summation of the S contents of the fractions is higher than the S content of the original fat as directly analysed, then this will show itself as an apparent increase in the GS_2U or GSU_2

TABLE 5—ERROR INTRODUCED BY DETERIORATION OF FATS

FAT	S (% mol)			POSSIBLE ERROR (% mol) IN GS_2U , GSU_2 AND/OR GU_3
	From direct analysis of fat (a)	Calculated from fractions (b)	(b-a)	
<i>Allanblackia floribunda</i> ⁴⁶	60.0	61.7	1.7	5.1
<i>Garcinia indica</i> ⁵⁰	58.5	60.4	1.9	5.7
Palm oil, Cameroons ⁵²	52.5	54.7	2.2	6.6
Palm oil, Bassa ⁵³	44.1	47.1	3.0	9.0
Hodgsonia fat ⁴²	48.1	51.0	2.9	8.7
Pig back ³⁰	44.1	46.4	2.3	6.9
Pig perinephric ³⁰	50.5	52.5	2.0	6.0
Ewe perinephric ⁴³	57.1	58.7	1.6	4.8
Ox, Calicut ⁴⁹	67.5	69.6	2.1	6.3
Ox, Bombay ⁴⁹	72.9	74.6	1.7	5.1
Cow, English ³⁸	58.7	60.9	2.2	6.6
Lard ⁷⁰	39.6	34.4	-5.2	15.6
Mutton tallow ⁷⁰	52.6	55.8	3.2	9.6
Badger fat ⁷¹	37.2	35.1	-2.1	6.3

values: when the S content of the original fat is higher than that arrived from the analysis of the fractions then the apparent GS_2U and/or GSU_2 values will be lower than the actual values. A difference of 1 per cent in the S content in such cases produces an error of 3 per cent in GS_2U , GSU_2 and GU_3 values. When the difference is appreciably more than 1 per cent, the error introduced in the glyceride type analysis will be large. An examination of the literature shows that in many of the fractional crystallization analysis reported such deterioration of fats had taken place. A number of examples of this type are recorded in Table 5, along with a statement of the possible error in glyceride types produced by this difference. Excepting where the amount of saturated acids in the fractions agrees with the saturated acids in the original fat to about 1 per cent, the use of such glyceride analyses will be very much limited.

The large error of about 8 per cent in the saturated acid contents of the fats analysed by the new procedures creates another difficulty. The error in S estimations may be positive in some fractions and negative in other fractions, and when summated for the whole fat may cancel out fully or partially. But the positive and negative error in the computation of the glycerides in the different fractions need not and may not cancel each other since different fractions are calculated to different types according to the S content. Thus, even when the summated S contents of the fractions agree with the S content of the whole fat, the component glyceride types may be in error, and at present no method is known by which this error can be detected and estimated.

To study these factors further, an investigation was undertaken (A. R. S. Kartha and A. S. Sethi, unpublished data) on the variation of saturated acid content as determined by the method reported earlier in this series¹² when a few fats were allowed to undergo peroxidation by incubation in an open glass vessel at 60°C. A beef tallow of saturated acid content of 55.5 per cent by weight of fat and iodine value 40 (obtained by courtesy of Dr. S. G. Brooker, New Zealand) and a commercial lard of saturated acid content 46.5 per cent and iodine value 51.2 were used for the studies. The saturated acid estimations were made on the autoxidizing beef tallow at iodine values of

38.7, 37.5 and 28.0 but the saturated acid content remained the same throughout at a value of 55.0-55.6 per cent. The lard was analysed at iodine values of 50.7, 38.0 and 27.0 and this series again showed a constant saturated acid content of 46.0-46.5 per cent. Thus it is evident that deterioration of fats as represented by the drop in iodine values by up to 25 per cent does not produce any variation in saturated acid content by the present technique. The success of the acetic acid-acetone permanganate method of Kartha in dealing with autoxidized fats depends on the fact that the epoxy compounds produced by decomposition of the cyclic peroxides are opened up by the action of acetic acid at the boiling point of the reaction mixture and the derivatives thus produced are subsequently oxidized into small fragments by the permanganate. These changes cannot be effected by the ordinary acetone-permanganate oxidation methods during which alkaline conditions are actually developed⁴. On the other hand, the cyclic peroxides or epoxy compounds derived therefrom do not have any iodine absorption, behave like saturated acids in iodine value determinations and thus give inaccurate results in methods based on iodine value determinations when partly peroxidized fats are analysed. Hence, these methods are evidently not the best suited for studies on glyceride structure. The ultimate effect of these factors is that partly peroxidized fats will show a lower saturated acid content by the modified Bertram's method¹² than by other available methods and particularly so by the difference method based on the iodine values of the mixed acids obtained by hydrolysis⁷². It may be noted that peroxidized fats when kept for some time out of contact with air show decrease in peroxide value due to decomposition of peroxides to non-peroxide compounds; the peroxides are also decomposed by heating in vacuum or with steam at high temperatures as in steam deodorizations. Fats which have undergone changes of this type may show low peroxide values but will contain the decomposition products of the peroxides and will show higher saturated acid contents by the difference method⁷² than by oxidation. Since Sethi and Kartha⁷³ have now established that there cannot be any error due to solubility of magnesium soaps of higher saturated acids during Bertram separation,

the difference in saturated acid contents observed by Riemenschneider *et al.*⁷² by oxidation and difference methods for four commercial fats of unknown origin would perhaps be traceable to the fats having undergone some deterioration at some time or other. The glyceride structure analyses recorded by these workers by crystallization methods would be subject to error due to the same reasons⁷².

It may be observed here that the restricted random distribution rule of glyceride structure³⁶ applies only to natural fats as synthesized in the depots and the glyceride type analyses of fats reported by Kartha were almost entirely done on pure specimens freshly extracted in the laboratory^{2,5}. Commercial fat specimens of unknown history are not suited for these fundamental studies and the convenience of the more ready availability of the latter is more than offset by the avoidable confusion produced by these analyses. An example of this type is provided by the recent analysis of a commercial lard of saturated acid content 39 per cent mols wherein a GSU₂ content of 59 per cent mols, not readily explicable on the restricted random distribution rule, was recorded⁷². An analysis of Swedish commercial lard (trade mark 'DANA') of saturated acid content 48 per cent mols (A. R. S. Kartha and R. Narayanan, unpublished data) showed only a GSU₂ content of 38-40 per cent which is in agreement with the rule. This demonstrates the considerable uncertainty which attaches to the analyses of fat samples of unknown history and it would appear that more useful contributions on the glyceride structure of natural fats can be obtained only by analysis of freshly extracted specimens of natural fats of known history and by methods of analyses which have been established to be as free from errors as possible.

Summary

Further evidence is presented to show that the Hilditch and Lea method of determining fully saturated glyceride contents of fats by acetone-permanganate oxidation is liable to positive error due to hydrolysis of azelaoglycerides. A critical study is made of the reasons why in most cases fractional crystallization gives lower GS₂U and GU₃ values and higher GSU₂ values than those obtained by azelaoglyceride estimation tech-

niques. The nature and extent of the error introduced into the determination of the saturated acid contents and glyceride type compositions by possible deterioration of fats during extended fractional crystallization studies are discussed.

Experimental evidence is adduced to show that the saturated acid content as determined by the acetic acid-acetone permanganate oxidation of Kartha and Bertram separation of hydrolysed oxidation products remains unchanged during deterioration of fats by autoxidation. Methods depending on the determination of iodine values will always register an apparent increase in saturated acid contents during autoxidation. Since a certain amount of oxidative deterioration will always take place during ordinary extraction and working up of fats, the present method of Kartha appears to be a reliable and accurate method for saturated acid determination in all glyceride structure studies.

Uncertainties connected with analysis of commercial specimens of fats for glyceride composition and application of restricted random distribution rule to these are discussed.

References

1. KARTHA, A. R. S., *Ph.D. Thesis, University of Madras*, 1949.
2. KARTHA, A. R. S., *Studies on the Natural Fats*, Vol. 1 (published by the author, Ernakulam), 1951, 1-83.
3. KARTHA, A. R. S., *J. Amer. Oil Chem. Soc.*, **29** (1952), 109.
4. KARTHA, A. R. S., *J. Amer. Oil Chem. Soc.*, **30** (1953), 280.
5. KARTHA, A. R. S., *J. Amer. Oil Chem. Soc.*, **30** (1953), 326.
6. KARTHA, A. R. S., *J. sci. industr. Res.*, **11A** (1952), 354.
7. KARTHA, A. R. S., *J. sci. industr. Res.*, **12A** (1953), 504.
8. HILDITCH, T. P. & LEA, C. H., *J. chem. Soc.*, (1927), 3106.
9. CAMA, J. S. *et al.*, *J. Sci. Fd. Agric.*, **4** (1953), 321.
10. KARTHA, A. R. S., *J. sci. industr. Res.*, **13A** (1954), 273.
11. KARTHA, A. R. S. *et al.*, *Curr. Sci.*, **18** (1949), 8.
12. KARTHA, A. R. S., *J. sci. industr. Res.*, **13A** (1954), 72.
13. KARTHA, A. R. S., *J. sci. industr. Res.*, **12A** (1953), 243.
14. HILDITCH, T. P. & COLLIN, G., *J. Soc. chem. Ind., Lond.*, **47** (1928), 261T.
15. HILDITCH, T. P. & PRIESTMAN, J., *J. Soc. chem. Ind., Lond.*, **49** (1930), 397T.
16. GUPTA, S. S. & MEARA, M. L., *J. chem. Soc.*, (1950), 1337.

17. HILDITCH, T. P. & PRIESTMAN, J., *J. Soc. chem. Ind., Lond.*, **49** (1930), 197T.
18. HILDITCH, T. P. & BUSHELL, W. J., *J. Soc. chem. Ind., Lond.*, **57** (1938), 48.
19. MEARA, M. L., *J. chem. Soc.*, (1949), 2154.
20. VIDYARTHI, N. L. & RAO, C. J. D., *J. Indian chem. Soc.*, **16** (1939), 437.
21. HILDITCH, T. P. & MURTI, K. S., *J. Soc. chem. Ind., Lond.*, **60** (1941), 16.
22. HILDITCH, T. P. *et al.*, *J. Soc. chem. Ind., Lond.*, **49** (1930), 363T; **54** (1935), 77T.
23. HILDITCH, T. P. & MADDISON, L., *J. Soc. chem. Ind., Lond.*, **59** (1940), 67.
24. MEARA, M. L., *J. chem. Soc.*, (1948), 722.
25. HILDITCH, T. P. *et al.*, *J. Soc. chem. Ind., Lond.*, **48** (1929), 46T.
26. HILDITCH, T. P. & SRIVASTAVA, R. K., *J. Amer. Oil Chem. Soc.*, **26** (1949), 1.
27. HILDITCH, T. P. & LONGENECKER, H. E., *Biochem. J.*, **31** (1937), 1805.
28. HILDITCH, T. P. & PAUL, S., *Biochem. J.*, **32** (1938), 1775.
29. HILDITCH, T. P. & BANKS, A., *Biochem. J.*, **26** (1932), 298.
30. HILDITCH, T. P. & PEDELY, W. H., *Biochem. J.*, **34** (1940), 971.
31. ACHAYA, K. T. & BANERJEE, B. N., *Biochem. J.*, **40** (1946), 664.
32. HILDITCH, T. P. & ACHAYA, K. T., *Proc. roy. Soc.*, **137B** (1949), 187.
33. HILDITCH, T. P. & BHATTACHARYA, R., *Analyst*, **56** (1931), 161.
34. KARTHA, A. R. S., *Studies on the Natural Fats*, Vol. 1 (published by the author, Ernakulam), 1951, 84-111.
35. KARTHA, A. R. S., *J. Amer. Oil Chem. Soc.*, **31** (1954), 85.
36. KARTHA, A. R. S., *J. sci. industr. Res.*, **13A** (1954), 471.
37. HILDITCH, T. P. & MURTI, K. S., *J. Soc. chem. Ind., Lond.*, **58** (1939), 310.
38. ATHERTON, D. & MEARA, M. L., *J. Soc. chem. Ind., Lond.*, **59** (1940), 95.
39. HILDITCH, T. P. & ICHAPOREA, M. B., *J. Soc. chem. Ind., Lond.*, **57** (1938), 44.
40. HILDITCH, T. P. & GREEN, T. G., *J. Soc. chem. Ind., Lond.*, **57** (1938), 49.
41. HILDITCH, T. P. & MEARA, M. L., *J. Soc. chem. Ind., Lond.*, **63** (1944), 114.
42. HILDITCH, T. P. *et al.*, *J. Soc. chem. Ind., Lond.*, **58** (1939), 26.
43. HILDITCH, T. P. & ZAKY, Y. A. H., *Biochem. J.*, **35** (1941), 940.
44. HILDITCH, T. P. & ZAKY, Y. A. H., *J. Soc. chem. Ind., Lond.*, **61** (1942), 34.
45. HILDITCH, T. P. & SALETTORE, S. S., *J. Soc. chem. Ind., Lond.*, **50** (1931), 468T.
46. MEARA, M. L. & ZAKY, Y. A. H., *J. Soc. chem. Ind., Lond.*, **59** (1940), 25.
47. HILDITCH, T. P. & STAINSBY, W. J., *J. Soc. chem. Ind., Lond.*, **55** (1936), 95T.
48. HILDITCH, T. P. & BUSHELL, W. J., *J. Soc. chem. Ind., Lond.*, **57** (1938), 48.
49. HILDITCH, T. P. & MURTI, K. S., *Biochem. J.*, **34** (1940), 1301.
50. HILDITCH, T. P. & MADDISON, L., *J. Soc. chem. Ind., Lond.*, **60** (1941), 258.
51. HILDITCH, T. P. *et al.*, *J. Oil Col. Chem. Ass.*, **34** (1951), 354.
52. HILDITCH, T. P. & CRAWFORD, R. V., *J. Sci. Fd. Agric.*, **1** (1950), 230.
53. HILDITCH, T. P. & CHAKRABARTY, M. M., *J. Sci. Fd. Agric.*, **2** (1951), 257.
54. HILDITCH, T. P. & CRAWFORD, R. V., *J. Sci. Fd. Agric.*, **1** (1950), 372.
55. HILDITCH, T. P. & MADDISON, L., *J. Soc. chem. Ind., Lond.*, **61** (1942), 169.
56. BJARNASON, O. B. & MEARA, M. L., *J. Soc. chem. Ind., Lond.*, **63** (1944), 61.
57. HILDITCH, T. P. & SRIVASTAVA, R. K., *J. Soc. chem. Ind., Lond.*, **67** (1948), 139.
58. HILDITCH, T. P. & PATHAK, S. P., *J. Soc. chem. Ind., Lond.*, **66** (1947), 421.
59. HILDITCH, T. P. & CROSSLEY, A., *J. Sci. Fd. Agric.*, **2** (1951), 255.
60. HILDITCH, T. P. & BARKER, C., cited by HILDITCH & CROSSLEY, *J. Sci. Fd. Agric.*, **2** (1951), 255.
61. HILDITCH, T. P. & MADDISON, L., *J. Soc. chem. Ind., Lond.*, **59** (1940), 162.
62. RIEMENSCHNEIDER, R. W. *et al.*, *Oil & Soap*, **17** (1940), 145.
63. HILDITCH, T. P. *et al.*, *J. Sci. Fd. Agric.*, **2** (1951), 142.
64. HILDITCH, T. P. & SIME, I. C., *Biochem. J.*, **36** (1942), 98.
65. HILDITCH, T. P. *et al.*, *J. Sci. Fd. Agric.*, **2** (1951), 245.
66. HILDITCH, T. P. & MENDELWITZ, A., *J. Sci. Fd. Agric.*, **2** (1951), 548.
67. HILDITCH, T. P. & BARKER, C., *J. Oil Col. Chem. Ass.*, **33** (1950), 6.
68. DOERSCHUK, A. P. & DAUBERT, B. F., *J. Amer. Oil Chem. Soc.*, **25** (1948), 425.
69. HILDITCH, T. P. & SEAVELL, A. J., *J. Oil Col. Chem. Ass.*, **33** (1950), 24.
70. QUIMBEY, O. T. *et al.*, *J. Amer. Oil Chem. Soc.*, **30** (1953), 186.
71. HILDITCH, T. P. *et al.*, *J. chem. Soc.*, (1950), 3145.
72. LUDDY, F. E. *et al.*, *J. Amer. Oil Chem. Soc.*, **31** (1954), 266.
73. SETHI, A. S. & KARTHA, A. R. S., *J. sci. industr. Res.*, **14B** (1955), 107.

Studies on Rauwolfia

V. CHANDRA

National Botanic Gardens, Lucknow

IN recent years the genus *Rauwolfia* has gained considerable importance because of the efficacy of *R. serpentina* Benth. in the treatment of hypertension. *Rauwolfia* is a large genus belonging to the family Apocynaceae, having about 131 species. The genus is distributed (Fig. 1) in the tropics, i.e. Central and South America, Africa, India, Ceylon, Burma, Malaya, Sumatra and Java. It has also been reported from China and Japan. The largest number of species is found in Africa and South America.

Generally *Rauwolfias* are shrubs, but a few, e.g. *R. caffra* Sond., are 60-70 ft. tall trees. Leaves are usually placed in whorls of 3-4 and sometimes opposite. The nerves are slender. Flower small, in terminal or pseudo-axillary 2-3 cymose umbel or corymbiform cyme. Peduncles alternating with terminal leaves and finally becoming lateral. Calyx five lobed or partite and eglandular within. Corolla, slaver-shaped cylindrical tube, mouth constricted, throat usually hairy within, lobes broad and overlapping. Disk large, cup-shaped or annular, entire or slightly lobed. Carpels two, distinct or connate. Style filiform. Stigma broad, capitate calyptiform at the base, tip bifid. Ovules two, collateral in each carpel. Ripe carpels, drupaceous, distinct or connate and usually one seeded. Seeds ovoid and fleshy, cotyledons flat and radicle straight or recurved.

The species so far recorded in different parts of the world are given below¹⁻⁶.

Africa—*R. caffra* Sond.; *R. congolana* Wildem. and Th. Dur.; *R. cumminisii* Stapf; *R. goetzei* Stapf, *R. gonioclada* K. Schum.; *R. inebrians* K. Schum.; *R. ivorensis* A. Cheval; *R. liveriensis* Stapf; *R. longea cuminata* Wildem. and Th. Dur.; *R. lamarckii* A. DC.; *R. leucopoda* K. Schum. ex Stapf, *R. macrophylla* Stapf; *R. mannii* Stapf; *R. mayombensis* Pellegr.; *R. mombasiana* Stapf; *R. monophyrena* K. Schum.; *R. nana* E. A. Bruce, *R. natalensis* Sond.; *R. oblquinervis* Stapf; *R. obscura* K. Schum.; *R. ochrosioides*

K. Schum.; *R. oreogiton* Markgraf; *R. oxyphylla* Stapf; *R. polyphylla* Benth.; *R. preussii* K. Schum.; *R. rosea* K. Schum.; *R. sambesiaca* Schinz; *R. senegambiae* A. DC.; *R. stuhlmannii* K. Schum.; *R. ichibangensis* Pellegr.; *R. verticillata* A. Chevalier; *R. volkensii* Stapf; *R. vomitoria* Afzel; and *R. welwitschii* Stapf.

America—*R. affinis* Muell.; *R. amazonica* Markgraf; *R. andina* Markgraf; *R. aroborea* Larranaga; *R. bahiensis* A. DC.; *R. bilabiata* Larranaga; *R. blanchetii* A. DC.; *R. boliviana* Markgraf; *R. brasiliensis* Spreng; *R. cardioarpa* K. Schum.; *R. divergens* Markgraf; *R. duckei* Markgraf, *R. elliptica* Malme; *R. grandiflora* Mart; *R. heterophylla* Willd. ex Roem. and Schult.; *R. indecora* R. E. Woodson; *R. lamarckii* A. DC.; *R. lanceolata* A. DC.; *R. lauretiana* R. E. Woodson; *R. linearisepala* Guillaumin; *R. longifolia* A. DC.; *R. macrocarpa* Standley; *R. mattfeldiana* Markgraf; *R. mollissima* Markgraf; *R. moricandii* A. DC.; *R. multiflora* Riley; *R. nitida* Sesse and Moc.; and *R. odontophora* Heurck and Muell.; *R. oppositiflora* Sesse and Moc.; *R. pachyphylla* Markgraf; *R. paraensis* Ducke; *R. parvifolia* Bert. ex Spreng.; *R. paucifolia* A. DC.; *R. pentaphylla* Ducke; *R. preussii* K. Schum.; *R. purpurascens* Standley; *R. polyphylla* Benth.; *R. praecox* K. Schum.; *R. psychotrioides* H.B. and K.; *R. rhonhofiae* Markgraf; *R. rostrata* Markgraf; *R. spinosa* Cav; *R. sarapiquensis* R. E. Woodson; *R. schueli* Speg.; *R. sellowii* Muell. Arg.; *R. sessilifolia* S. Moore; *R. sprucei* Muell. Arg.; *R. stenophylla* Donn.; *R. suaveolens* S. Moore; *R. ternifolia* H.B. and K.; *R. weddeliana* Muell. Arg. and *R. woodsoniana* Standley.

Australia—*R. caffra* Sond.; *R. canescens* L.; *R. heterophylla* Willd. ex Roem and Schult.; *R. natalensis* Sond.; and *R. psychotrioides* H.B. and K.

Burma—*R. microcarpa* Hook. f.; *R. peguana* Hook. f.; and *R. rivularis* Merrill.

Ceylon—*R. littoralis* Rusby; *R. mollissima* Markgraf; and *R. sanctorum* R. E. Woodson.



FIG. 1 — WORLD DISTRIBUTION OF RAUVOLFIA

China — *R. chinensis* Hemsl.

Cuba — *R. cubana* A. DC.; *R. linearifolia* Britton and P. Wils; *R. salicifolia* Griseb.; *R. strempelioides* Griseb.

India — *R. alphonsiana* Muell. Arg.; *R. Beddomei* Hook. f.; *R. biauriculata* Muell. Arg.; *R. canescens* L.; *R. decurva* Hook. f.; *R. densiflora* Benth. ex Hook. f.; *R. micrantha* Hook. f.; *R. nitida* Jacq.; *R. pulparia* Roxb. ex Sen.; and *R. serpentina* Benth.

Islands Comoro — *R. concolor* Pichon.

Indo-China — *R. cambodiana* Pierre ex Pitard; *R. chaudocensis* Pierre ex Pitard; and *R. littoralis* Pierre ex Pitard.

Philippines — *R. amsoniaefolia* A. DC.; *R. loheri* Merrill; *R. palawanensis* Elmer; *R. membranacea* Merrill; and *R. samarensis* Merrill.

Java — *R. javanica* Koerd. and Valet.; *R. major* Nichols.; *R. reflexa** Koerd. and Valet.; *R. reflexa* Teijsm and Binn.; and *R. serpentina* Benth. ex Kurz.

Madagascar — *R. celastrifolia* Baker; *R. clavunculus* K. Schum.; *R. media* Pichon; *R. confertiflora* Pichon; and *R. trichophylla* Baker.

Nossibe Islands — *R. obtusiflora* A. DC.

Malaya — *R. perakensis* King and Gamble; and *R. spectabilis* Boerl.

Palau Islands — *R. insularis* Markgraf; *R. laxiflora* Kanehira; and *R. mangiferoides* Kanehira.

Siam — *R. cambodiana* Pierre ex Pitard; *R. densiflora*† Warb; *R. densiflora*† Benth. ex Hook.; *R. littoralis* Pierre ex Pitard; *R. sumatrana* Jack; *R. membranifolia* Kerr; *R. ophiorrhizoides* (Kurz.) Kerr; *R. perakensis* King and Gamble; *R. serpentina* Benth. ex Kurz.

Sandwich Islands — *R. degeneri* Sherff; *R. forbesii* Sherff; *R. helleri* Sherff; *R. mauiensis* Sherff; *R. molokaiensis* Sherff; *R. remotiflora* Degener and Sherff; and *R. sandwicensis* A. DC.

*The specific name *R. reflexa* Koerd. and Valet. is occupied by *R. reflexa* Teijsm and Binn.

†The specific name *R. densiflora* is already occupied by *R. densiflora* Benth. and Hook.

Sumatra — *R. sumatrana* Jack.

Saint Thomas Island — *R. dichotoma* K. Schum.; and *R. pleiosiadica* K. Schum.

Habit not certain — *R. lycioides* Cav.; and *R. semperflorens* Schlechter.

In India about nine species have so far been recorded. Of these the most important are *R. serpentina* Benth. and *R. canescens* L.

Rauvolfia serpentina Benth. (Sanskrit: *Sarpagandha*; for other vernacular names see Appendix) has been in use for the treatment of snake bite, hysteria, dysentery and fevers in India. Its beneficial effects on patients suffering from insanity and high blood pressure were first discovered in India about 40 years ago. Since then many chemical and pharmacological investigations have been carried out on the medicinal properties of this plant. A number of alkaloids have now been isolated from the dried roots of *R. serpentina*.

***Rauvolfia serpentina* Benth.**

Distribution — This species has been reported in India (Fig. 2) from different parts. It is usually found in damp shady places up to an altitude of 4,000 ft. It occurs in the Indo-Gangetic plains, Siwalik and the Sub-Himalayan tract of the Punjab, and eastward in Bihar, Bengal and Assam. The species is found in Central and South India along the ghats from Bombay to Travancore. According to recent reports, the species is getting scarce throughout India and at present it is rare in U.P., C.P., Bihar, Andhra and West Bengal. It

is found throughout Ceylon in moist and shady places up to an altitude of about 1,800 ft. It is known to occur in the Andaman Islands. In Burma it is frequently found all over Pegu and Martaban areas up to Tenasserim. In Java it is scattered all over the country up to an altitude of 2,000 ft. It is also found in Siam, Malaya and Sumatra.

Description — *R. serpentina* Benth. (Fig. 3A) is an upright perennial shrub 1-3 ft. in height. It is glabrous and has deciduous habit in the plains of India.

Root — *R. serpentina* develops a tap root which grows vertically downwards and develops numerous branches. Studies on the root development in *R. serpentina* carried out at the National Botanic Gardens, Lucknow, have shown that the tap root gives rise to laterals soon after its penetration into the soil⁷. The largest number of lateral roots occurred up to a depth of 1 ft. after which the thickness of the main root is markedly reduced. The maximum depth to which the main root penetrates is about 9 ft.

Small pieces of the dried roots of *R. serpentina* are sold in the market. These are collected from 3 to 4 years old plants and dried in shade. The dried specimens are cylindrical, slightly tapering, curved, rather tortuous and rarely have rootlets. The root breaks easily with a quick snap. The root bark is coarse, whitish grey in colour with irregular longitudinal ridges over it. The outer layers of the bark are soft and tend to scale off easily from the harder portions. The inner surface of the peeled bark is yellowish and the inner wood has a fairly smooth surface. Well-dried roots are odourless and have a bitter taste.

Sometimes pieces of stem or rhizome are found attached to the roots sold in the market. These closely resemble the roots but are less uniform in diameter and are knotty and tortuous. They are distinguished by a smooth transverse cut surface which exhibits a central pith of small diameter.

A transverse section of root (Figs. 4 and 5) shows that cork consists of layers of cells with thickened walls^{8,9}. The cells are of two types: cells of large diameter and cells of smaller diameter. Cork cells occur in alternate bands of the two types of cells. Secondary meristem cells appear polygonal and isodiametric in a tangential section,

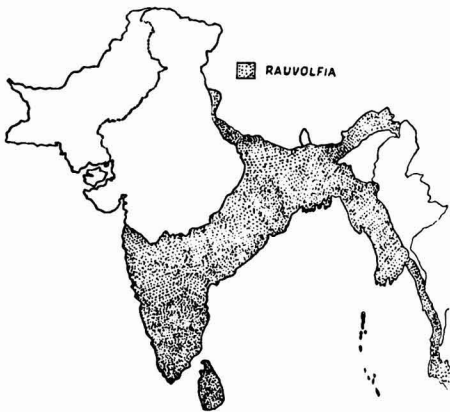


FIG. 2 — DISTRIBUTION OF RAUVOLFIA IN INDIA

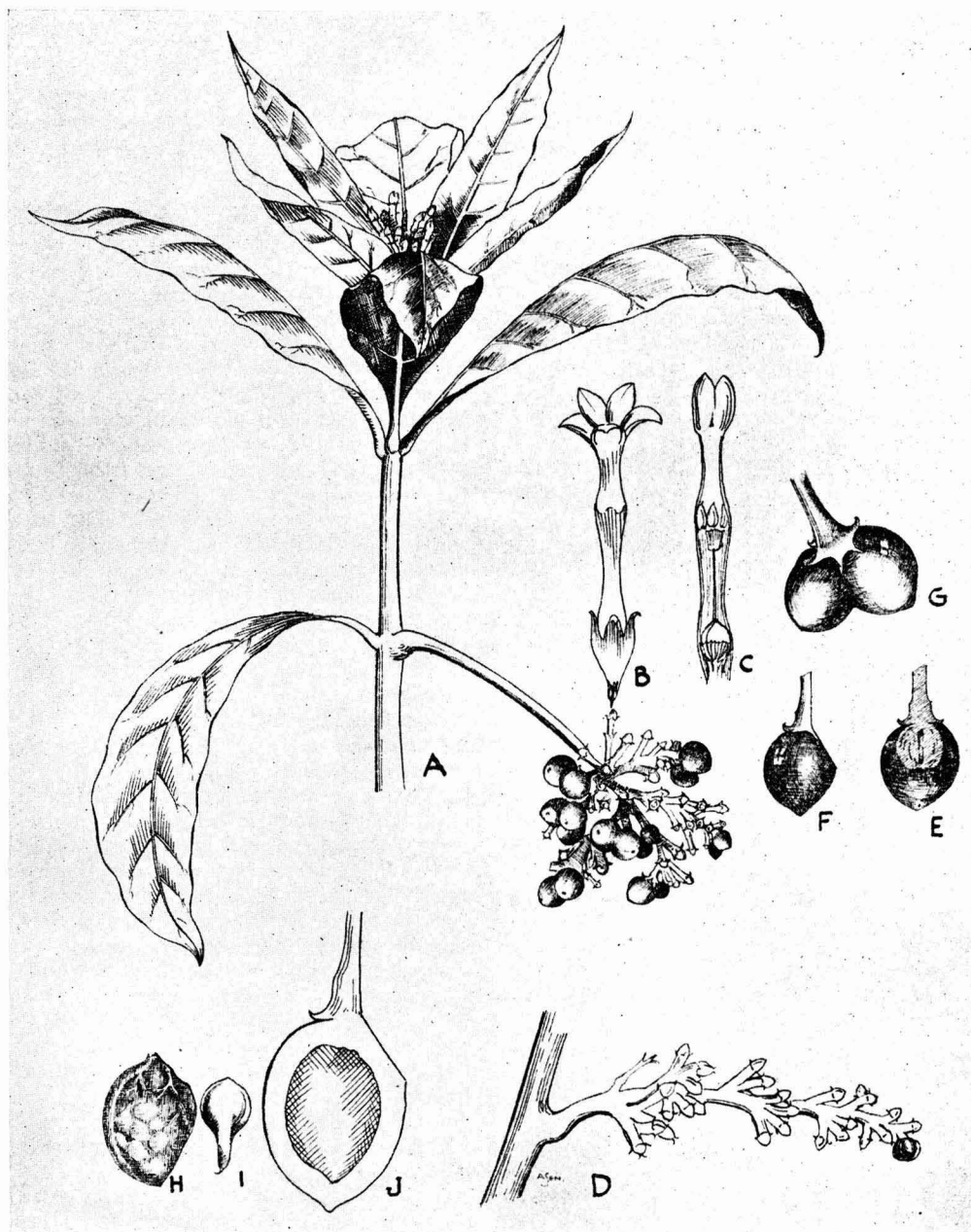


FIG. 3—*Rauwolfia serpentina* BENTH. [A, plant of *Rauwolfia serpentina* (natural size); B, single flower of *Rauwolfia serpentina*; C, section of *R. serpentina* flower showing anthers; D, an inflorescence with a ripe fruit (natural size); E, F and G, mature fruit $\times 3$; H, seed $\times 5$; I, cotyledons (enlarged); J, section of the fruit (enlarged)]

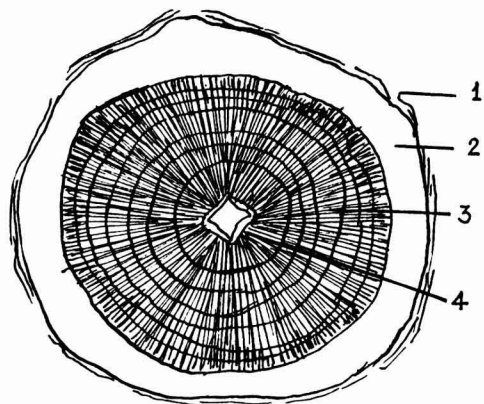


FIG. 4—DIAGRAMMATIC T.S. of *Rauwolfia serpentina* MATURE ROOT $\times 3$ [1, cork; 2, cortical tissue; 3, secondary xylem; 4, primary xylem]

and rectangular and radially flattened in a transverse section. Interspaces are absent in this tissue. These cells often appear crushed in commercial samples. The primary cortex consists of parenchyma cells heavily packed with starch grains. The secondary cortical tissues extend up to the xylem elements and are so heavily packed with starch grains that the appearance of the secondary phloem tissue is obliterated. Stone cells are absent. Cambium is indistinct in dry specimens. The secondary xylem is conspicuous.

Stem and leaves—The stem is green, erect, usually unbranched and slender. When the plant is old, the bark is pale green. The leaves are generally in whorls, and more crowded in the upper part of the stem. Some leaves are opposite and alternate. The leaves are simple, glabrous, lanceolate or obovate, thin, entire, green above, pale below, 2.5-16.7 cm. wide, with acuminate to blunt or rounded apex. The main nerves are in 7-15 pairs, usually widely spaced and alternate to opposite. Secondary nerves occur in between the principal nerves. The petiole is 3-8 mm. long, somewhat obscure owing to the leaf blade running down onto it.

The inflorescence (Fig. 3A) is generally terminal but sometimes axillary. It is usually in a dense crowded cyme forming a hemispheric head on the ends of peduncles which are 5-12.5 cm. long. The flowers are quite prominent, being 1-1.3 cm. long, and white to pinkish in colour. Flowering

starts in March and ends in October but under cultivation the flowering period is usually longer. Calyx lobes are almost free, deltoid to lanceolate, 1.3-3 mm. long with acute apex, often with 1 or 2 minute teeth on the margin near the base. Corolla (Fig. 3B) salver-shaped, slightly swollen little above the middle where the anthers are attached inside the tube; glabrous outside and pilose inside rounded from about middle to orifice; lobes ovate, orbicular with apex, and 1.5 to 3.5 mm. long. In bud, it is glabrous, convolute with left margins overlapping. Stamens are free. Filaments are inserted well below the orifice of the tube and are 3-5 mm. long. Anthers are oblong and 1.3-1.4 mm. long. Thecae rounded at base. Anthers dehisce along their full length. Throat hairy. Disk cup-shaped. The ovary is about 1.2 mm. long, truncate, rounded and slightly concave at apex, narrowed to stipe-like base. Carpels are united at base to about the length of disk. Two ovules are suspended in each cell. Style is about 8 mm. long. Stigma has 2 minute apicules.

Fruit (Fig. 3E, F, G) is drupaceous, sometimes single but generally didymous, united half way, oval, slightly flattened, 5-6.5 mm. long, 4.5 to 5 mm. broad. The apices are blunt, divergent and so the sinus makes a V shape. Flesh thin. Endocarp is hard (stony), lightly rugose, the disk remaining as a thin collar at the base of the fruit. When the fruits are ripe they appear purple black in colour.

The seeds (Fig. 3J) are single in each fruit, oval, flattened and about 4-6 mm. long. The seed with stone intact is hard, white, tapering on one side and broad on the other. The surface is rough and dull. The endosperm copious and soft. The embryo is erect. Cotyledons two, aplanate and broadly oval (about 2 mm. long).

Cultivation of *R. serpentina*

R. serpentina can easily be cultivated where rainfall is over 30 in. The plant prefers clayey soils and grows well under semi-shady conditions. *R. serpentina* has been observed to grow well under the shade of trees (mango) in conjunction with *Clerodendron infortunatum* and similar undergrowth. It can be propagated by planting root stock and cuttings of root or stem after treatment with growth-promoting hormones. Attempts have been made in the past to cultivate it

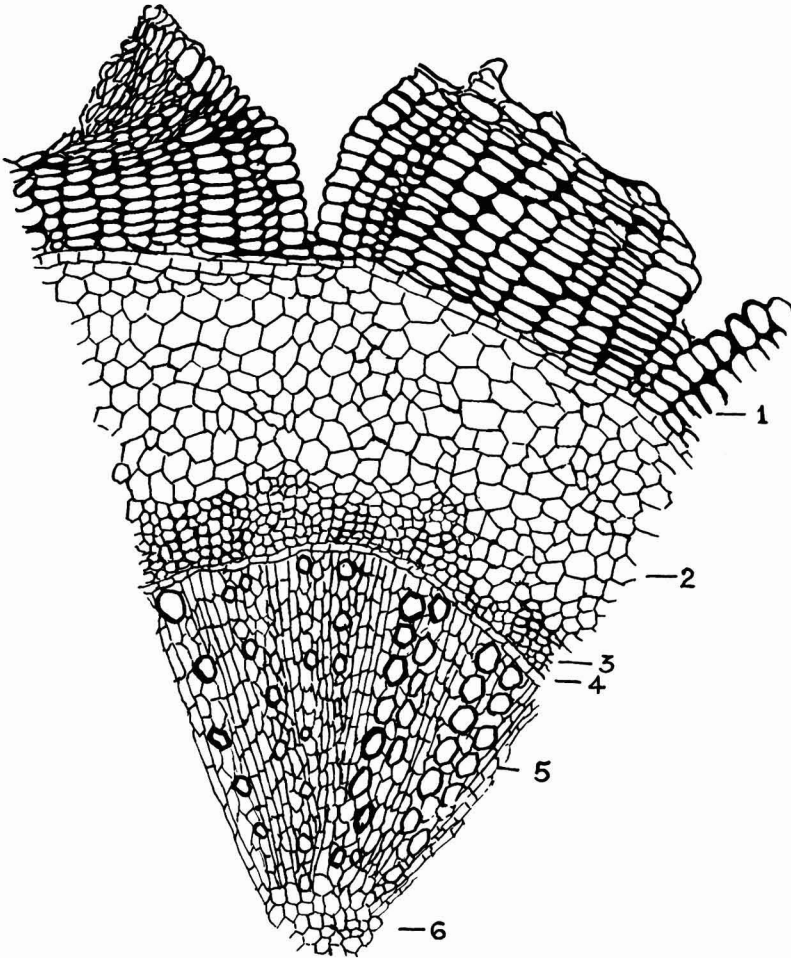


FIG. 5 — T.S. OF YOUNG ROOT OF *Rawolfia serpentina* $\times 110$ [1, cork; 2, cortical tissue; 3, phloem; 4, cambium; 5, xylem; 6, pith]

under artificial conditions but the plant never bore fruit. A plant raised from seeds at the New York Botanical Gardens was reported to have flowered after 4 or 5 years. The plants in Java are reported to mature without much difficulty and the maximum height to which the plants grow is 50 cm. in 2 years. The plant fruits readily after flowering. Experiments carried out in West Java have demonstrated that stem cuttings root, although not easily. Propagation by seed is difficult, only 30 per cent germination being obtained. The plant does not do well

in the moist climate of West Java¹⁰. The Superintendent, Royal Botanic Gardens, Peradeniya, has also reported that the germination of the seeds takes about 2-3 months. He suggests that the quickest way to propagate *R. serpentina* is by division of root stock. In Ceylon, all the root stocks planted get established in two weeks.

Experiments on the propagation of *R. serpentina* are in progress at the National Botanic Gardens, Lucknow, and other places in India, and its successful cultivation has

been reported from a number of places. The experiments carried out at the National Botanic Gardens, Lucknow, have shown that the percentage germination of seeds sown in pots and in the ground was about 7-15 per cent. Germination ranging between 15 and 20 per cent was recorded at Madras and a slightly higher percentage at Dehra Dun. Germination of seeds at Lucknow was observed to be good during the period July to September.

On germination the primary root emerges in 20-25 days, the hypocotyl elongates and brings the cotyledons above ground. The cotyledons which are at first fleshy, increase in size and become light. The terminal bud develops, followed by lateral buds, and in 30-40 days the seedling establishes itself well giving rise to new leaves and shoots.

When seeds are sown directly in the soil, they either do not germinate or the percentage of germination is poor. Cuttings of roots¹¹ treated with growth-promoting hormones (indolyl acetic acid) and planted in pots have been found to put forth new shoots and roots. Stem cuttings (4-6 in. long), treated similarly with growth hormones, were found to take root within 15 days. The plants so raised and transplanted in the field do well.

Experimental plantation of *R. serpentina* has also been carried out at the Forest Research Institute, Dehra Dun, and good results have been obtained. A 2 years old plantation has been found to yield 2,000 lb. of roots. The alkaloid content of the roots of cultivated plants is higher. It has also been observed that the alkaloid content of the roots can be increased by the application of better methods of cultivation. Different parts of roots contain varying amounts of total alkaloids; the lateral fibrous roots (which are at present discarded) yield a higher percentage of total alkaloids than the main root.

Plantations at high altitudes have also been attempted in India, but at 7,000 ft. the plants die.

Tillage — A nursery should be first established for raising plants in the month of March or April. The plot should be preferably in shade and close to irrigated land. Beds of convenient size should be made. Badhwar, Karira and Ramaswami¹² have recommended 4 ft. bed for raising the seedlings. They have also suggested that one-twentieth

of an acre nursery will give sufficient number of plants for transplanting in an acre of land. Five oz. of seed are enough for an acre and the best time of sowing is in the month of May. The seeds should be sown in lines 3 in. apart. After sowing, the seeds should be covered by leaf-mould and the beds should be irrigated immediately.

Transplanting should be done in the month of July after rains in well-prepared fields, and the plants should be planted 2 ft. apart. During monsoon months, only weeding is needed and in winter two or three hoeings should be done.

The root and stem cuttings are similarly planted in nurseries either in pots or in the soil and then transplanted during the rains. Plants planted 2 ft. apart, in rows, do well. Other interculture operations should be regularly carried out for proper development of roots.

Commercial varieties — Five varieties of the drug are available in the market⁹. Differences have been observed in the alkaloidal content of roots collected from the swampy districts of Bihar and from those collected from Dehra Dun area¹³. The variety of *R. serpentina* collected from Dehra Dun area has been reported to contain maximum pharmacological activity. Differences have also been observed in the pharmacological action of roots collected from different localities¹⁴. Efforts are being made in the National Botanic Gardens, Lucknow, to evolve a strain possessing high alkaloidal content.

Diseases — *R. serpentina* has been observed to be affected by a leaf spot disease caused by *Alkernaria* spp. Minute, brown, dark coloured spots appear on the leaves which enlarge to prominent dark brown circular lesions of 0.3 mm. or more in diameter. These spots appear almost anywhere on the leaf and in all cases the centre of the spot becomes papery and brittle, and ultimately the leaf is torn and dies from the centre. The fungus also affects the inflorescence and the flower appear blackened.

Pests — Insect pests also attack the plant. It has been reported that the inflorescence and the tender fruits are badly attacked by certain sap-sucking insects which can easily be controlled by dusting with Hexidol (10 per cent).

Storage — *R. serpentina* roots should be properly dried and stored to preserve its

alkaloidal content. Unless thoroughly dried under shade, the roots are attacked by moulds and there will be a reduction in their alkaloidal contents. A fall of about 25 per cent in total alkaloidal content has been observed in the case of roots affected by mould. *R. serpentina* roots should be stored in clean airtight containers.

Rauwolfia canescens Linn.

This is the most common adulterant in commercial samples of *Rauwolfia serpentina* Benth. In India it is known by the vernacular name *Bara Chanda*, but is not described in Indian floras, being American in origin. It can be easily distinguished from *R. serpentina* by its habit, i.e. much branched stem with red coloured, round, single fruits and dull coloured leaves. It was probably brought to India as an ornamental plant, and it has gradually spread all over India. Its original home is said to be West Indies, but it is to be found in all areas where *R. serpentina* grows. It has been reported to occur in Bombay¹⁵ and Madras States¹⁶.

The plant is reported to occur in most of the moist and hot parts of India. Chemical investigation of *R. canescens* Linn. has been attempted before and work on this plant is being carried out at the School of Tropical Medicine, Calcutta, and other places. The alkaloidal constituents are mostly present in the roots. The alkaloid Rauwolscine has been isolated from the roots of the plant.

Description—A 10-12 years old plant, growing at the National Botanic Gardens, Lucknow, is about 6 ft. in height, but usually *R. canescens* Linn. is a small shrub, 1-3 ft. in height. It is deciduous in habit and prefers full sunlight.

Root—It has a tap root which penetrates vertically with numerous side branches. Maximum number of thick lateral roots is found to a depth of 2 ft.

The root bark is dark grey in colour, hard and woody. It fractures with difficulty. The inside of the bark and the wood is white. Dried specimens are odourless. The roots are very bitter to taste. They are sold along with *R. serpentina* roots in pieces of varying length and diameter. The bark of *R. canescens* is thinner and less easily detachable from the wood. However, the roots of *R. canescens* can be distinguished from those of *R. serpentina* from its characters described below.

The root is characterized by 16-20 layers of cork cells. The phellogen cells resemble those of *R. serpentina*. The secondary tissue is filled with starch grains. The secondary phloem is made up of sieve tubes, companion cells, phloem ray cells and phloem parenchyma cells. Groups of stone cells are also present. The phloem region can be distinguished from the secondary cortex by smaller phloem parenchyma. The stone cells vary in shape, rounded polygonal or rectangular. Cambium is present. The major portion of root also is made up of xylem vessels. It has wood parenchyma with abundant vessels. Tracheids are rare.

The root powder consists of starch cells, stone cells and cork cells, and resembles *R. serpentina* root powder.

Stem and leaves—Stem is erect, dichotomously branched, hard and woody. The bark can be peeled with difficulty. The colour of the bark is light grey and that of inner wood is white. Leaves are generally crowded at the top portions of the plants. These are of unequal sizes, usually in whorls of 3 or 4 entire, oblong, lanceolate or elliptical 8.7 cm. long and 4.0 cm. broad and tomentose. Veins are 9-11 pairs and are prominent below. Fainter veins are present in between the main lateral nerves. Apex acute. Petiole is short, 6 mm. long and existipulate. It is throughout hairy, a few hairs near the base are well developed and thicker than others.

Inflorescence and flowers—Inflorescence cymose, generally having terminal or pseudo-axillary umbel-like cyme. Peduncles 8 mm. to 4 cm. long, hairy, rounded and green. Calyx lobes rounded short and 6-partite. Flowers are white and small. Corolla 5 lobed and about 0.1 mm. long, lobes very short and rounded. Carpels two.

Fruit and seed—Fruit is a drupe which is round and 6-10 mm. in diameter. Pyrenes rugose and when ripe it turns to dark brown or purple colour. Seeds ovoid and 6 mm. long and 3 mm. broad at base including stone, albuminous, endocarp hard, rough and white in colour.

Cultivation—It is easily propagated by seeds and grows well in the open. In India, the seeds are usually allowed to germinate during the rainy season and the plant becomes about a foot in height by winter.

References

1. DURAND, TH. & JACKSON, B. D., *Index Kewensis* (Clarendon Press, Oxford), Suppl. 1 (1886-95), 358.
2. HILL, A. W., *Index Kewensis* (Clarendon Press, Oxford), Suppl. VI (1916-20), 172; Suppl. VII (1921-25), 205; Suppl. VIII (1926-30), 202; Suppl. IX (1931-35), 232.
3. HILL, A. W. & SALISBURY, E. G., *Index Kewensis* (Clarendon Press, Oxford), Suppl. X (1936-40), 191.
4. HOOKER, J. D. & JACKSON, B. D., *Index Kewensis* (Clarendon Press, Oxford), Suppl. II (1895), 692.
5. PRAIN, D., *Index Kewensis* (Clarendon Press, Oxford), Suppl. III (1901-5), 149; Suppl. IV (1906-10), 198; Suppl. V (1911-15), 214.
6. THISELTON & DYER, W. E., *Index Kewensis* (Clarendon Press, Oxford), Suppl. III (1901-5), 156.
7. CHANDRA, V., *J. sci. industr. Res.*, **14C** (1955), 36.
8. WILLS, T. E. & ROHATGI, S., *J. Pharm. & Pharmacol.*, **1** (1949), 292-305.
9. DUTTA, S. C. & MUKERJI, B., *Pharmacognosy of Indian Root & Rhizome Drugs* (Manager of Publications, Delhi), 1950, 83.
10. MANACHINO, J., *Econ. Bot.*, **8** (1954), 349-65.
11. CHANDRA, V., *J. sci. industr. Res.*, **13A** (1954), 113.
12. BADHWAR, R. L. *et al.*, *Indian For.*, **81**(4) (1955), 252-57.
13. SIDDIQUI, S. & SIDDIQUI, R. H., *J. Indian chem. Soc.*, **12** (1935), 37.
14. BHATIA, B. B. & KAPUR, R. D., *Indian J. med. Res.*, **32** (1944), 177-82.
15. COOKE, T., *Flora of the Presidency of Bombay*, Vol. 2 (Taylor & Francis, London), 1903, 126-28.
16. GAMBLE, J. S., *The Flora of the Presidency of Madras*, 1935, 805-20.

APPENDIX

Vernacular names of *Rauvolfia serpentina* Benth.

- Bengali — *Chandra, Chota Chand*
 Canarese — *Amelpodi, Chandrika, Garud-pathal, Sutra Nanni, Sutranaabi, Vishwa Nabhi*
 Gujarati — *Naya*
 Hindi — *Chandra, Chota Chand, Chota Chandra, Harkai Chand, Nai, Nakulikanda, Naga Bail, Isroll, Dhama Barue*
 Malayalam — *Amelpori, Chivana-avelpori, Harkai, Sjouinna-amelpodi, Ts Jovanna-Amel-poeti, Vantuvala*
 Marathi — *Amelpodi, Harki, Moogsavel, Sapasanda, Tohovanna*
 Oriya — *Dhannerna, Sanochedo*
 Sanskrit — *Ahim, Mardani, Alilata, Bhadra, Chandrika, Kaheshwar Chandrika, Naga Gandha, Nakuleshta, Pashumahana Karika, Sarpagandha, Surasa, Rata Patrika, Vishna Sham, Vasupupha, Vishnashini*
 Tamil — *Chiven-amelpodi, Covannamilpori, Eiya-kunda, Negliever*
 Telegu — *Dum Parasan, Patalagadhi, Patala gandhi, Patal garuda*
 Urdu — *Pagal ki dawa*

Indian Science Congress, 1957

DR. B. C. ROY, CHIEF MINISTER, WEST BENGAL, is the General President for the 1957 session which will be held at Calcutta. The sectional presidents elected are: *Agricultural Sciences* — Dr. E. S. Narayanan (Delhi); *Anthropology and Archaeology* — Dr. M. N. Srinivas (Baroda); *Botany* — Prof. S. N. Das Gupta (Lucknow); *Chemistry* — Prof. S. M. Mehta (Bombay); *Engineering and Metallurgy* — Prof. G. P. Chatterji (Howrah);

Geology and Geography — Dr. B. C. Roy (Calcutta); *Mathematics* — Prof. K. Chandrasekaran (Bombay); *Medical and Veterinary Sciences* — Dr. C. R. Das Gupta (Calcutta); *Physics* — Prof. K. R. Dixit (Ahmedabad); *Physiology* — Dr. Inderjit Singh (Agra); *Psychology and Educational Sciences* — Dr. S. M. Mohsin (Patna); *Statistics* — Dr. P. K. Bose (Calcutta) and *Zoology and Entomology* — Dr. M. B. Lal (Lucknow).

Quality Control in Glass Industry—A Symposium

A TWO-DAY symposium on Quality Control in Glass Industry was held at the Central Glass & Ceramic Research Institute, Calcutta, during 21-22 December 1955 under the joint auspices of the Institute and the Indian Section of the Society of Glass Technologist, Sheffield. The symposium was inaugurated by Prof. M. S. Thacker, Director, Scientific & Industrial Research. Mr. D. N. Sen, Chairman, Advisory Board of the Central Glass & Ceramic Research Institute, presided. Dr. Atma Ram, Director of the Institute, delivered the opening address.

Inaugurating the symposium, Prof. Thacker traced the development of glass industry since World War II. The Indian glass industry, he said, had now fairly established itself and the annual production was about 120,000 tons valued at Rs. 4-5 crores. Though some of the factories have modernized their units by introducing automatic machines, India still imports several types of glassware. Efforts have, therefore, to be made to improve production techniques and take up production of new items. Prof. Thacker assured the glass technologists and manufacturers present that he and his colleagues would do everything possible to assist the industry in solving their problems.

Dr. Atma Ram, in his opening address, said that glass industry was one of the important industries serving the diverse needs of man. Though great progress had been made in the quality of indigenous glasswares produced, considerable improvement was still needed. One of the handicaps of the Indian glass industry, he said, was the high cost of raw materials. A stage has, however, been reached for a concerted drive to improve the quality of products and minimize losses so that the products could be produced to the satisfaction of the consumer and at reasonable prices.

An appreciable part of production is used for making electric lamps, scientific apparatus, pharmaceutical requirements, etc., and if the quality of glass produced does not conform to required standards, the consuming

industries would suffer. One of the methods by which uniform quality and reduction in the cost of production could be achieved is by the introduction of quality control measures. So far, with the exception of testing raw materials and finished goods in some of the factories, quality control has not been introduced in the industry as a regular practice.

The purpose of quality control programme is to ensure that the product is within the tolerance limits set for it. To detect any deviations from the standards set, it is necessary to work out tests which could give an indication of the deviations so that corrective measures could be taken. Merely testing the finished product is not enough; it only helps in sorting. In order to be effective, the tests prescribed have to be simple, speedy and easy of interpretation. Cost, however, is an important consideration, and if the cost of quality control measures exceeds the saving effected in the cost of production, the very purpose of introducing the measures is defeated.

Dr. Atma Ram described the various requirements of raw materials and emphasized the necessity for employing suitable raw materials for the production of quality goods. He suggested that the glass industry should establish co-operative organizations for processing the raw materials such as sand, limestone, etc., and supplying the required grade for the industry.

Twenty-six papers dealing with (1) quality control in the glass industry, (2) statistical quality control, (3) control of furnace operation, and (4) testing of glass and glassware were presented at the symposium. Of these 11 papers were contributed by foreign scientists.

Quality control in glass industry

Most of the papers presented dealt with testing procedures for inhomogeneity, blisters, bubbles, neckring cracks, surface crizzles, strength and thermal shock. Simple and rapid methods for measuring the chemical and physical properties of glasses were described. The relative advantages of CIE,

Munsell and Hunter colour notations were discussed and suggestions for controlling colour in glass were made.

In an interesting paper on the general aspects of quality control in the glass industry, Prof. W. E. S. Turner observed that as a result of his recent visits to a large number of glass factories in India he was convinced of the necessity of introducing quality control in the Indian glass industry.

Testing of raw materials and finished products as an important aid to quality control programme was emphasized in most of the papers. Testing is expensive and it should be cut down to the minimum necessary to give information as to the causes of defects in the products and how they could be remedied. The number and types of tests to be carried out depend on the degree of control desired. For example, by measuring the density and softening points of a glass, it is possible, by employing a graphical method, to determine the amounts of silica, alumina, alkali and alkaline earths in glass. These two physical characteristics of the glass can, therefore, be employed for controlling the composition of glass. Similarly, thermal expansion and low temperature viscosity measurements could also be helpful in quality control of glass.

There are instances where the normal quality control measure of relying on inspection alone is not enough. For example, in the manufacture of beer bottles, it has been suggested that quality control should be applied only to bottles which have already been inspected to the extent of 100 per cent. This method is not only a check on the quality of production but also on the quality of inspection. From the information gained by inspection of packed ware, a record of the general quality of the manufacturing run could then be prepared. By these means, a manufacturer can ensure that the subnormal bottles in a batch are kept down to a very small percentage without the need for re-inspection of large proportions of the goods manufactured.

An improved quality control programme has been in operation at the Hartford-Empire Co., U.S.A., resulting in the production of glass of high quality and constant composition. The three-phased programme consists of (1) control of composition, (2) special measurements, and (3) control of furnace operation. Glass composition is controlled

by density and viscosity measurements and chemical analyses. Measurement of the homogeneity of the product also gives a good index of the entire control programme. Furnace operation is controlled by comparing optical temperature and daily tonnage data with such glass characteristics as are directly related to furnace operation such as seed and blister count. Collection of temperature distribution data and analyses of the products of combustion at weekly intervals are also useful in quality control measures.

Statistical quality control

Of the three papers presented under this head, one dealt with the collection, presentation and study of data to aid industrial efficiency and emphasized the importance of choosing the right kind of observation to record. Reference was made in this paper to two advanced statistical techniques employed in quality control, namely (1) use of control charts, i.e. the practice of recording the results of sampling inspection at various stages of a series of manufacturing processes leading to reduction of losses incurred by rejection on final inspection and (2) use of sampling inspection technique at the final stage leading to classification of the product, viz. satisfactory, just satisfactory, unsatisfactory and bad. The stabilization of the production process before going into more detailed inspection is emphasized. In the second paper entitled "Application of statistical methods in the study of breakage of glass-house pots", it has been shown that it is possible to find out the causes of breakage by suitable statistical treatment of data relating to the average life of glass-house pots. The third paper outlines the fundamentals of statistical quality control procedure with the help of a typical example — bursting pressure tests on beer bottles. The use of 'nul' test, a common example of which is the thermal shock test, for purposes of quality control was discussed.

Furnace design and operation

One of the papers in this group dealt with some aspects of furnace design and operation such as quality of refractories and fuel employed, heat distribution, furnace pressure, and supply of combustion air and fuel, which affect the quality of glass. The conditions conducive to satisfactory furnace operation

and the part the furnace plays in quality control of glass were discussed in another paper. Selection of suitable temperatures which satisfy the melting rate required of a particular furnace, steady fuel feeding, selection of refractories best suited for particular conditions, steady batch charging and withdrawing of glass at a constant state are considered important for good and efficient furnace operation. In the third paper were outlined the probable causes of defects introduced in glass due to the type of refractories used. Suggestions were made for eliminating these defects, and the properties and range of composition for different types of refractories suitable for glass-melting furnaces were indicated.

Testing of glass and glassware

There were five papers dealing with this aspect of quality control. Standard methods

for routine examination of glass for inhomogeneity and data on maximum tensile strain due to inhomogeneity permissible on the surface of glass for different types and sizes of containers were described in one of the papers. Techniques for carrying out thermal endurance tests on commercial glassware, the use of polariscope as a check on the process of annealing of glass were described in two other papers. The fourth paper dealt with a rapid qualitative method for determining the variation in coefficient of expansion of glasses and the use of this property in quality control. The method has been recommended for controlling the composition of glass batches. The requirements of containers in the pharmaceutical industry other than neutral glass containers and the various tests employed to determine their suitability were described in detail in another paper.

Centenary of Bessemer's Invention

THE YEAR 1956 MARKS THE CENTENARY OF Sir Henry Bessemer's invention of what is now familiarly known as the Bessemer process to convert pig iron into steel. The invention effected substantial reduction in the price of steel and greatly influenced the future of structural engineering.

Bessemer was born on 19 January 1813 at Charlton, Hertfordshire, England. He learnt mechanics from his father, but eagerness for enquiry and his inventive proclivities made him a prolific inventor in later life. Early in his career he showed his inventive genius by producing perforated dies for preventing the re-use of old stamps. Among his later successful inventions was the building of a special cross-channel steamer named 'The Bessemer'. Bessemer's attention was drawn to the problems of steel manufacture, while he was attempting to improve the construction of guns. The process he patented in-

involved decarbonization of cast iron by blowing a forced blast of air through molten pig iron to obtain malleable iron in a fluid state.

When Bessemer first presented his paper entitled "On the manufacture of malleable iron and steel without fuel" at a meeting of the Royal Association for the Advancement of Science at Cheltenham in 1856, his claims were heard with incredulity. His attempts to work out his process in his steelworks erected at Sheffield proved abortive, but undaunted, he laboured strenuously against many odds and finally in 1865 succeeded in establishing the feasibility of his process.

Bessemer founded the Iron and Steel Institute in 1869 and became its President in 1871. He was elected Fellow of the Royal Society and was knighted in 1879. He died on 15 March 1898.

R E V I E W S

AN INTRODUCTION TO PROCESS CONTROL SYSTEM DESIGN by A. J. Young (Longmans, Green & Co., London—New York—Toronto), 1955. Pp. xvii + 378. Price 42s. In his acknowledgements, the author has stated that "the book represents an attempt to provide simple introduction to the study of process control systems and of the factors which influence their design". In this endeavour, the author has drawn upon his vast fund of personal industrial experience and published books and papers in the field.

The opening chapter stresses the need for theoretical and experimental analysis of plant characteristics to exploit the economic potentialities of automatic controls. The next five chapters deal with the theoretical plant analysis leading to the chapter on experimental frequency response analysis, the backbone of control system design at the present stage of knowledge. Then follow chapters on the characteristics of plant and control systems, operation of simple control systems and prediction of best controller setting with the aid of graph. Chapters 10-17 contain, from the point of view of a process design engineer, valuable information on various controllers with both single and combination systems, the effect of phase lag attenuation and plant lag in process control, the nature of the transfer stages found in plant units and calculation of response of such stages, valve characteristics and the consideration disturbances in control. This is followed by a chapter on complex control systems and a concluding chapter on a brief procedure for process control system design. The appendix contains lots of selected supplementary information of theoretical nature for reference purposes.

The author has dealt with the basic principles of process control in a logical sequence in quantitative terms with emphasis on dynamic characteristics of the plants, which are vital to the process design engineer. The frequency response approach, practically bereft of mathematics, employed in the treatment of the subject, and the numerous illustrative examples and graphs representing

the data have extended the utility of the book to plant engineers. He has presented to the process design engineers a quantitative rational approach as an alternative to empiricism for the synthesis of control equipment. The book thus satisfies the long-felt need in the field of process control design. Some of the outstanding features of this book are: (1) maintenance of high pedagogical standards in the presentation of the material; (2) employment of widely used standard terminology in the text which makes the book simple and familiar reading; and (3) the distinctly practical design bias of the subject matter.

The author has succeeded in his attempt to bring about a comprehensive book on process control system design. The book will not only be useful as a text-book for an introductory course in process control system design but will also serve the needs of process control designers and engineers as a valuable reference book.

N. S. NANDEESWARAIYA

QUALITATIVE ORGANIC ANALYSIS AND SCIENTIFIC METHOD by A. McGookin (Chapman & Hall Ltd., London), 1955. Pp. vii + 155. Price 15s.

Though there are a number of books on qualitative organic analysis published in the English language in Britain, America and India, there is justification for the appearance of yet another written by Dr. A. McGookin. This has a novel feature in it: it lays emphasis not only on a rational procedure but also on the scientific method. The book is the result of over 30 years of experience of the author in teaching the subject. Dr. McGookin is of the opinion that qualitative organic analysis is the most important means of instilling the principles of scientific method into the minds of students and that it should not be regarded merely as an exercise in laboratory technique.

In eight chapters the subject of qualitative analysis is developed in a natural manner based on the three essential methods of science: experiment, observation and inference. The experimental chapters are divided

into three parts. Part I is devoted to preliminary tests, Part II to special tests and Part III to hydrolysis and products of hydrolysis. The philosophical discussion of observation and inference will be quite useful even for senior students taking up a research career, since by observing the precautions given, many avoidable errors can be eliminated and those under the category of unavoidable ones reduced in number. The usual list of organic compounds with their physical constants and their derivatives has been omitted here since probably the object is not the spotting of compounds but analysis. The text is written clearly and is interspersed liberally with quotations from various sources which are by themselves interesting and thought-provoking.

The book can be strongly recommended to students of organic chemistry in universities and technical colleges. For a book of this type, which should be rightly popular, the price is probably too high for an average Indian student.

T. R. SESHADRI

INDIA'S MINERAL WEALTH by J. Coggin Brown & A. K. Dey (Oxford University Press, Bombay), 1955. Pp. xxiv + 761. Price Rs. 30

This is the third edition of the well-known book which was originally published under the same title by Dr. J. Coggin Brown in 1923 as a pocket-size volume. It was revised and considerably added to in 1936. The present edition is several times the size of the second edition and has been prepared with the collaboration of Dr. A. K. Dey, Superintending Geologist of the Geological Survey of India, with the original author who was formerly an officer of the Geological Survey of India.

As the first edition was written to include all the territories which lay in the original Indian Empire, this edition also deals with India, Pakistan and Burma.

The book is divided into five parts which deal respectively with the mineral fuels; metals and their ores; materials used in building, agriculture, ceramic industries, paint industries and other non-metallic minerals; precious and semi-precious stones; water and soils. There are 19 individual chapters each dealing with a small group of closely connected mineral deposits. Each chapter deals with deposits of a small group

of minerals fairly thoroughly and follows more or less the lines on which the quinquennial reviews of mineral production are published by the Geological Survey. Some notes are given on the history of the more important deposits and their geology and on the distribution, production, etc., of individual minerals. Graphs illustrative of production and maps of the location of the deposits are given with regard to most important minerals. A feature which will quickly become out of date is the listing of present producers of certain minerals, though this will be useful temporarily for people in the mineral trade. There are also numerous references to some small occurrences which are not of any particular interest except that they serve to give a more or less complete picture of the present-day knowledge.

The last two chapters are devoted to water supply and soils respectively. These are considered from a general all-India point of view and form good summaries of our general knowledge on these subjects.

The book gives a comprehensive and reliable review of the present knowledge of the mineral resources of India, Pakistan and Burma. It is illustrated by several photographs of mines and maps of various mineral deposits or particular minerals. There are several tables interspersed with the text. The classified bibliography at the end, which includes a list of selected papers, runs to 20 pages while index occupies 32 pages. The book is bound to occupy an important place as a handy reference work on the mineral resources of India, Pakistan and Burma and will no doubt become very popular. The printing and get-up are of a high standard, though the price, for the Indian public, and particularly for students, is rather high.

M. S. KRISHNAN

STUDIES OF MINERAL NUTRITION BY USE OF TRACERS by Orlin Biddulph [*The Botanical Review*, 21(5) (1955), 251-96]

Radioactive isotopes have been extensively used in recent years as tracers in studies on mineral nutrition of plants, animals and various micro-organisms. Dr. Biddulph in this number of the *Botanical Review* has comprehensively dealt with the botanical aspects of this subject giving details of procedures such as direct counting and auto-

REVIEWS

radiography as also the absorption and metabolism of calcium, copper, iodine, iron, manganese, molybdenum, phosphorus, sulphur, sodium and zinc. The basic requirement of a tracer, according to the author, is that "it should be chemically and physically exactly equivalent to the substance it represents or displaces and that it in no appreciable way affects the system differently from its normal counterpart". Almost all the isotopes used in mineral nutrition studies conform to the above requirement and the amount of radioactive material used is in such minute quantity that it does not constitute any health hazard. Consequently, extensive investigations have already been carried out by the use of various available isotopes in studies on mineral nutrition in plants.

Under procedures, an account is given of the manner Geiger counters are used and the method of direct counting as also details of micro-autoradiography, which technique has been used with remarkable success in certain types of plant tissues. The author has also described studies relating to absorption of various minerals in plants. Thus, it has been found that potatoes, corn, cotton and tobacco vary greatly in absorption of fertilizer phosphorus on soils of comparable

native phosphorus content. Further, the additional advantage which may be gained by simultaneous use of two tracers in the same plant section has also been illustrated with suitable examples from published reports. In addition, the investigations reported on the metabolism of various elements such as calcium, copper, iron, manganese and others have been very well reviewed with extensive references to the literature. However, the author's treatment of the subject of radiation injury is rather inadequate. The recently published papers on the biological effects of radiation, from the proceedings of the International Conference on Peaceful Uses of Atomic Energy held in Geneva in August 1955, cover a more extensive ground. Perhaps, for the same reason, this review may be found wanting and not quite up to date in regard to some other aspects of mineral nutrition studied by the use of tracers. All the same, Dr. Biddulph's attempt in collecting all the material he was able to get on this subject in one review of this kind is indeed a very commendable effort and the review deserves to be read by botanists, plant physiologists and others who are interested in the use of radioactive isotopes.

P. S. SARMA

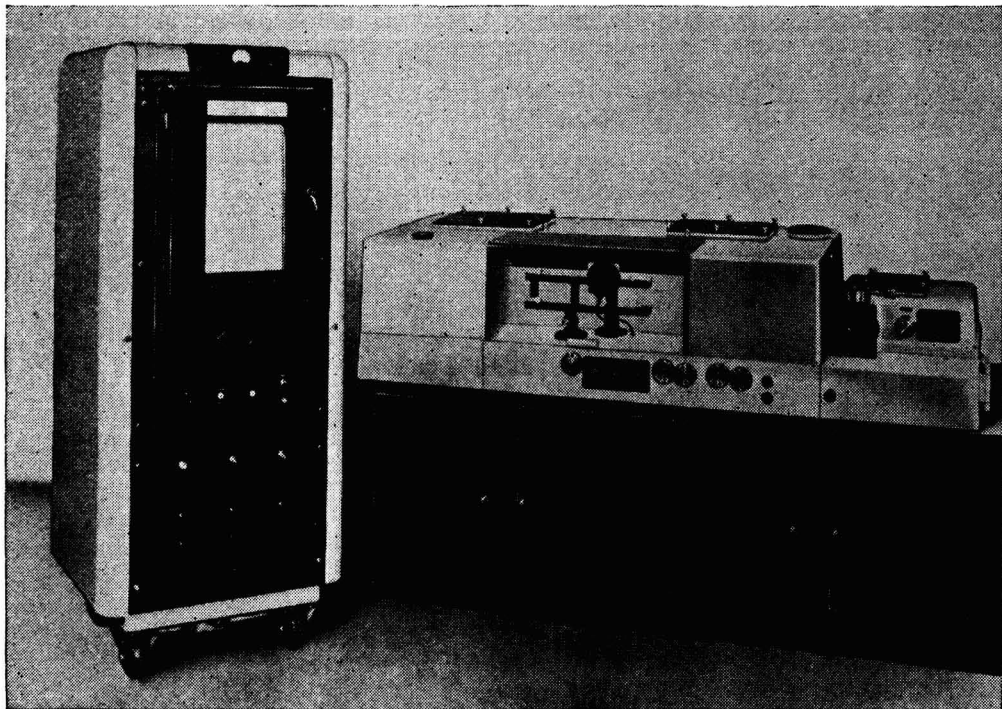
Recent Publications

- *FLOOD ESTIMATION AND CONTROL by B. D. Richards (Chapman & Hall Ltd., London), 1955. Pp. xiii+187. Price 35s.
- *COMPREHENSIVE INORGANIC CHEMISTRY by Thomas D. O'Brien (Macmillan & Co. Ltd., London), 1955. Pp. xii+193. Price 37s. 6d.
- *SYNTHETIC ION-EXCHANGERS — RECENT DEVELOPMENTS IN THEORY AND APPLICATION WITH A CLASSIFIED BIBLIOGRAPHY by G. H. Osborn (Chapman & Hall Ltd., London), 1955. Pp. ix+419. Price 30s.
- *STEELS FOR THE USERS by R. T. Rolfe (Chapman & Hall Ltd., London), 1955. Pp. xvi+399. Price 45s.
- *TREATISE ON INORGANIC CHEMISTRY: Vol I by H. Remy (Elsevier Publishing Co., Amsterdam — Houston — London — New York) (*Distributors: Cleaver-Hume Press Ltd., London*), 1956. Pp. xxi+866. Price £ 5 5s.
- THE ESSENTIALS OF EDUCATIONAL STATISTICS by Cornell (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 394. Price \$ 5.75
- EVOLUTION GENETICS AND MAN by Dobzhansky (John Wiley & Son Inc., New York). Pp. 409. Price \$ 5.50
- ANDROGENS: BIOCHEMISTRY, PHYSIOLOGY & CLINICAL SIGNIFICANCE by Dorfman-Shipley (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 576. Price \$ 7.00
- HETEROCYCLIC COMPOUNDS: Vol. V and VI by Elderfield (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 770. Price \$ 21.00 each
- PRINCIPLES & TECHNIQUES OF APPLIED MATHEMATICS by Friedman (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 324. Price \$ 8.00
- ESSAYS IN BIOCHEMISTRY by Graff (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 376. Price \$ 6.50
- THE THERAPEUTIC USE OF ARTIFICIAL RADIOISOTOPES by Hahn (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 420. Price \$ 10.00
- ENGINEERING DRAWING & GEOMETRY by Hoelscher-Springer (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 484. Price \$ 8.00
- POWER SYSTEM STABILITY: Vol. III by Kimbark (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 344. Price \$ 10.50
- APPLIED ELECTRICAL MEASUREMENTS by Kinnard (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*)
- THE CHEMISTRY OF PHENOLIC RESINS by Martin (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*)
- ANALYSIS OF ELECTRIC CIRCUITS by Middendorf (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 328. Price \$ 6.00
- STERIC FACTORS IN ORGANIC CHEMISTRY by Newman (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 682. Price \$ 10.50
- BEARING LUBRICATION ANALYSIS by Slaymaker (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 5.00
- PSYCHOPHARMACOLOGY. Edited by Nathan S. Kline (American Association for the Advancement of Science, Washington), 1955
- VENOMS. Edited by Mrs. Eleanor E. Buckley & Nandor Porges (American Association for the Advancement of Science, Washington), 1955
- WATER FOR INDUSTRY. Edited by Meredith F. Burrell & Jack B. Graham (American Association for the Advancement of Science, Washington)
- THE FUTURE OF ARID LANDS. Edited by Gilbert F. White (American Association for the Advancement of Science, Washington), 1955
- THEORY AND PRACTICE OF LUBRICATION FOR ENGINEERS by Fuller (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 425. Price \$ 10.50
- THE ANALYSIS OF STRUCTURES by Hoff (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Pp. 492. Price \$ 9.50
- ELECTRIC NETWORK SYNTHESIS — IMAGE PARAMETER METHOD by Reed (Prentice-Hall, New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 8.00
- NETWORK ANALYSIS by Van Valkenburg (Prentice-Hall, New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 13.00
- RESONANCE IN ORGANIC CHEMISTRY by Wheland (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 15.00
- ORGANIC SYNTHESIS by Cairns (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 3.75
- ELECTRONIC TRANSFORMERS & CIRCUITS by Lee (John Wiley & Son Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 7.500
- PRINCIPLES & PROBLEMS IN ENERGETICS by Bronsted (Interscience Publishers Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 3.50
- TOPOLOGICAL TRANSFORMATION GROUPS by Montgomery-Zippin (Interscience Publishers Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 5.50
- CELLULOSE & CELLULOSE DERIVATIVES, Part III by Ott-Spurlin (Interscience Publishers Inc., New York) (*Distributors in India: Asia Publishing House, Bombay*). Price \$ 12.00

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

HILGER RECORDING INFRA-RED SPECTROPHOTOMETER H800

Incorporating the Double Beam in Time System



Actual Users Include

GENERAL ELECTRIC CO. LTD., ENGLAND

**ATOMIC ENERGY RESEARCH
ESTABLISHMENT, ENGLAND**

ESSO PETROLEUM CO. LTD., ENGLAND

SKANSKA ATTIKSFABRIKEN, SWEDEN

KODAK LTD., ENGLAND

**LABORATOIRE DE CHIMIE PHYSIQUE
DE LA FACULTE DES SCIENCES DE
PARIS, FRANCE**

OSAKA UNIVERSITY, JAPAN

NOGOYA UNIVERSITY, JAPAN

**INSTITUTO SPERIMENTALE ZOOTECH-
NICO, ITALY**

Sales Installation & Service

ASSOCIATED INSTRUMENT MANUFACTURERS (INDIA) LIMITED

**INDIA HOUSE
FORT STREET
P.O. BOX 119
BOMBAY**

**85 CLIVE BUILDINGS
P.O. BOX 2136
CALCUTTA**

**17 MOUNT ROAD
P.O. BOX 2439
MADRAS**

**SUNLIGHT INSURANCE
BUILDING
MINTO ROAD EXTN.
NEW DELHI**

How strong must the foundation be for 43 lakh houses?

In the last few years, large segments of our population have moved into the cities. Here they live in unbelievably congested tenement houses, adding to the cities' already acute housing shortage. We need 43 lakh houses to ease the strain on our cities.

In 1947 our cement production was 1.45 million tons. Today, it is 4.34 million tons—almost three times the 1947 figure. 40,000 people are employed in 26 modern, efficiently run factories.

In our developing economy steel is

essential. That is why the Tata Iron & Steel Company has launched an expansion programme which will raise its capacity.

Ingot Production	
1955	1,050,000 tons
1959	2,000,000 tons

Private enterprise serves the Nation

**THE TATA IRON AND
STEEL COMPANY LIMITED**



*Equip your
laboratory
with*

**LABORATORY & PHARMACEUTI-
CAL CHEMICALS, ANALYTICAL &
LABORATORY REAGENTS,
AMINO ACIDS, STAINS, DRUGS,
VITAMINS, ETC.**

Directly imported by

S. MATHURADAS & Co.
P.O. BOX No. 2113
PRINCESS STREET
BOMBAY 2

Gram : " SMATHURCO "

Phone : 30273

CAMBRIDGE pH METER

ELECTRODE

BUFFER TABLET

Available from Stock

PYROMETER

THERMOCOUPLE

COMPENSATING LEAD

RECORDER, CHART, INK

ETC.

★

Full details from:

S. SIRCAR & Co. Ltd.

16 BONFIELD LANE
CALCUTTA 1

Telephone: 62761

Grams: ' LABFURNISH '

LABORATORY FURNISHERS

**DHUN MANSION, VINCENT ROAD
DADAR, BOMBAY 14**

★

JUST RECEIVED

PAUL WAECHTER

German Students' & Medical
Microscopes

MEMMERT

Electric German Ovens

ROTOFIX

German Centrifuges

CAMBRIDGE

Dial Thermometers

MUFFLE FURNACES

STIRRERS

Electric, German

ZEAL'S

Factory Hygrometers

plus

LABORATORY GLASSWARE, etc.

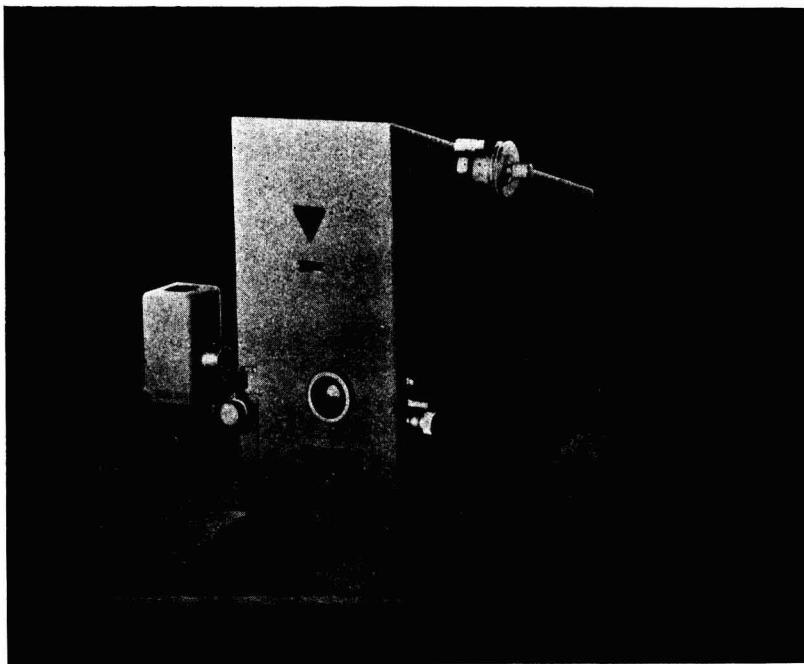
FURTHER PARTICULARS ON APPLICATION

★

Branch Office:

**MOTILAL MANSION
KAPASIA BAZAR, AHMEDABAD 2**

Bausch & Lomb
GRATING MONOCHROMATORS



Highest efficiency monochromatic light tailored to your exact wavelength need — U-V, VISIBLE, INFRA-RED. Select the equipment that meets your specific requirements . . . for monochromatic light of the highest spectral purity and intensity. 250 mm. or 500 mm. Monochromators, with your choice of gratings for full range coverage (2,000-14,000Å, first order) or more for intensive study in the ultraviolet or infra-red.

Certified Precision Gratings

High Dispersion

Linear Wavelength Scale

Write for illustrated folder D-259 to

SOLE AGENTS

MARTIN & HARRIS Ltd.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

NOTES & NEWS

Virus synthesis

SCIENTISTS AT THE UNIVERSITIES of California and Washington have been able to separate tobacco mosaic virus (TMV) particle into its component protein and ribonucleic acid (RNA). Neither of the components by itself is infectious but infectivity is restored by mixing the two together in a test tube. The small protein particle and RNA threads at the core of the virus were mixed in a test tube, when about 1 per cent of the infectivity of the original material was regained.

The newly formed infectivity is probably due to both protein and RNA — neither is the exclusive agent of genetic transmission. This brings up the possibility of an artificial hybrid virus made from the protein of one type of TMV with nucleic acid from a mutant which has a different effect on the plant.

The results represent the first instance of reactivation of an infectious particle from component parts in a test tube. The work opens up several approaches to an attack on virus diseases, as well as new investigations of some of the most basic biological problems [*Sci. Newsletter*, 68 (1955), 292; *Chem. Engng. News*, 33 (1955), 4034].

Structure of enzymes

RECENT WORK CARRIED OUT AT the Emory University, U.S.A., has indicated that a number of aminopeptidases are non-protein in character. Starting with an aminopeptidase preparation that showed only a single component by electrophoresis, a number of aminopeptidases, each with a molecular weight of about 6,000, has been isolated by column chromatography. Since the components are composed of a nucleotide, glucosamine and a peptide, a molecular weight of 6,000 places these enzymes in the non-protein category.

Another important point this work has revealed is that fragments split from the original enzyme retain physiological activity. Fifteen separate aminopeptidases

isolated from swine kidney aminopeptidase by ion-exchange chromatography have been found to retain 70 per cent of the overall activity of the original enzyme preparation [*Chem. Engng. News*, 33 (1955), 4033].

Enzymatic synthesis of dextran

DEXTRAN PRODUCED BY BACTERIAL fermentation or enzymatic method has high molecular weight and must be depolymerized and fractionated to yield a product of molecular weight $75,000 \pm 25,000$ to be clinically suitable as a blood-plasma volume expander. The yield of clinically useful dextran is, therefore, low.

A new enzymatic method for directly converting sucrose to dextran of the desired molecular weight employ dextran-sucrose obtained from *Leuconostoc mesenteroides* NRRL B-512, cultivated in a medium containing sucrose, Basamin-Busch yeast hydrolysate and salts. Enzyme, sucrose, and primer concentrations, primer type, and reaction temperature will affect the molecular weight of synthesized dextran. Dextran of low molecular weight is preferable to maltose as a primer. Dextran primer of low molecular weight may be obtained from synthesis reactions as a byproduct of recovery of dextran of clinical molecular weight either by using the dextran below the 'clinical' fraction in molecular weight, or by hydrolysing the dextran higher in molecular weight than the clinical fraction. Increasing the molecular weight of the primer increases the molecular weight of dextran synthesized. For production of dextran of molecular weight $75,000 \pm 25,000$ suitable weight-average primer molecular weights are in the range of 15,000 to 20,000 for dextran fractions and 20,000 to 40,000 for dextran hydrolysates. For a primer recycling process in which primer utilization is balanced by primer production, it probably would be necessary to use composite primers of fractions of low molecular weight and hydrolysed fractions of high molecular weight. Investigations are being

conducted to determine the practicability of such a recycling operation.

High yields of products having suitable molecular weight for clinical use have been obtained by performing the reaction at approximately 15°C. or less, using 10 per cent sucrose concentration, enzyme concentrations of 20 to 40 dextran-sucrose units per ml., and dextran of low molecular weight as primer. The synthetic product is adjusted to the average molecular weight desired primarily by varying primer molecular weight and concentration and, secondarily, by adjusting fractionation conditions. Products of molecular weight $75,000 \pm 25,000$ have been obtained in yields greater than 25 per cent of reaction sucrose by using 2 per cent concentration of primer dextran, having molecular weight in the vicinity of 20,000, and by fractionating the reaction mixture between the limits of 42 and 50 per cent actual methanol concentration [*Industr. Engng. Chem.*, 47 (1955), 1593].

Albomycin, a new antibiotic

ALBOMYCIN, A NEW ANTIBIOTIC obtained from cultures of a species of streptomycetes, *Actinomyces subtropicus*, has been manufactured during recent years in the Soviet Union. This antibiotic strongly inhibits the growth of Gram-positive cocci, chiefly pneumococcus and staphylococcus. Moreover, it inhibits the growth of staphylococci resistant to other antibiotics, including penicillin, streptomycin, tetracycline and erythromycin. It inhibits the growth of staphylococci in an extreme dilution (1 in 7×10^8) — an activity about 10 times greater than that of penicillin. It is also effective against a number of Gram-negative bacteria — e.g. the colidysenteric group of organisms and Friedlander's bacillus.

Albomycin forms a reversible complex with the serum proteins, which facilitates its circulation in the body. Pharmacological study has revealed that albomycin persists in the blood in effective concentrations after a single subcutaneous dose for as long as two or three days. It is non-toxic, and is well tolerated in large doses — up to 50 million units per kg. (1.4 mg./20 g.) — given subcutaneously or intravenously. No side reactions were noted after intrathecal injections in children.

Albomycin has proved effective in the treatment of pneumonia, especially in young children, in the septic complications of dysentery and measles, and in meningitis due to penicillin-resistant pneumococci. It has also been used in the treatment of peritonitis and other surgical infections and for penicillin-resistant prostatitis and gonococcal urethritis.

Albomycin is a basic substance and forms salts with various acids. Chemically pure sulphate of albomycin is in the form of an amorphous red powder, easily soluble in water, slightly soluble in methanol but insoluble in other organic solvents. The pure preparation of albomycin sulphate contains 4.16 per cent of iron which seems to be attached by a chelate bond to the hydrous group of serine contained in the molecule of albomycin. In addition to serine, hydrolysates of albomycin contains ornithine, glutamic acid, alanine, glycine, proline, and an unidentified amino acid.

The mechanism of the antibacterial action of albomycin has also been studied. It has been observed that albomycin, independently of concentration, inhibits the growth of staphylococci, *E. coli*, and other bacteria only in the presence of oxygen. This study leads to the conclusion that albomycin interferes with the action of an enzyme that contains iron and transports oxygen [*Brit. med. J.*, (1955), 1177].

Filipin, a new antibiotic

FILIPIN, A NEW ANTIBIOTIC ISOLATED from soil fungus *Streptomyces filipinensis* from Philippines, has been shown to be effective against a number of human pathogenic fungi. Filipin is also found effective against a few seed-rotting fungi, but it has not shown any activity against bacteria. It belongs to a new family of antifungal agents and resembles closely another fungicide, fungichromin, recently announced [*Sci. News-letter*, 68 (1955), 265].

A new antirabies vaccine

A NEW ANTIRABIES VACCINE PREPARED from fixed rabies virus of high titres grown in embryonated duck eggs is claimed to be almost devoid of the encephalomyelitis-producing qualities that occasionally occur with the use of rabies vaccine prepared from rabbit

brain. The new vaccine is claimed to have caused no severe systemic reactions in 20 human subjects who had sustained bites from dogs, squirrels, cats, rats, mice or monkeys. Virus-neutralizing antibodies were demonstrated in 12 out of 13 patients tested 14 days after the vaccine was administered [*Science*, 122 (1955), 112].

A new haemoglobin

The presence in normal adult blood of a small amount of a new haemoglobin component having electrophoretic properties different from those of the main component, haemoglobin A, is reported. The material was isolated by zone electrophoresis of a dialysed haemoglobin solution (8 per cent concentration) in a starch slab covered with polyethylene sheeting. The absorption curve in the visible region for this component was the same as that for haemoglobin A. No significant differences were found in the ultraviolet spectrum. Comparison of this component with the known abnormal haemoglobins indicated that it shows a mobility in various buffers similar to that of haemoglobin E.

Electrophoresis in free solution in barbital buffer (pH 8.6; $\Gamma_2/0.05$) also demonstrated this component when a haemoglobin concentration of 3 per cent or more was employed. The mobility calculated from the descending pattern was -1.94×10^{-5} compared with -3.48×10^{-5} for the main A component. Quantitative analyses of this slow component in the blood of 26 individuals, including normal persons and patients with a variety of chronic diseases, indicated a mean value of 2.6 per cent of the total haemoglobin with a range of 1.8-3.5 per cent.

Normal adult blood showed, in addition, small amounts of a haemoglobin migrating faster than haemoglobin A in barbital buffer [*Science*, 122 (1955), 288].

New acid chloride synthesis

A NEW ACID CHLORIDE SYNTHESIS has been developed by Dr. Louis A. Carpino and co-workers of the University of Massachusetts, U.S.A., in which the reaction is carried out by dissolving a hydrazide in nitromethane and saturating the solution with hydrogen chloride gas. Chlorine is then passed through the mixture until the

precipitate of the hydrochloride dissolves; this indicates that the reaction is complete. Since the reagent chlorine and the reaction products hydrogen chloride and nitrogen are all gaseous, the resulting solution contains only the desired acid chloride, which can be obtained by distillation.

The process represents a distinctly new and general method for preparing acid chlorides. All other useful methods require the corresponding acid to be reacted with a phosphorus, sulphur or organic halide. Thus, the method might prove particularly valuable in preparing acid halides of organic compounds which are unknown as the acids but stable as the hydrazides, such as carbonic and carbamic acid derivatives. Rapidity of reaction is another advantage of the process; *p*-nitrobenzhydrazide is converted to the acid chloride in 3-5 min. whereas reaction of the corresponding acid with thionyl chloride requires 6 hr. of fluxing [*Chem. Engng. News*, 33 (1955), 4173].

Germicidal iodine

THE GERMICIDAL PROPERTIES OF iodine have been found to be due chiefly to the diatomic form of this element. Iodine in diatomic form has a wide anti-microbial spectrum, being a highly effective viricidal, sporicidal and bactericidal agent. The diatomic form of iodine is about 10-100 times as effective germicidally as the usual tri-iodide form. Animal tests point to a very low toxicity index for diatomic iodine, in spite of its germicidal effectiveness. For treating some infections caused by micro-organisms such as fungi or viruses where current antibiotics are practically useless, diatomic iodine may find application [*Chem. Engng. News*, 33 (1955), 4170].

Einsteinium and Fermium

THE NAMES EINSTEINIUM (SYMBOL E) and Fermium (symbol Fm) have been suggested for elements No. 99 and 100, both discovered in debris from the October 1952 H-bomb explosion by G. Seaborg. Element No. 101 has already been named Mendelevium.

Zincon indicator

THE REAGENT ZINCON (2-CARBOXY-2'-HYDROXY-5'-SULPHO-FORMAZYL BENZYL BENZENE) used for the

colorimetric determination of zinc has now been found suitable as an indicator in titrations using EDTA. The indicator is prepared by dissolving 0.13 g. of finely powdered zincon in 2 ml. of 1M sodium hydroxide which is then diluted to 100 ml. with water.

Zinc is titrated directly in a buffered ammoniacal medium (pH 9-10). Copper, nickel, cobalt, iron (Fe^{+++}), indium and calcium are determined by adding an excess of EDTA solution and back titrating with a standard zinc solution. Aluminium and chromium are determined by boiling first with excess of EDTA solution before adding ammonia solution. With chromium a boiling time of 15 min. is necessary.

Magnesium and alkaline earths do not yield a colour with the indicator, but when zinc is titrated with EDTA solution in their presence, magnesium and strontium are partly titrated, and calcium is titrated with zinc. There is no interference from barium [*Industr. Chem.*, **31** (1955), 629].

Saline water irrigation in calcareous soils

WITH CONTINUOUS USE OF SALINE water for irrigation purposes, the chemical and physical properties and hence the fertility status of a soil may be markedly affected. This problem has been investigated at the Soil Science Department of the Hebrew University, Jerusalem, to clarify the mechanism of physical and chemical changes taking place in calcareous soils when irrigated with saline water and to study the interaction between the various factors.

The normal lime content of the soil studied varied between 24 and 50 per cent clay, comprised about half of the lime-free minerals. The amount of coarse sand and humus as well as the amount of soluble salts were negligible. Texturally they were medium to heavy loams. Percolation experiments were carried out using irrigation water of different degrees of salinity and distilled water alternately. Characteristic permeability curves were obtained and chemical changes were followed by analysing the percolate and the soil.

Contrary to general assumption, the large amounts of calcium carbonate present in the soils did not contribute sufficient amounts of calcium ions to the soil solution to prevent the normal exchange re-

action between the dissolved ions of the percolating saline water and the exchangeable bases of the clay mineral complex. The absorption of sodium ions manifested itself by the swelling of the soil and by a sharp drop in its permeability. This was especially evident when the free salts were leached out by distilled water, a condition obtaining during winter rains. Subsequent application of saline water to the still wet soil did not restore the initial good permeability, unless the swelled and dispersed clay again became aggregated. A change to suitable irrigation water is not sufficient to reaggregate the soil; on the other hand, the process is aided by the drying of the soil.

It is suggested that gypsum be applied regularly as a preventive soil conditioner on all soils where permanent irrigation with more or less saline water is carried out [*Bull. Res. Council. Israel*, **58** (1955), 83].

Ammonium persulphate production

THE OPTIMUM CONDITIONS FOR the formation of ammonium persulphate by the electrolysis of ammonium sulphate have been studied. From a theoretical point of view, anode current density should be high with respect to oxygen, and cathode current density low for hydrogen. Favourable conditions were achieved in this respect by using a platinum cathode, and keeping a surface ratio of 4:1 between anode and cathode, which could be increased to 5:1 at higher current densities.

The most favourable operating conditions for continuous electrolysis of ammonium bisulphate vary with current density: at a current density of 1.85 amp./sq. cm. the concentration of ammonium hydrogen sulphate should be 808-75 g./litre, the upper limit of the sp. gr. of the electrolytic being 1.42; at a current density of 1.15 amp./sq. cm., the ammonium bisulphate concentration should be between 820 and 855 g./litre.

The electrolysis of ammonium sulphate can also be carried out under batch conditions without stabilizers and without the use of a diaphragm. Current density is kept high, temperature is kept below 15°C. by continuous introduction of cooled electrolyte, and the persulphate formed at the anode is continuously removed. The process can be operated con-

tinuously in an apparatus consisting of three separate units: an electrolytic cell, the crystallizer and settler from which the clear electrolyte is withdrawn and cooled, and the saturator, into which fresh ammonium bisulphate is fed [*Industr. Chem.*, **31** (1955), 575].

Tinning of cast iron

CAST IRON IS DIFFICULT TO TIN by the hot-dipping process owing to the presence of graphite which can appear as outcrops or smears at the surface. Suitable preparative procedures aim at either removing surface graphite, or at covering it over with a readily tinned metal. A new method developed, the direct chloride method, has proved very successful for tinning grey cast irons and also Meehanite and spheroidal graphite irons.

The article to be tinned is blasted thoroughly with angular steel grit (70 mesh) and then degreased by trichlorethylene vapour method. If a very smooth surface is necessary, a water-barrelling operation may be carried out at this stage. The article is then immediately dipped in an aqueous flux made up of sodium chloride 6 lb., ammonium chloride 3 lb., hydrochloric acid 2 parts and water 10 gal. (100 lb.).

The piece is then lowered slowly into the first tinning pot, the surface of which is covered by a layer of flux at least one inch in thickness. The flux which contains zinc chloride 8 parts, sodium chloride 2 parts and ammonium chloride 1 part is kept in a freely ebullient condition by frequent additions of water. The temperature of the tin is maintained in the range 300°-320°C. The article is kept in the tin-pot for at least 5 min. before subsequent tinning manipulating operations are carried out [*Chem. Tr. J.*, **137** (1955), 1590].

Wallboard from coconut husk

DURABLE AND STRONG WALLBOARDS can be made from coconut husk shorts and coir dust by the following process. The unretted coconut husk, either fresh or dry, is fed to a defibrating machine and the bistile fibres separated from the other constituents of the husk. The latter are then made to pass through a rotary dryer and a wil- lowing machine to separate the long mattress fibres from the coir

dust and shorts. The loose, dry coir dust and shorts of 6 in. thickness pass through a board-forming machine where it is pressed and reduced to about 1 in. thickness in a continuous slab of preformed board. The board is cut to proper length and placed in a multiple hot plate hydraulic press for pressing into either soft or hard board, depending upon the pressure applied. The boards, which can be produced in any size and thickness without lamination, are smooth on both sides. They are inherently insect-proof, fire-retarding and water-repellent, and may be sawed, nailed, glued, and finished for flooring, sidings, ceiling and roofing [*Philippine agric. Engng. J.*, 5 (1954), 18].

Applications of molybdenum

A SYMPOSIUM ON INDUSTRIAL applications of molybdenum chemistry was held under the aegis of the Division of Industrial and Engineering Chemistry at the last meeting of the American Chemical Society, Cincinnati, Ohio. The papers presented cover the use of molybdenum as a catalyst, as a pigment, as a metal coating and as an alloying material for metals for use in the chemical industries [*Industrial & Engineering Chemistry*, 47 (1955), 1492-1516].

About 90 per cent of the total production of molybdenum is used in ferrous alloys, and metallic molybdenum and high molybdenum alloys, used principally in electrical applications, account for another 5 per cent. The rest covers all chemical uses.

Catalysts — Molybdenum is one of the most widely used catalytic elements, its estimated consumption in 1955 being 1,200,000 lb. As a transition element, molybdenum has the incomplete inner shell of electrons needed for catalytic activity. It forms a variety of compounds in all valence states with varying catalytic activities and selectivities. Most of these compounds are resistant to common catalyst poisons. Molybdenum compounds are used commercially to catalyze seven types of chemical reactions: oxidation, hydrogenation, dehydrogenation, isomerization, cyclization, chlorination and condensation. Promising results have also been obtained in the fields of dehydration, polymerization and alkylation. The principal commercial applications of molybdenum

catalysts today are the reforming of straight-run naphthas, desulphurization and upgrading of petroleum stocks, hydrogenation of coal and shale oil, oxidation of aromatics to acids, oxidation of alcohols to aldehydes, and chlorination of aromatic compounds.

Molybdenum is usually used in the form of oxides and sulphides and as molybdates. As molybdenum has six oxidation states, there is a tendency for oxidation or reduction of the catalyst taking place under operating conditions. This frequently has substantial effect on catalytic properties. Supports such as alumina-silica and activated charcoal increase greatly the effective surface area of molybdenum catalysts. Compounds of vanadium, iron, cobalt and nickel have been found to be important promoters. Mixed catalysts of molybdenum and other elements are often more active than molybdenum alone.

Inorganic pigments — The principal molybdenum containing inorganic pigment is molybdate orange. This pigment is deep reddish orange approaching light red in hue, and is characterized by brilliance, high tinctorial strength, very good opacity, good permanency and excellent application properties. Chemically, molybdate orange is a solid solution of lead chromate, lead molybdate and lead sulphate. The production of molybdate orange involves all the conventional techniques for the manufacture of chemical by precipitated pigments and presents some specialized problems. A metastable system, as well as a three-component system, is involved and suitable stabilizers must be used in the manufacture of the pigment to maintain its desirable properties.

A general manufacturing procedure is as follows: A solution of sodium chromate, sodium molybdate, and sodium sulphate is added to a lead nitrate solution at temperatures 15°-30°C. using efficient stirring and maintaining excess lead at the end of the addition. Stirring is continued till the desired colour develops; then a stabilizer, like alum, is added. It is then filtered, washed, dried and ground.

Molybdate orange pigments as a group have excellent brilliancy, strength and opacity. They find use in a wide variety of applications — paints, enamels, finishes

for farm tools and construction machinery, printing inks, plastics, floor coverings, papers, coated fabrics, and pigmented leather finishes. One of the new applications is in internally pigmented synthetic fibres, such as cellulose acetate and nylon. In addition to their use as prime colour pigments, molybdate oranges have considerable use in combination with organic reds. To meet the variety of applications and required properties, over 20 different molybdate orange pigments are available in the market.

Organic pigments — The principal use of molybdenum in organic pigments is in the form of the complex heteropoly acids, phosphomolybdic and phosphotungstomolybdic acids. These acids along with phosphotungstic acid constitute a group of precipitating agents for several classes of basic and other dyestuffs that produce three valuable related class of pigments known as phosphomolybdic acid (PMA) colours, phosphotungstic acid (PTA) colours, and phosphotungstomolybdic acid (PTMA) colours. The preparation of a pigment from a dyestuff by this method results in a product lower than the original material in brilliance and strength yet very satisfactory for a pigment and with much improved light fastness and other related properties.

PTA pigments are clearer and brighter than PMA colour. PTMA colours are likewise cleaner than the corresponding PMA products. PTMA colours are superior in light fastness to either PMA or PTA colours alone.

The principal uses for PMA pigments, as well as PTA colours, are in the field of printing inks. Other important applications include tinting and shading of white paper, in water colours, show card inks, wax crayons, manufacture of coloured paper and enamels for children's toys.

Metal coatings — There are two ways in which molybdenum is used in the formation of protective or decorative coatings on metal. In the first, generally known as molyblacks, molybdenum is the principal constituent of the coating. Such coatings are often applied electrolytically. In the second type, molybdenum acts as an accelerator or promoter for coatings. The iron phosphate-type pre-paint treatments belong to this class.

Molyblack coatings are used commercially, particularly for blackening zinc, electro-deposited zinc, and zinc-base alloys. They may be deposited not only electrolytically but in certain cases also by immersion. On zinc surfaces they give surprisingly good outdoor weathering and form excellent bases for air-dry painting, lacquering or enamelling.

In an improved patented process for zinc plating, a mirror-like finish is obtained using a zinc cyanide bath containing a substantial proportion of molybdenum as a soluble compound. The deposits are not of zinc but alloys of zinc with small amounts of the alloying metal. Another patent claims the rust-proofing of iron and steel surfaces by treatment with a boiling dilute solution of a metaphosphate of molybdenum or tungsten in combination with a metaphosphate of iron. Another patent describes a process for the rust protection of ferrous metals by treatment with an aqueous solution containing 5-10 per cent of molybdic anhydride, 2-10 per cent sodium acid sulphate and 80-93 per cent sodium sulphate. The process can be carried out at room temperature.

Materials for I.C. engines

UNDER A RESEARCH SCHEME sponsored by the Council of Scientific & Industrial Research, investigations were undertaken at the Indian Institute of Science, Bangalore, on the various aspects of the development of heavy duty parts of internal combustion engines. The results have now been compiled and issued in the form of a report.

The report is divided into three parts.

Part I — Materials for internal combustion engines and their influence on the industry in India by Prof. H. A. Havemann and Shri M. R. Raghavan gives a comprehensive survey of the raw materials used and the methods for producing I.C. engine parts. The report reviews the operational conditions encountered by the major components and the relative merits of different methods of production employed. The economic and technical aspects of the design of different types of engines are discussed and facilities for the production of components from indigenous materials are described.

From the information collected regarding the facilities for production of materials as well as fabrication of engine components and availability of raw materials, it seems practicable as well as profitable for India to have its own internal combustion engine industry to manufacture its requirements. Tentative recommendations have been made regarding the use of certain materials for the manufacture of components. In order to determine the relative merits of the materials it is proposed to test the components made from these materials in specially designed testing machines as well as in actual engines.

It is suggested that research work should be undertaken first with the object of elimination or, at least reduction of scarce materials like nickel in the production of materials needed by the industry. Substitute materials so developed should mostly consist of indigenous raw materials. Secondly such qualities of the raw materials which affect the design of components should be studied, and finally, designs should be evolved to match the material situation as well as the available means of special treatment of materials such as machining and finish. Lastly, the design should take into account interchangeability and ease of replacement of unserviceable components so that maintenance and servicing requirements are met with such designs.

Part II — Cast iron as crankshaft material by Prof. H. A. Havemann, Shri R. G. Narayanamurthy and Shri T. R. Raghuthama Rao reviews the various methods of manufacture of crankshafts in relation to the facilities available in India. The influence of various mechanical properties on the suitability of a crankshaft material are discussed, and the effects of various design features especially on the bending strength of cast crankshafts are outlined.

It is suggested that a centralized foundry should be installed in each area for the manufacture of high duty parts including crankshafts. This provision would ensure economy and allow specialization in those complex procedures necessary to guarantee the highest quality. A supply of uniform quality raw materials is essential for improvement of the final product. Grey cast iron is produced by a large number of

foundries and some of them can supply high duty cast iron as per specifications.

Part III — Experiments with cast iron crankshafts by Prof. H. A. Havemann, Shri R. G. Narayanamurthy and Shri T. R. Raghuthama Rao is concerned with the influence of various design features of cast crankshafts in respect of their operational reliability.

Experiments conducted at the Indian Institute of Science have indicated that certain cast iron materials are well suited for crankshafts of high speed diesel engines, either as such or after some adaptation in design or material treatment. Spheroidal graphite cast iron has proved to be an effective cast crankshaft material in replacement of forged steel shafts. Further work is necessary to establish the suitability of using acicular cast iron and Meehanite.

Detailed investigations are necessary to ascertain the effect of variations in chemical composition, process of production and treatment of the materials of construction on the general qualities of machining and final operational behaviour of the components made out of them as reflected in the values of bonding and fatigue strength. The geometry of crankshaft as such exerts considerable influence on the suitability of a given material for it and this problem has been recommended for further investigation.

Export of radio-isotopes

SEVENTEEN EXPERTS FROM 13 countries met on 23 and 24 June 1955 at Unesco Headquarters in Paris under the Chairmanship of Prof. Pierre Auger, Director of the Department of Natural Sciences, to discuss the problems of distribution, transportation and utilization of radio-isotopes. The following six recommendations to the Director General of Unesco were unanimously adopted by the experts: (1) to collect information on all the existing national and international regulations concerning safety measures to be taken for the transport of radio-isotopes and to prepare a set of draft regulations for international acceptance and use; (2) to undertake the study of a system for the rapid customs clearance of radio-isotopes; (3) to take all appro-

appropriate steps to reduce allocation and sales formalities to a minimum; (4) to organize informative meetings on problems involved in the distribution, transportation and utilization of radio-isotopes, and to publish an international bulletin giving information on new applications and procedures involving radio-isotopes; (5) to undertake a study of regulations or codes of procedure relating to waste disposal and the serious attendant dangers, and to prepare for international action in this field; and (6) to collect information on the use of labelled molecules as a research technique, and to study and propose methods of achieving closer international collaboration in the field of production and use of tracer molecules.

Laboratory research in antibiotics

A RESEARCH LABORATORY BUILT and equipped at a cost of c. Rs. 15 lakhs has been added on to the Pimpri Penicillin Factory to provide facilities for research and training in the field of antibiotics. The research centre has been attached to Pimpri factory with a view to keep the research workers in touch with practical aspects of plant operation and for the expeditious application of results of research for the improvement of processes and the products.

The building is a two-floor L-shaped structure with a floor area of c. 24,000 sq. ft. There are a number of air-conditioned rooms in which temperatures are maintained constant at 37°, 30°, 24°, 5° and 4°C. There are at present the departments of Mycology, Bacteriology, Biochemistry, Organic Chemistry and Physical Chemistry. The bias for research is on antibiotics from all aspects.

The following problems are being tackled in the laboratory at present: (1) Evolution of strains of *P. chrysogenum* by mutation, selection or other methods with a view to obtaining a strain which can produce larger quantities of penicillin; (2) study of the optimum conditions for the production of maximum amounts of penicillin; (3) study of the metabolism of the mould as well as the substrates added to the medium in the course of fermentation; (4) study of biosynthesis of penicillin by

the mould under the conditions of fermentation; (5) study of the effect of agitation and aeration on the oxygen transfer to the medium and mycelium; (6) preparation of new salts of penicillin and studying the rate of excretion and maintenance of therapeutic concentrations in the blood stream of animals and later clinically; and (7) screening of indigenous microorganisms for the production of antibiotics.

Rubber research and development

THE ESTABLISHMENT OF A RUBBER Research Association and a Central Research Institute with one or two zonal research centres was decided at a meeting of the representatives of the Association of Rubber Manufacturers, Calcutta, and Indian Rubber Industries Association, Bombay, the Ministry of Commerce and Industry, Indian Rubber Board and the National Chemical Laboratory, Poona. The meeting, which was held in Delhi during January 1956, was presided by Prof. M. S. Thacker, Director, Scientific & Industrial Research.

It was also decided at the meeting that a cess on the consumption of rubber, both indigenous and imported, should be levied at Rs. 8 per ton and the collection should be made available for meeting expenditure of the proposed research association. The association will have a 15-member committee with the Director, Scientific & Industrial Research, as Chairman.

Iron ore deposits in Orissa

NEARLY 27 MILLION TONS OF IRON ore are estimated to occur in the Tomaka and Kansa areas of Cuttack district in Orissa, according to a preliminary investigation carried out by the Geological Survey of India. Another 2-3 lakh tons of iron ore is also expected to be available from the deposits near Tungaisuni and Bodasil in the same district. Besides, about 20,000 tons of fairly high grade or occur near Kharipadia, 5 miles south of Sukinda (P.I.B.).

Grading lemongrass oil

A NEW SCHEME FOR COMPULSORY grading and marking of lemongrass oil according to Agmark grades has come into operation

from 1 January 1956. The specifications notified in the provisions of the Agricultural Produce (Grading and Marking) Act, 1937, have been evolved in consultation with the Indian Standards Institution.

Exports of lemongrass oil will henceforward be allowed from India only under the Agmark grading certificate issued by the Essential Oils Grading Laboratory set up in wharf area of Cochin Port. The specific mention in the grading certificate of the percentage of citral will ensure better prices for the superior grade of lemongrass oil [*Indian Tr. J.*, 195 (1956), 8].

Indian Standards

Chemical Analysis of Copper (IS: 440-1955) — This standard covers the method of sampling and test procedures for the determination of copper, lead, tin, nickel, iron, arsenic, antimony, bismuth, selenium, tellurium and oxygen in various grades of copper used in industry.

Chemical Analysis of Brasses and Bronzes (IS: 441-1955) — This standard covers methods of sampling and chemical analysis of various grades of brasses and bronzes used in different industries. The methods described deal with the determination of copper, lead, tin, manganese, phosphorus, nickel, iron, silicon, aluminium, zinc, arsenic and antimony.

Indian Standard Sand (IS: 650-1955) — The standard sand shall be of quartz, of light grey or whitish variety and shall be free from silt. The sand grain shall be angular, the shape of the grains approximating the spherical form; elongated and flattened grains being present to a very small extent. The standard sand shall pass through 15 sieve 85 (842 microns) and not more than 10 per cent by weight shall pass through 15 sieve 60 (592 microns).

The standard sand shall be free from organic impurities. The loss of weight on extraction with hot hydrochloric acid of sp. gr. 1.16 (conforming to IS: 265-1950) shall not be more than 0.25 per cent.

Sheet Linoleum (IS: 653-1955) — This standard covers the requirements and the methods of test for plain, moire, jaspe and marble sheet linoleum used as floor coverings.

Proceedings of the Atoms for Peace Conference

A COMPLETE SURVEY OF THE status of development of nuclear power in the world for peaceful purposes is being published by the United Nations in 16 volumes of *Proceedings of the International Conference on the Peaceful Uses of Atomic Energy*. The series will constitute the only official and unabridged report of the proceedings of the international conference held in Geneva in August 1955. It will comprise all the papers submitted to the conference (about 1,050), together with an edited record of the discussions concerning each paper.

Volume III, entitled *Power Reactors* (III, edition), the first of the sixteen to be printed, has already been published. This 400-page book contains 30 papers presented to the Geneva conference on the peaceful uses of atomic energy and verbatim records of six sessions of the conference. It describes reactors now operating and plans for future reactors that will produce usable power in the form of heat or electricity. The types of fuels and how they will be used are also considered in this volume.

The following is a complete listing of the 16 volumes which comprise this publication: Vol. 1—*The World's Requirements for Energy: The Role of Nuclear Power* (\$ 8.00), Vol. 2—*Physics, Research Reactors* (\$ 8.00), Vol. 3—*Power Reactors* (\$ 7.50), Vol. 4—*Cross-sections Important to Reactor Design* (\$ 7.50), Vol. 5—*Physics of Reactor Design* (\$ 9.00), Vol. 6—*Geology of Uranium and Thorium* (\$ 9.00), Vol. 7—*Nuclear Chemistry and the Effects of Irradiation* (\$ 10.00), Vol. 8—*Production Technology of the Materials Used for Nuclear Energy* (\$ 10.00), Vol. 9—*Reactor Technology and Chemical Processing* (\$ 10.00), Vol. 10—*Radioactive Isotopes and Nuclear Radiations in Medicine* (\$ 8.00), Vol. 11—*Biological Effects of Radiation* (\$ 8.00), Vol. 12—*Radioactive Isotopes and Ionizing Radiations in Agriculture, Physiology and Biochemistry* (\$ 9.00), Vol. 13—*Legal, Administrative, Health and Safety Aspects of Large-scale Use of Nuclear Energy* (\$ 7.00), Vol. 14—*General Aspects of the Use of Radioactive Isotopes: Dosimetry* (\$ 6.50), Vol. 15—*Applications of Radioactive Isotope and Fission Pro-*

ducts in Research and Industry (\$ 7.50), and Vol. 16—*Record of the Conference* (\$ 5.00).

The full series (\$ 130.00), or individual volumes, may be ordered from United Nations official sales agents in various countries.

National Building Organization Quarterly Journal

THE NATIONAL BUILDING ORGANIZATION, a semi-autonomous body set up by the Ministry of Works, Housing and Supply, Government of India, in 1954, recognizing the necessity of a comprehensive national approach to all aspects of housing, has started a new quarterly journal, the first issue of which was published in December 1955 (Manager of Publications, Government of India, Delhi; price Rs. 2 or 3s.). The journal will publish in addition to contributed articles on various aspects of building construction, design and technique, abstracts of technical journals and research reports received by the organization, building construction and building materials statistics. The first issue includes the following articles: Building materials—the weakest link; studies on the effect of subgrade soils containing sodium sulphate on building structures constructed on subgrade; economical roof truss designs through modern timber engineering; and pozzolonic activity of clays.

Career and professional status of research worker

THE UNESCO SECRETARIAT HAS recently published a report entitled *The Career and Professional Status of the Research Worker*. The report is divided into four parts, relating respectively to a definition of the career of the 'research worker', the latter's place in the organization of scientific research and in society, problems connected with recognition of the professional status of the research worker, and, lastly, the most favourable 'research climate'.

Bulletin of the India Section of the Electrochemical Society

THE SOCIETY HAS BROUGHT OUT A special number of the bulletin [4 (1955), No. 4] in connection with the Aluminium Centenary.

The Technical Section of this issue contains the following articles: The history of aluminium; Bauxite resources of India; A perspective of the Indian aluminium industry; Aluminium in the consumer industries in India; Aluminium in telecommunication industry; some aspects of aluminium research in India; Aluminium in nuclear engineering; competition between steel and aluminium; Recent books on aluminium; and Recent literature on aluminium.

Fats and Oils Abstract Service

BEGINNING WITH THE JANUARY 1956 issue the Fats and Oils Abstract Service, published by Interscience Publishers Inc., New York, is being edited by Dr. W. O. Lundberg. The policy of the Abstract Service is to bring to its readers up-to-date, concise coverage of the world literature in the field of fats and oils. There will be no change in the form and indexing of the abstracts, but there may be some changes in emphasis, reflecting recent industrial and scientific trends. In the detergent field complete coverage will be maintained of papers dealing with fundamentals, but there will be less emphasis on specialized industrial and commercial applications. Greater number of papers will be covered in the fields of nutritional qualities of edible fat and oil products and of new industrial products from inedible fats and oils.

Announcements

■ *The First Regional Conference on Electron Microscopy in Asia and Oceania* will be held at Tokyo after September 1956. It is proposed to organize a Regional Committee consisting of the representatives of each national committee on this occasion. The Society of Electron Microscopy, Japan, expects to constitute the Regional Committee with a chairman and an executive committee selected from the representatives of Australia, India, New Zealand and Japan.

■ *The International Conference on Large Electric Systems* (C.I.G.R.E.) will hold its sixteenth convention from 30 May to 9 June 1956 in Paris. One hundred and sixteen papers, in English or French, will be read and discussed during the

convention. The subjects to be discussed are: Generation, transformation and cutting off of current; construction, insulation and maintenance of overhead and underground lines; operation, interconnection and protection of large high voltage networks.

There is an Indian National Committee for the C.I.G.R.E. of which Prof. M. S. Thacker is the Chairman.

■ *The Geological, Mining and Metallurgical Society of India* — The following office-bearers have been elected for the year 1956: *President*, Dr. C. S. Pichamuthu (Bangalore); *Vice-Presidents*, Mr. Jayantilal Ojha (Calcutta) and Mr. W. B. Metre (Digboi); *Joint Secretaries*, Prof. N. N. Chatterjee (Calcutta) and Prof. N. L. Sharma (Dhanbad); *Treasurer*, Prof. P. C. Datta (Calcutta).

■ *Indian Botanical Society* — The following office-bearers have been elected for the year 1956: *President*, Dr. A. C. Joshi (Chandigarh); *Vice-Presidents*, Prof. P. Maheshwari (Delhi) and Rev. Fr. H. Santapau (Bombay); *Secretary*, Prof. J. Venkateswarlu (Waltair); *Chief Editor, Business Manager and Treasurer*, Prof. T. S. Sadasivan (Madras).

■ *Award of Doctorate Degrees* — The following persons have recently been awarded the Ph.D. Degree by the University of Delhi: V. B. Mahesh (*A study of naturally occurring and synthetic flavanone derivatives*); Inderjit Singh (*Radiation effects and P ion showers*); R. Narayana (*Morphological and embryological studies in the family Loranthaceae-Loranthoidae*); O. P. Mittal (*A study of the structure and synthesis of oxygen ring compounds present in lichen and other plant sources*); B. Bhau-mik (*On the nature of primary cosmic rays from the study of east west asymmetry and the fine structure*).

H. S. Pareek (*The petrological study of Talcher coals*) has recently been awarded the Ph.D. Degree by the Aligarh Muslim University.

INSTRUMENTS AND APPLIANCES

EQUIPMENT FOR SMALL-SCALE APPLICATIONS

Equipment manufacturers in U.S.A. are now producing small-

size models of their standard process equipment, designed to handle a wide range of materials in the laboratory, pilot plant or in small-scale production in units. Such apparatus is made of stainless steel construction so that it may be used under a variety of conditions. The following equipment are described to illustrate the new trend.

The Turba-film evaporator introduced by Rodney Hunt Machine Co. has a heat transfer area of 1 sq. ft. and is designed for use with heating medium up to 250 lb./sq. in. gauge and 700°C. A variable speed drive permits the rotor speed to be changed as desired for various process studies. It uses the same agitated film method of operation as Rodney Hunt's larger equipment.

A pilot-filter specially designed by American Plant Equipment Co. for carrying out process studies is a small pressure filter which can be used for gathering data on filtering rates and filter cake characteristics and for investigating the effects of differential filtering pressures and throughput on flow rates. The filter is portable and can be set up in the plant to filter liquids as they are processed. One, two or three vertical filter leaves can be placed in use: with three identical leaves spaced at 1½ in. centre a filter area of 1 sq. ft. is available. Maximum working pressure is 80 lb./sq. in.

A small, light-weight mill for product development, laboratory control work and standardization of production formulas has been developed by Morehouse Industries of Los Angeles. The mill is equipped with high-speed aluminium oxide grinding disks and has a throughput of 1-3 gal./hr.

A laboratory mill for producing test and pilot dispersions was recently introduced by Kinetic Dispersion Corp., Buffalo. A solid agglomerate in a liquid carrier is accelerated rapidly by a rotor within a slotted cylindrical stator. The solids are dispersed by impingement against the slots, so that operation does not rely on shear effects or the maintenance of close tolerances between moving parts under pressure. The capacity of the unit is ¼ to ½ gal.

Bethlehem Foundry & Machine Co., Bethlehem, Pa., have designed a small heat transfer system which is said to approxi-

mate plant conditions in a pilot plant unit. The system employs Du Pont's Hi-Tec eutectic salt as a circulating medium to attain temperatures from 650° to 1,000°F. without pressure. The heat transfer salt is heated by immersion electrical heaters which are suspended individually from the tank cover for easy removal or replacement. A cast steel centrifugal pump mounted on the tank cover circulates the hot salt. Available sizes have heat outputs ranging from 10,000 to 250,000 B.t.u./hr. [*Industr. Engng. Chem.*, 47 (1955), No. 9, Part 1, 58A].

PNEUMATIC FLATNESS TESTER

The Metrology Division of the National Physical Laboratory, London, has devised a pneumatic flatness tester for measuring the flatness of photographic plates without exposing it to light. The sensitive plate is placed emulsion downwards on three balls which are outside the picture area and thus do not damage the emulsion. Six jets of air are blown upwards against the sensitive emulsion at a pressure of less than ¼ lb./sq. in. and the pressure variations are shown by changes in the level of coloured water in six vertical glass columns calibrated in microns. The magnification of the apparatus, i.e. the extent of change in water level in the glass column due to a change in the distance between the jet and the plate, is 2,500. The gauge works off a normal factory air supply through a pressure regulating valve so that its readings are not affected by changes of supply air pressure. Its readings are not affected by temperature also. To test a plate for flatness, the operator just places it on the three balls and looks at the levels in the tubes.

The gauge can also be adapted for testing the contours of complicated shapes by arranging jets at different heights to blow at points where the surface is to be explored (D.S.I.R. Press Release No. 3581-1955).

MINISONIC HOMOGENIZER

Minisonic, a new self-contained homogenizer for laboratory and small batch production, employs the principle of ultrasonic cavitation for emulsification and homogenization. The device developed by Ultrasonics Ltd., Otley, Yorks,

requires no pre-mix vessels or ancillary plant. A definite quantity of the continuous phase of an emulsion is introduced into the outer funnel and recirculated via the vibrating element while the disperse phase is taken up from the inner funnel at regulated speed. The progress of emulsification can be observed through the transparent P.V.C. hose and the finished emulsion is discharged by the same flexible hose. Pre-mixed emulsions are processed by using the outer funnel without the inner one.

Emulsification and dispersion are effected by the blade which vibrates at its natural frequency in the liquid stream leaving the jet form. Use of this homogenizer is reported to result in far faster and more effective preparation of emulsion than by the conventional means. It is often possible to reduce the content of surface-active agents, and one gallon of emulsion can be made within a minute or two. No aeration of the emulsion occurs as it forms in a completely closed system [*Chem. Prod.*, **18** (1955), 472].

AUTOMATIC WIRING MACHINE

The Bell Telephone Laboratories have developed an ambidextrous machine that can automatically wire complex electrical apparatus. The machine uses a process for making solderless wrapped connections, also developed at Bell Laboratories. Connections are made by automatically wrapping six turns of solid conductor wire around a rectangular terminal. The high wrapping tension provides an airtight, corrosion-resistant contact between the wire and terminal at numerous points.

The experimental machine uses two rotating spindles. The wire is fed directly from a large spool. One spindle pulls the wire, in an inverted L-shaped movement, to a connecting terminal. At the same time the wire is cut to the correct length at the second spindle. The spindles remove a bit of insulation from each end of the wire as they whip the bare wire ends around the terminals. This produces a pressure of about 15,000 lb./sq. in. at each contacting area. Following their punched tape instructions, the spindles then pick up the supply wire from the spool and move to the next electrical connection where the process is repeated. Machine wiring eli-

minates the need for preparing, storing and handling many short pieces of wire [*J. Franklin Inst.*, **260** (1955), 349].

AUTOMATIC VELOCIMETER

The National Bureau of Standards, U.S.A., has developed an instrument that automatically measures the speed of sound in the sea to depths of *c.* 300 ft. and plots the result as a function of depth or time. Because of its high accuracy and almost instantaneous response, the velocimeter is expected to be a useful addition to underwater signalling and detecting apparatus.

The NBS velocimeter consists of a pair of piezoelectric transducers of polarized barium-calcium-lead titanate and a reflector, mounted to form a sound path of fixed length. The sending transducer is connected to a pulse generator, and the receiving transducer provides the input for a high-gain pulse-shaping amplifier. The amplifier output retriggers the pulse generator, which then applies another pulse to the sender. The sender in turn produces in the water a sound pulse to actuate the receiver. Thus the system continually regenerates a sound pulse whose repetition rate, or frequency, depends on the time it takes the pulse to move through water. Since the path length is fixed, the frequency depends only on the speed of sound through the water and on the circuit delays. Any variations in sound velocity are recorded as variations in the operating frequency of the velocimeter [*J. Franklin Inst.*, **260** (1955), 320].

MILATOMIC FILTER

The Atomic Instrument Co., Cambridge, Mass., are the distributors for the Milatomic filter which is especially suitable for use in collection and assay of radioactive precipitates. The Milatomic filter has a high degree of retention, and is capable of separating quantitatively extremely fine particles of the order of 1-20 microns from liquid vehicles. This material filters microscopic and sub-microscopic particles as a surface phenomenon or by screening action, in which retention is defined by pores of controlled dimensions. There are 35 million pores, nearly molecular in size, to the square

centimeter. The filter material is 85-87 per cent porous.

The cellulose filter has been widely used in programmes to study laboratory exhaust duct and reactor stack discharge. The filter has application also in monitoring critical areas in or adjacent to raw materials processing plants where treating of ores for nuclear purpose may produce a dangerous concentration of radioactive dust. Another reported use of the filter in atomic energy is in studies of the effects of radiation on biological organisms. The filter has also been used in experimental studies of volume reduction.

BIBLIOGRAPHICAL LIST OF PAPERS PUBLISHED IN SOME INDIAN SCIENTIFIC PERIODICALS, JANUARY 1956

CHEMISTRY

Analytical

BENEGAL, U. K., BOSE, S. K. & GHOSH, A. N., Zinc oxide in composite pigments. A rapid method of estimation, *ISI Bull.*, **8** (1956), 3

BOSE, A. N., A simple microbiological assay method for vitamin B₁₂ in liver extracts, *Indian J. Pharm.*, **17** (1955), 203

LAKSHMAN RAO, B. R. & PATEL, C. C., Spectrophotometric estimation of thorium by murexide, *Proc. Indian Acad. Sci.*, **42A** (1955), 317

MEENAKSHISUNDARAM, T. K. & SRIKANTAN, B. S., A note on the conditions for obtaining chromatograms of cations on alumina for estimation from the dimensions of zone, *J. Indian chem. Soc.*, **32** (1955), 801

MEHTA, S. C. & DAKSHINAMURTI, C., Spectrographic analysis of soils in the copper arc, *Curr. Sci.*, **24** (1955), 409

PADMANABHAN, C. V. & SUNDARAM, S., A new method for the estimation of nitrogen in cellulose nitrate, *Curr. Sci.*, **24** (1955), 403

PAUL, R. C. & APAR SINGH, Potassium metaperiodate as a volumetric reagent. Part VI. Bromometric method, *J. Indian chem. Soc.*, **32** (1955), 736

RAO, N. A. N. & WADHWANI, T. K., Quantitative estimation of amino-acids by circular paper chromatography, *J. Indian Inst. Sci.*, **37A** (1955), 130

Biological

- BANERJEE, R. M., DHINGRA, P. K. & DAS, N. B., Effect of vitamin B₁₂ and methionine on the biological value of pulse proteins, *Sci. & Cult.*, **21** (1956), 384
- BAPAT, D. S. & VENKATARAMAN, K., Potential anti-tubercular compounds. Part III. 7-Amino-flavone, *Proc. Indian Acad. Sci.*, **42A** (1955), 336
- BOSE, B. C., VIJAYVARGI, R. & TRIVEDI, C. P., A preliminary phytochemical study of *Pterocarpus marsupium* Roxb., *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 143
- COHLY, M. A., An electrophoretic study of bovine plasma albumin-methyl orange complex at 25°C., *J. Indian Inst. Sci.*, **37A** (1955), 89
- DAS GUPTA, A. & NANDI, P. N., Paper chromatographic study of the amino acid contents of some higher fungi, *Sci. & Cult.*, **21** (1956), 385
- DATTA, S. K., Analytical aspects of some organic compounds. Part II. Determination of palladium by *p*-aminosalicylic acid, *J. Indian chem. Soc.*, **32** (1955), 785
- GHOSH, T. N. & DUTTA, S., Search for new antispasmodics. Part VII, *J. Indian chem. Soc.*, **32** (1955), 791
- MITRA, S. N. & CHATTERJI, R. K., Alcohol acidity as a measure of soundness of *ata* (whole meal flour), *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 139
- MITRA, S. N., Utility of the "albuminoid ammonia" value in the analysis of foodstuffs. Part II. Analysis of fruit juices, squashes and cordials, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 164
- PILLAI, N. C., VAIDYANATHAN, C. S. & GIRI, K. V., A blood anticoagulant factor from the latex of *Carica papaya*. Part I. Purification and general properties, *Proc. Indian Acad. Sci.*, **42B** (1955), 316
- VENKOB RAO, S., RAMACHANDRAN, K. & ZAHEER, S. H., Studies on the seed cake of *Annona squamosa* (sitaphal). Part I. The nitrogenous constituents of the seed cake, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 133

Inorganic

- AZIM, S. M. A. & REHMAN, A., Potentiometric studies in oxida-

tion-reduction reactions: Oxidation with potassium iodate, *J. Indian chem. Soc.*, **32** (1955), 708

- JAIN, T. C., Decomposition of potassium persulphate in presence of *d*-mannitol, *J. Indian chem. Soc.*, **32** (1955), 728
- KAIMAL, K. G. & BHATTACHARYA, A. K., Formation of complex compounds between cadmium chloride and ammonium chloride, *Curr. Sci.*, **24** (1955), 414
- KHARKAR, D. P. & PATEL, C. C., Peroxide of titanium, *Curr. Sci.*, **24** (1955), 413
- MEHROTRA, R. G., Reaction of the alkoxides of silicon, titanium and zirconium with hydrogen bromide, *J. Indian chem. Soc.*, **32** (1955), 759
- MITRA, G. & RAY, A., Fluochlorates, *Sci. & Cult.*, **21** (1956), 379
- SARJU PRASAD & SHARMA, P. D., On the formation of compounds in organic solvents. Part I. Reaction between silver iodide and iodides of mercury, cadmium and zinc, *J. Indian chem. Soc.*, **32** (1955), 705

Organic

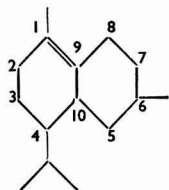
- ALEYKUTTY, (Miss) A. A. & BALIAH, V., The Friedel-Crafts reaction of acenaphthene and fluorene with arylsulphonyl chlorides, *J. Indian chem. Soc.*, **32** (1955), 702
- ALEYKUTTY, (Miss) A. A. & BALIAH, V., The Fries rearrangement of 4-methyl-7-coumarinyl benzenesulphonate, *J. Indian chem. Soc.*, **32** (1955), 773
- BANDYOPADHYAY, H. N., Horn plastics. Part III. Effect of phenols, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 148
- BANDYOPADHYAY, H. N., Distance between acidic and basic side chains in horn keratin, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 174
- BHARGAVA, P. N. & GOSWAMI, G. C., Studies on 2-*m*-tolylimino 3-*m*-tolyl-4-thiazolidone, *J. Indian chem. Soc.*, **32** (1955), 763
- BHARGAVA, P. N. & CHITEYYA, B., A note on 2-*p*-tolylimino 3-*p*-tolyl-4-thiazolidone, *J. Indian chem. Soc.*, **32** (1955), 797
- BHATTACHARYYA, N. K., Friedel-Crafts reaction involving unsaturated ketones and esters. Part IV. The study of the Friedel-Crafts reaction between methylheptenone and toluene, *J. Indian chem. Soc.*, **32** (1955), 711
- DASGUPTA, S. & BHOLA NATH, A study of infra-red absorption spectra of staphisine and a new alkaloid, *J. Indian chem. Soc.*, **32** (1955), 767
- DUTTA, P. C. & GHOSH, N. R., Sesquiterpenes and related substances. Part III. Synthetic studies on santonin, *J. Indian chem. Soc.*, **32** (1955), 741
- GHOSH, D. K., New evidence for the preponderance of the cis form in orthochlorophenol molecule, *Indian J. Phys.*, **29** (1955), 450
- GHOSH, T. N. & DUTTA, S., On the synthesis of Δ^1 -pyrroline derivatives. Part I, *J. Indian chem. Soc.*, **32** (1955), 719
- GHOSH, T. N. & DUTTA, S., *iso*-Quinoline derivatives. Part II, *J. Indian chem. Soc.*, **32** (1955), 755
- GUHA, S. K., CHATTERJEA, J. N. & SINHA, A. K., Indigoid vat dyes of the isatin series. Part IX. 3-Indole-2'-(4'-chloro)thionaphthene-indigos, *J. Indian chem. Soc.*, **32** (1955), 777
- KASTURI, T. R. & IYER, B. H., Fixed oil from *Elettaria cardamomum* seeds, *J. Indian Inst. Sci.*, **37A** (1955), 106
- KRISHNAN, M., Heterocyclic compounds. Part VI. Synthesis of substituted pyrido-(1, 2a)-pyrimidine-2-ones, *Proc. Indian Acad. Sci.*, **42A** (1955), 289
- MEHTA, T. N. & KOKATNUR, M. G., Urea adducts of fatty acids. Part VI. Component fatty acids of coconut oil, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 158
- MITRA, S. N. & ROY, S. C., Detection of cane sugar in milk and its products, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 168
- MOHAPATRA, G. N. & ROUT, M. K., Mercurated derivatives of 2-arylimino 4-thiazolidones, *J. Indian chem. Soc.*, **32** (1955), 715
- PATEL, S. R. & NARGUND, K. S., Synthesis in acridine series. Part II, *J. Indian chem. Soc.*, **32** (1955), 770
- RANGASWAMI, S., SANKARASUBRAMANIAN, S. & VENKATA RAO, E., Isolation of β -acetyl-digoxin from the leaves of *Digitalis lanata* Ehrh. grown in Kashmir, *Indian J. Pharm.*, **17** (1955), 253
- SOMASEKHAR RAO, A. & MUTHANA, M. S., Synthesis of 1-ethyl and 5-ethyl azulenes, *J. Indian Inst. Sci.*, **37A** (1955), 79

- SOMASEKHARA, S. & PHADKE, R., Synthesis of fused heterocyclics. Part I, *J. Indian Inst. Sci.*, **37A** (1955), 120
- VIG, O. P., KESSAR, S. V., KUBBA, V. P. & MUKHERJI, S. M., Polynuclear aromatic hydrocarbons. Part I. A new route to anthracene and 1:2-benzanthracene derivatives, *J. Indian Chem. Soc.*, **32** (1955), 697
- Physical**
- CHATTERJEE, B., Equation for the total potential of clay membrane electrodes, *J. Indian Chem. Soc.*, **32** (1955), 739
- DESHPANDE, P. K. & BHAT, G. N., Bubble pick-up studies with alumina, *J. Indian Inst. Sci.*, **37A** (1955), 141
- KATTI, P. K. & RUSTGI, O. P., A note on the boiling points of regular solutions, *Curr. Sci.*, **24** (1955), 406
- MITRA, D. K. & CHATTERJEE, B., Clay membrane electrodes for the measurement of zinc, manganese and cobalt ion activities, *J. Indian Chem. Soc.*, **32** (1955), 751
- SHUKLA, R. P. & BHATNAGAR, R. P., Kinetics of cation exchange reaction in solvents other than water. Part II. Effect of water on exchange of copper ion on Amberlite IRC-50, *J. Indian Chem. Soc.*, **32** (1955), 782
- TALATI, A. M., A note on Gibling's corrections, *J. Indian Chem. Soc.*, **32** (1955), 799
- ENGINEERING**
- CADAMBE, V., KAUL, R. K. & TEWARI, S. G., Flexure of thin elastic plates under specified edge tractions, *Indian J. Phys.*, **29** (1955), 403
- CHADDA, L. R. & HEM RAJ, Role of detrimental salts in soil stabilization with and without cement—The effect of sodium carbonate, *Indian Concr. J.*, **29** (1955), 401
- HAVEMANN, H. A., Development of a compression apparatus and studies on heat transfer and combustion of rapidly compressed and oscillating gases, *J. Indian Inst. Sci.*, **37B** (1955), 121
- JAYARAM, B. N., Derivation of constants of a n -unit cascade transformer, *J. Indian Inst. Sci.*, **37B** (1955), 162
- RAMA RAO, B. V., Direct determination of slopes and deflections of beams by cantilever analysis, *Indian Concr. J.*, **29** (1955), 404
- RIDEOUT, V. C. & TUNG, T. P., The bandpass distributed amplifier, *J. Indian Inst. Sci.*, **37B** (1955), 138
- ROY, J. M., Correlation between noon f_oF_2 and sunspot number, *J. Instn. Telecomm. Engrs.*, **2** (1955), 45
- GEOLOGY**
- BHAGWAN DASS, A note on the metamorphic faces of the epidiorites in the vicinity of Gaya, *Sci. & Cult.*, **21** (1956), 370
- MAHADEVAN, C. & SUBBA RAO, M., Marine sediments off Kalin-gapatam on the east coast of India, *Curr. Sci.*, **24** (1955), 412
- MOOKHERJEE, A., Manganiferous micas of Madhya Pradesh and their origin, *Sci. & Cult.*, **21** (1956), 380
- SADASIVAIAH, M. S. & AGRAWAL, Y. K., Origin of indialite (cordierite) bearing and other vitrophyric and hornfelsic rocks, *Curr. Sci.*, **24** (1955), 411
- SINHA, R. C., Need for proper sampling in geological studies, *Sci. & Cult.*, **21** (1956), 375
- MATHEMATICS-STATISTICS**
- BASU, D., On statistics independent of a complete sufficient statistic, *Sankhya*, **15** (1955), 377
- CHANDRA SEKAR, C., AGARWALA, S. P. & CHAKRABORTY, P. N., On the power function of a test of significance for the difference between two proportions, *Sankhya*, **15** (1955), 381
- DUTT, M. M., The production function for Indian manufactures, *Sankhya*, **15** (1955), 417
- KALLIANPUR, G. & RADHAKRISHNA RAO, G., On Fischer's lower bound to asymptotic variance of a consistent estimate, *Sankhya*, **15** (1955), 331
- MASUYAMA, M. & SENGUPTA, J. M., On a bias in a crop-cutting experiment (application of integral geometry to areal sampling problem—Part V), *Sankhya*, **15** (1955), 373
- PATNAIK, P. B., Hypotheses concerning the means of observations in normal samples, *Sankhya*, **15** (1955), 343
- SINGAL, M. K. & RAM BEHARI, Generalization of normal curvature of a curve in a Riemannian V_n , *Proc. Indian Acad. Sci.*, **42A** (1955), 309
- SIVA RAM, Multidimensional hypergeometric distribution, *Sankhya*, **15** (1955), 391
- WAGNER, K., A new test of business trends, *Sankhya*, **15** (1955), 399
- PHYSICS**
- AGARWAL, B. K., Specific heat and entropy of liquid He^3 , *Curr. Sci.*, **24** (1955), 405
- BANERJEE, C. C., On the variation of p - p scattering cross-section with energy, *Indian J. Phys.*, **29** (1955), 380
- BISWAS, D. C., An approximate method of calculating the vibration frequencies of 1, 1, 1-trichloroethane molecule, *Indian J. Phys.*, **29** (1955), 446
- DUTTA ROY, S. K., An improved method of measuring the absolute susceptibilities of single crystals over wide ranges of temperature, *Indian J. Phys.*, **29** (1955), 429
- GOPAL RAO, M. S. V. & RAMACHANDRA RAO, B., Effect of solar eclipse of 20th June 1955 on long distance shortwave transmissions, *Curr. Sci.*, **24** (1955), 408
- HARIHARAN, T. A. & SENICH, R., Raman spectra of the hydrocarbon cyperene II, *Proc. Indian Acad. Sci.*, **42A** (1955), 285
- KARMOHAPATRA, S. B., On two directional focussing magnetic analysers, *Indian J. Phys.*, **29** (1955), 393
- KRISHNAMACHARI, S. L. N. G., Force constants for substituted germanes. Part II. $GeCl_3H$ and $GeCl_4$, *Indian J. Phys.*, **29** (1955), 384
- MAZUMDAR, M., On the Raman spectra of ethylene chlorohydrin and n -propyl chloride in the vapour state, *Indian J. Phys.*, **29** (1955), 361
- NARASIMHA RAO, D. V. G. L., Dipole moment of 2:4 dinitrofluorobenzene, *Curr. Sci.*, **24** (1955), 407
- NARASIMHA RAO, D. V. G. L., Dipole moment of indene, *Indian J. Phys.*, **29** (1955), 398
- NARAYANAN, P. S., Raman spectrum of cesium bromide, *Proc. Indian Acad. Sci.*, **42A** (1955), 303
- PURANIK, P. G., Assignment of the Raman frequencies of methyl and ethyl benzoates and ethyl cinnamate, *Proc. Indian Acad. Sci.*, **42A** (1955), 326

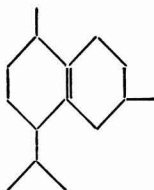
- RAGHUPATHI RAO, C., Sound absorption coefficients based on intensity measurements of diffraction orders, *Proc. Indian Acad. Sci.*, **42A** (1955), 331
- SAHA, N. K. & KAILA, K. L., Source straggling of α -particles from a polonium source, *Indian J. Phys.*, **29** (1955), 417
- SRIVASTAVA, G. P., Dielectric properties of amines and methylene chloride at 3.38 cm., *Curr. Sci.*, **24** (1955), 409
- SUNDARA RAJA IYENGAR, K. T. & LAKSHMANA RAO, S. K., Problems connected with the rhombus. II. Plastic torsion, *J. Indian Inst. Sci.*, **37B** (1955), 113
- SUNDARAMMA, (Miss) K., Paramagnetic resonance in some cupric salts, *Proc. Indian Acad. Sci.*, **42A** (1955), 292
- TAWDE, N. R. & CHANDRATREYA, P. V., Mass asymmetry effect in Hutchisson's theory of vibrational transition probabilities, *Indian J. Phys.*, **29** (1955), 388
- VEPA, R. K. & TRIVEDI, N. K., Pulse techniques for acoustical measurements in broadcast studios, *Indian J. Phys.*, **29** (1955), 369
- WAGH, R. V., On the energy of an isolated fluid sphere, *Sci. & Cult.*, **21** (1956), 373
- TECHNOLOGY
- BHAT, R. V., GUPTA, P. R. & KAPUR, R. L., Indigenous cellulosic raw materials for the production of pulp, paper and board. Part XXVIII. Wrapping papers from the blue gum (*Eucalyptus globulus* Labill.), *Indian Pulp Pap.*, **10** (1955), 307
- DAS, D. K., MITRA, S. K. & DAS, B. M., Photomicrographic study of crackly leather. Part I, *Bull. cent. Leath. Res. Inst.*, **2** (1955), 73
- DATE, W. B., BHATIA, D. S. & SUBRAHMANYAN, V., Studies on the shelf life of *besan wadi* — An Indian sweet, *Bull. cent. Food tech. Res. Inst.*, **5** (1955), 23
- GONDHALEKAR, G. H. & MAHAJAN, P. G., Quantitative assessment of progressive degradation of paper pulps on repeated reuse, *Indian Pulp Pap.*, **10** (1955), 319
- KANJI, S. K. & NIYOGY, S. C., The preparation of aromatic spirit of ammonia, B.P., *Indian J. Pharm.*, **17** (1955), 254
- MACMILLAN, W. G. & BHATTACHARJEE, H. P., Analytical studies of photochemically degraded jute. Part I, *J. Indian chem. Soc.*, **32** (1955), 731
- NANDY, S. C., SEN, S. N. & DAS, B. M., Investigations on the curing of hides and skins. Part II, *Bull. cent. Leath. Res. Inst.*, **2** (1955), 69
- NATH, A. K. & SAHA, A. N., Solvent segregation of mohua oil, *Indian Soap J.*, **21** (1955), 125
- NAYUDAMMA, Y. & SELVARANGAN, R., Studies in chrome tanning. Part I. Complexing properties of certain salts of inorganic acids, *Bull. cent. Leath. Res. Inst.*, **2** (1955), 118
- SAHA, N. C. & SAHA, A. N., Utilisation of Andaman resin. Part I, *J. Indian chem. Soc., industr. Edn.*, **18** (1955), 153

ERRATUM

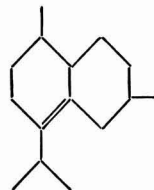
In the article entitled "Studies on Black Damar: Part II — Structure of the New Sesquiterpene (Damarene) from the Resin Oil", **15B** (1956), page 26, R.H. column, structural formulae I, II and III are wrongly printed. The correct formulae are:



I



II



III

Progress Reports

CENTRAL LABORATORIES FOR SCIENTIFIC & INDUSTRIAL RESEARCH, HYDERABAD (DECCAN), ANNUAL REPORT, 1954

THE NEW BUILDING OF THE LABORATORIES was formally opened by the Prime Minister, Shri Jawaharlal Nehru, on 2 January 1954, and most of the sections commenced working in the new building during the year. A beginning was made for working out processes on semi-pilot plant and pilot plant scales. Dehydrated castor oil with a viscosity of 1.2 poises was produced on a pilot plant scale. Pilot plant work was also in progress in connection with briquetting and low temperature carbonization of non-coking Indian coals. A pilot plant for processing cottonseed was fabricated.

The following patents were taken out during the year: (1) Production of sulphur dioxide from calcium sulphate; (2) production of (primary, secondary, tertiary and mixed) sodium phosphates; (3) manufacture and purification of fatty acids; and (4) light coloured fatty acids from dark cottonseed oil refining foots.

The important research activities of some of the sections are presented below.

Entomology — Ten per cent solutions of the oils of *Pongamia glabra*, *Semicarpus anacardium*, *Crotum teglium*, bitter almonds and dhatura (*Datura stramonium*) in white oil were found to be toxic to cockroaches. The oil of *Pongamia glabra* was found to be nerve poison. As a contact poison a 12 per cent solution of the oil gave 100 per cent mortality in the case of *B. chinensis* in 24 hr. and a 10 per cent solution in acetone was found to be highly toxic to houseflies. A 4 per cent solution of *A. squamosa* seed oil in acetone gave 100 per cent mortality in the case of houseflies in 24 hr.

Chlorinated turpentine oil solution in kerosene (5 per cent) was found to be satisfactory as a domestic pesticide while its emulsion with water proved highly toxic to plant insect pests. The keeping quality of chlorinated turpentine against stored grain pests was found to be satisfactory; acetone solutions stored for 73 days retained their toxicity.

Fats and oils — Work on the antioxidant action of *katha* and aca-catechin was extended to the study of their carry-over properties in fried materials. Incorporation of 0.05 and 0.1 per cent catechin to oil increased the storage time of fried potato chips from 5 days to 18 and 36 days respectively.

Fuels — Of the different fractions obtained by low temperature carbonization of coal in a Lurgi-Spielgas plant, the heavy tar fraction after modification with lime was found to be a suitable binder for the briquetting of coal fines. Briquettes with compression strength of 900-1,000 lb./sq. in. were obtained with weathered coal fines 70-80, tar 8-10, lime 1, and water 10-12 per cent; the materials were mixed at 70°-75°C. for half an hour and briquetted at 400 lb./sq. in. pressure.

Heavy chemicals and fertilizers — The ion-exchange resin, Zeocarb-215, was found to accomplish

complete and easy removal of sodium impurity from potassium bromide.

Studies on the preparation of magnesium sulphate from iron pyrites revealed that heating the mixture of magnesite and pyrites in limited but known volume of air and without stirring, gave better yields than heating the mixture in the presence of excess air and under constant stirring. The process worked out earlier for the manufacture of sulphuric acid by the decomposition of gypsum at 900°C. in the presence of sodium sulphate and bauxite ($\text{CaSO}_4 : \text{Al}_2\text{O}_3 : \text{Na}_2\text{SO}_4 :: 4 : 1 : 2$ moles) has been shown to be economical.

Another similar scheme being investigated aims at the production of sulphur dioxide from calcium sulphate in the presence of sodium hydroxide, alumina and sodium aluminate. Maximum decomposition (80-85 per cent) was obtained when the reactants were taken in the molar ratio ($\text{CaSO}_4 : \text{Al}_2\text{O}_3 : \text{NaOH} :: 4 : 2 : 2$). The results indicate that the mechanism of these reactions is not similar to that of the decomposition of calcium sulphate in the presence of sodium sulphate and alumina. The latter reaction takes place with the formation of aluminium sulphate at the intermediate stage, the former involves the formation of sodium sulphate and its decomposition.

The active carbons produced from groundnut hulls, teakwood saw dust and 'coalsite' (a low temperature coke obtained by the carbonization of Hyderabad coals) have high adsorption capacities. Promising applications for these products are in caramel decolorization and absorption of organic vapours. The high adsorption capacities of groundnut hull carbon and of the carbon from 'coalsite' for benzene and acetone vapour at 35°C. and their low percentage retentivity of acetone make them highly suitable for the recovery of acetone in acetate silk industry.

Biochemistry — The addition of small amounts of primary alcohols (ethyl and methyl; 0.5-2 per cent) to molasses media supplemented with nutrient salts was found to increase the yield of citric acid during fermentation by *Aspergillus niger*.

Studies were continued to elucidate the mechanism of the formation of itaconic acid by the fermentation of carbohydrates. The results obtained so far confirm that glycolysis is the initial sequence in the formation of itaconic acid. With arsenite in the medium, ketoacids accumulate in the culture medium, especially pyruvic and α -ketoglutaric acids. The presence of the latter indicates its derivation from isocitrate or aconitate or citrate, though these have not been identified in the culture media.

JUTE RESEARCH IN INDIA

THE PROGRAMME OF THE INDIAN CENTRAL JUTE Committee for the year 1953-54 included expansion of its research activities and opening of research outstations in jute-growing States, a Chemical Technology Department in the Technological Research

Laboratory and investigating centres to study prices, make market surveys, etc.

In addition to the normal annual grant-in-aid of Rs. 10 lakhs, received by the Committee, the Government of India made available a further sum of Rs. 230,000 for the purchase of apparatus and equipment for the Jute Research Institute.

The research scheme — biochemical investigations on processes involved in the retting of jute — transferred from the Calcutta University, has been made a permanent scheme of the Jute Agricultural Research Institute. The Committee was also financing two research schemes, (1) effect of X-rays, neutrons and γ -rays on jute seed, and (2) impregnation of bleached jute yarn with suitable synthetic resins, at the Bose Institute, Calcutta.

The total area under jute during the year was 1,196,000 acres as compared to 1,817,000 in 1952-53, and the output fell to 3,128,000 bales from 4,605,000 bales in the previous year.

The following is a brief review of the work carried out during the year at the Jute Agricultural Research Institute and the Technological Research Laboratory:

Agricultural research — Two varietal trials, one *capsularis* and one *olitorius*, were carried out during the year. Among the *capsularis* strains C 39-213 and CT-919 gave 11 and 8 per cent respectively higher yield than the control D 154. Fanduk and C42-kj-321 were superior to the other varieties in respect of quality ratio. The improved strains of *olitorius*, O40-753, O39-620 and O40-632 gave 23, 18 and 18 per cent respectively higher yields than the control C.G.

When dry and pre-soaked seeds of *C. capsularis* (C 39-212) and *C. olitorius* (O40-632) were treated with soft X-rays, variations were noted in the leaves only at lower dosages while at higher dosages variations occurred in the stem and reproductive organs as well.

Some interesting results have been obtained from the studies on the cell walls of the ultimate fibre cells. Each wall shows four to six principal layers, each one consisting of two to six subsidiary layers. The principal layers alternate with each other, whereas the subsidiary layers within each principal layer maintain one direction only. When they are bleached and deliquified, balloons develop in jute as frequently as in cotton. Factors other than anisotropy in orientation and constricting power of the primary wall seem to be involved in the formation of balloons.

Agronomical studies relating to spacings and manuring effects on early and late varieties of *C. capsularis* have shown that the late variety D 154 when manured gives the highest fibre yield (24.8 md./acre) with a spacing of 3×12 in. in line-sown plots against 19.19 md. in D 154 and 16.62 md. in Fanduk (early variety) from broadcast unmanured plots. The effects of spacing and manuring, when considered separately, were significant. The combined treatment effect was significant at 1 per cent level.

Nitrogen proved to be the significantly effective component in nitrogen phosphorus and potassium trials. Applications of 20 lb. and 40 lb. nitrogen per acre increased the fibre yield by 29.28-59.68 per cent in *C. capsularis* and 17.97-39.25 per cent in *C. olitorius*. The effect of phosphorus or potassium, alone or in combination, did not appear to have any beneficial effect so far as the yield of fibre is concerned.

Soil — The cause of fibre colour has been ascribed to the presence of tannin in jute plants and of iron in retting water; pH of the retting water also seems to play an important part. Colouration has been found to be comparatively more in water having high or very low pH values. The colour of the fibres, however, can be removed by treatment with 2 per cent citric or hydrochloric acid or 2 per cent tamarind extract for 5 min.

Technological research — Fundamental study on the chemistry of hemicelluloses of jute fibre has revealed that hemicellulose has a branched structure and a molecular weight of c. 20,000. Examination of the hemicelluloses of six other bast fibres reveals more or less similar component parts as in the case of jute. Further evidence has been obtained in support of the hypothesis about an ester linkage between hydroxyl groups of lignin and carboxyl groups of polyuronide hemicellulose of jute fibres. Complete removal of lignin from the fibre is not possible by treatment with sodium chlorite without a pretreatment with dilute alkali. The residual lignin (as a chloro derivative) in the holocellulose has been isolated and estimated.

Torsional rigidity of jute, ramie and sisal has been measured. Heavier filaments have generally lower rigidity modulus, and porosity appears to be related inversely to rigidity.

From X-ray diffraction patterns of several jute samples, it appears that free silica is present in the fibre in appreciable amounts.

Further work on woolenization of jute fibre has shown that the cost of processing works out to a rupee for a pound of woolenized jute. Mill trials on the production of blankets containing 40 per cent woolenized jute have yielded encouraging results.

Some progress has been made in devising a method for the accurate determination of fineness of jute fibre. The method consists in cutting the fibre into very short lengths (2-3 mm.) and measuring the fineness of such filaments.

Sliver and yarn irregularities were measured at different stages of manufacture, and the effect of variation of dollops on the regularities of sliver and yarn was also studied. Irregularity appears to diminish as the sliver passes through the breaker and finisher cards and the first drawing, but seems to increase as it passes through the second drawing and roving frames. Elimination of roving frame by the introduction of third drawing in slip draft spinning system has been found to be a definite advantage.

INDIAN PATENTS

[A few of the Patent Applications notified as accepted in the Gazette of India, Part III, Section 2, 31 December 1955 to 21 January 1956, are listed below.]

Chemicals, plastics, rubber, paints and allied products

52165. Production of calcium nitrate, pure mono-ammonium phosphate and nitrogen-phosphorus-containing fertilizer from raw phosphate: *Comprising of dissolving raw phosphate in nitric acid, dividing the solution into parts A and B, cooling part A to crystallize out calcium nitrate tetrahydrate; in next step the remaining solution is neutralized with ammonia gas to give mono-ammonium phosphate and other precipitates, and in next step solution B is converted to nitrogen-phosphorus fertilizer by neutralization and evaporation and addition of precipitates from previous step* — NORSK HYDRO-ELEKTRISK KVAELSTOFAKTIESELSKAB
52681. New azo dyestuffs: *Diazotizing an amino-phenyl benzthiazole derivative and coupling with a coupling component which is itself capable of forming complex metal compounds* — I.C.I. LTD.
53248. Improvements in or relating to detergent compositions: *Consists of soap and 0.01-5 per cent by weight of a thiuram disulphide and a stabilizing compound* — UNILEVER LTD.
53352. Process for producing nitriles: *Reacting a halogenide (alkyl)₃ CCH₂CH₂-Hal with a cyanide* — ARTIEBOLAGET PHARMACIA
53671. New anthraquinone vat dyestuffs and process for their manufacture: *In an anthraquinone the substituent present in 1-position is converted into an NH₂ group, the substituent present in 4-position converted into acylamino group, the substituent present in 2-position condensed with an amine and hetero ring closure effected* — CIBA LTD.
54505. Process for introducing oxygen into steroids: *A steroid containing a methyl group in 13-position is subjected to the oxidizing action of an enzyme derived from an animal organism* — CIBA LTD.
51623. Phenthiazine derivatives and their production: *By reacting a 1-pyrrolidino-3-halogenpropane with phenthiazine* — SOCIETE DES USINES CHIMIQUES RHONE-POULENC
51829. Preparation of acylated 3, 5-diaminopolyiodo benzoic acid: *Treating a 3-amino-5-lower alkanoyl amino-di-iodo benzoic acid with a lower alkanoyl acid or a derivative thereof* — STERLING DRUG INC.
52780. Methods of producing polyhalogen phenyl sulphones and the use of such compounds for combating the stages of development of mites: *Coupling 2: 4: 5-trihalogenobenzene-sulphohalogenide with benzene, monohalogenobenzene or 1: 2: 4-trihalogenobenzene in the presence of an agent like AlCl₃* — N. V. PHILIPS' GLOELAMPENFABRIEKEN
53432. Production of aromatic carboxylic acids and/or their esters: *An alkali salt of benzene dicarboxylic acid in which the carboxyl groups are not in the para-position, is heated above 340°C. in the presence of a catalyst containing cadmium or zinc and the salt is converted into acid or ester* — HENKEL & CIE. G.M.B.H.
53532. Process for curing ethoxyline condensates: *An ethoxyline condensate is reacted with an organic compound having at least three active hydrogen atoms attached to the nitrogen atoms of aromatic di- or poly-amines* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ
53821. Preparation of N-aralkyl-N-(acyloxy-alkyl)-halogenated-alkanamides: *Reacting an N-aralkyl-N-(hydroxyalkyl)-halogenated alkanamide with an acylating agent to produce the corresponding acyloxy compound* — STERLING DRUG INC.
54415. Composition for making odourless, non-exuding vinylidene chloride copolymer film: *Incorporating in the copolymer, 2.5-5 per cent of a partially aromatic ester plasticizer, 1-2.5 per cent of an aromatic ester of salicylic acid and 0.5-1.5 per cent of a neutral glyceride* — THE DOW CHEMICAL CO.
53551. New dyestuff intermediates of the pyrroline series: *Treating a dinitrile with ammonia* — I.C.I. LTD.
53620. Production of carbon monoxide hydrogenation catalysts: *Pulverizing the metals, iron, cobalt or nickel and/or their oxides, accelerators and/or supporting materials, moulding said powders in admixture with water and separating the catalyst grains of equal size* — RUHRCHEMIE AKTIENGESSELLSCHAFT & LURGI GESELLSCHAFT FUR WARMETECHNIK M.B.H.
53772. Manufacture of salts of sulphuric acid esters leuco vat dyestuffs of the anthraquinone series: *Reacting vat dyestuffs with diethyl cyclohexyl amine, an inert diluent and chlorosulphuric acid* — DURAND & HUGUENIN
- 53822 and 53823. Improvements in the manufacture of organic substances of very high molecular weight: *Causing unsupported streams of the solution and of a precipitant to impinge simultaneously on the same area.*
Forming streams of solution of high molecular organic substances and of a precipitant in contact with one another and causing the streams to intermix intimately — BRITISH CELANESE LTD.
54445. Manufacture of basic heterocyclic ethers: *Reacting a substituted 9(10H)-acridone or 9-xanthone or 10-thioxanthone with a di(lower alkyl)-amino-(lower alkyl)-halide in the presence of an acid acceptor* — HOFFMANN-LA ROCHE & Co. AKTIENGESSELLSCHAFT
54609. Improvements relating to amino-glycosidopurine anils and peptide and dipeptide derivatives thereof: *Reacting an aminoglycosidopurin or a peptide or dipeptide thereof with an*

- aryl or heterocyclic aldehyde — AMERICAN CYANAMID CO.
54976. Manufacture of sulphur containing pyridine compound: *Reacting a sulphinic acid of the formula R-SO₂H with vinyl pyridine and converting the resulting sulphone into acid or quaternary salts* — HOFFMANN-LA ROCHE & CO. AKTIENGESELLSCHAFT
52129. Manufacture of mercurated hydroxyl-alkyl biuret derivatives and preparations containing the said derivatives: *Alkyl biuret compound is reacted with mercury salt in presence of water or alcohol* — CIBA LTD.
52272. Manufacture of sulphuric esters of the leuco derivatives of primary 2-amino-anthraquinones: *Reacting a metal salt of the leuco compound or a complex compound comprising the metal salt of the leuco compound with a sulphating agent in the presence of an amide* — I.C.I. LTD.
52274. Process for producing tri-β-haloaliphatic thionophosphates: *An organic hydrocarbon cyclic oxide or sulphide is reacted with a trihalide of trivalent phosphorus and sulphur, or with thiophosphoryl halide* — ETHYL CORP.
52286. Production of 4-hydroxy-coumarins: *A malonic acid diaryl ester is reacted with AlCl₃* — GEIGY A.-G.
52555. Basically substituted carboxylic acid amides and a process of preparing them: *Acyllating 1-aminobenzene containing in 2-position a halogen atom and in 6-position an alkyl radical, with aliphatic amino carboxylic acid* — FARBWERKE HOECHST AKTIENGESELLSCHAFT VORMALS MEISTER LUCIUS & BRUNING
53383. Dyestuff compositions: *Comprising one phthalocyanine compound selected from cobalt, iron, tin or vanadium phthalocyanines and one or more tetra-azaporphin compounds* — I.C.I. LTD.
53572. Process for preparing polysulphuric acid esters of chitosan: *Chitosan is reacted with an acid, the salt is dissolved in formamide and the solution sulphated with chlorosulphonic acid* — HOFFMANN-LA ROCHE & CO. AKTIENGESELLSCHAFT
53713. Process and apparatus for converting heavy hydrocarbons: *Hydrocarbon feed is injected in dense fluidized mass at various levels* — ESSO RESEARCH & ENGINEERING CO.
53771. Preparation of C-nitrosodiarylamines: *From the corresponding N-nitrosodiarylamines with the help of a halohydric acid in which the reaction medium contains at least one alcohol containing more than two carbon atoms* — COMPAGNIE FRANCAISE DES MATIERES COLORANTES
53870. Production of quinolinol compounds: *By condensing 5-chloro-8-quinolinol with formaldehyde and an amine* — PARKE, DAVIS & CO.
53913. Process for preparing lysergic acid amides and intermediate useful in the preparation thereof: *By reacting dry lysergic acid with trifluoro-acetic anhydride at a temperature below about 0°C. in a dispersing agent inert to the reactants* — ELI LILLY & CO.
53956. Process for preparing an unsaturated C₁₀ diol: *Condensing 8-(2', 6', 6'-trimethyl-1'-cyclohexen-1'-yl)-2, 6-dimethyl-2, 4, 6-octatrien-1-al with alkali metal acetylide and condensing the condensation product with said octatrien-1-al* — HOFFMANN-LA ROCHE & CO. AKTIENGESELLSCHAFT
54082. Depolymerization of 4-methyl-2: 4-diphenylpent-2-ene: *By heating 4-methyl-2: 4-diphenylpent-2-ene in the presence of a phenol of boiling point above 220°C.* — SOCIETE DES USINES CHIMIQUES RHONE-POULENC
- 54786 and 54787. Improvements in or relating to decomposition of alkali metal amalgams: *Decomposing the amalgams with aqueous or alcoholic decomposing fluids in presence of catalyst.*
Amalgam is decomposed with aqueous or alcoholic decomposing fluids in presence of catalyst — OLIN MATHIESON CHEMICAL CORP.
55446. Process for reforming gasolines or gasoline fractions by means of platinum-containing catalysts: *Catalyst, after usual reduction treatment and before hydrocarbon is passed over, is conditioned by treatment with hydrogen containing hydrogen sulphide* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ
- Chemical processes, engineering and equipment**
54001. Process and apparatus for performing exothermic reactions under high pressure and at elevated temperature: *Reaction gases are passed serially through catalyst layers and heat exchangers, the heat of reaction evaporating the coolant, the coolant is cooled outside the reaction chamber and returned in a closed cycle to the heat exchangers* — MONTECATINI SOCIETA GENERALE PER L'INDUSTRIA MINERARIA E CHIMICA
54051. Chemical lignocellulose pulping process and product: *Cooking with dilute aqueous solution of hydrotropic salt* — MCKEE DEVELOPMENT CORP.
54224. Continuous process for the electrolysis of aqueous bromide or iodine solutions, and electrolytic cell therefor: *A stream of fresh electrolyte is fed into the electrochemically neutral zone* — MAKHTSAVEI ISREAL
54508. Process and apparatus for the catalytic cracking of hydrocarbon oils: *The catalyst issuing from the reactor is passed to a stripper provided in the regenerator, the stripper being near its bottom in direct communication with the regenerator* — N.V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ
52204. Improvements in or relating to gas-fractionating systems: *Gas fractionating column is cooled at its upper side by means of a gas refrigerator* — N. V. PHILIPS' GLOELAMPENFABRIEKEN
53477. Improvements in froth flotation processes: *Concentrating the minerals by adding a collector agent and a frother* — NATIONAL CHEMICAL PRODUCTS LTD.
52352. Separation of saturated and unsaturated keto-steroids: *The mixture is reacted with Girard reagent T or P, then treated with a water-soluble aldehyde to liberate saturated ketones, the pH of the aqueous medium is thereafter lowered to liberate the unsaturated ketones* — G.N.R.D. PATENT HOLDINGS LTD.
53334. Separation of a mixture of substances by distillation and/or absorption: *Wherein gases discharged from the resist, or a part thereof, are allowed to expand in a vortex tube and cold thus generated is used to cool a stream flowing in or out of the unit* — N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ

54047. Process for the catalytic dehydrogenation of hydrocarbons: *Mixing preheated hydrocarbon with superheated steam before entry in catalyst chamber* — CHEMISCHE WERKE HULS AKTIENGESELLSCHAFT

54585. Improvements in epoxidation: *Reacting ester of water-insoluble unsaturated aliphatic acid with an aqueous mixture having a pH of at least 0.5 and containing hydrogen peroxide, acetic anhydride and a salt of metals of groups I and II of periodic table* — ROHM & HAAS CO.

Physics, general

52145. Improvements in or relating to magnetic recording media: *Comprising a thin flexible sheet carrying a layer of metallic iron crystallites of less than 0.1 micron dimensions* — THE GENERAL ELECTRIC CO. LTD.

52672. Improvements in electromagnetic frequency radar detection systems: *Using travelling wave oscillator whose frequency is varied by varying the velocity of the electron stream of the travelling wave tube* — COMPAGNIE GENERALE DE TELEGRAPHIE SANS FIL

52674. Frequency-modulated signal discriminator: *Including a mixer circuit adapted to receive both the frequency-modulated signal and an a.c. voltage, the beats thus provided being utilized for periodically quenching a super-regenerative oscillator and means for detecting the r.m.s. output voltage of the said oscillator* — COMPAGNIE GENERALE DE TELEGRAPHIE SANS FIL

52675. Improvements in ultra-high frequency wave radiating devices: *Comprising a series of co-axial portions, each portion being characterized by the fact that at least one geometrical parameter thereof varies progressively from one end of the portion to the other, passing from a minimum to a maximum, then returning to a minimum* — COMPAGNIE GENERALE DE TELEGRAPHIE SANS FIL

Drugs and pharmaceuticals

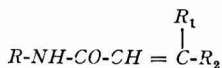
52357. New antibiotic and process for its preparation: *Cultivating aerobically a strain of streptomycetes 3486 in a nutrient medium* — SOCIETE DES USINES CHIMIQUES RHONE-POULENC

52466. Manufacture of nor-steroids: *An acylating agent is caused to act on a 16:17 α -oxide-20-ketopregnane compound in the presence of an acid catalyst* — CIBA LTD.

52950. Process for the manufacture of steroids: *Treating 13-unsubstituted tertiary-17- α -hydroxy-D-homo-12:18 bisnorsteroid with an agent capable of eliminating water* — CIBA LTD.

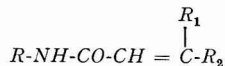
53030. Fungicidal and insecticidal compounds and compositions formed of complex double salt: *Heating complex double salt of resin amine complex and water-insoluble carboxylic acid metal soap* — SCIENTIFIC OIL COMPOUNDING CO. INC.

53316 and 53317. Process for the production of new anaesthetic compounds: *Reacting dialkylamine with*



where R_1 is hydrogen or alkyl group and R_2 is alkyl group.

Reacting piperidine or monoalkylpiperidine with



where R_1 is hydrogen or alkyl and R_2 is alkyl group — ED. GEISTLICH SOHNE A.G. FÜR CHEMISCHE INDUSTRIE

51632. Pathalocyanine precursors and their conversion: *Phalonitrile, Cu or Ni salt, ammonia and a catalyst or a di-imino-isoindoline and a Cu or Ni salt are reacted to yield the compounds* — E.I. DU PONT DE NEMOURS & CO.

53562. Preparation of steroid substances: *A steroid sapogenin is heated in the presence of one or more carboxylic acids containing acids containing 2-20 carbon atoms* — G.N.R.D. PATENT HOLDINGS LTD.

52820. Process of increasing the physical stability of aqueous suspensions of penicillin compounds: *Aqueous suspensions of penicillin compounds are stored in ampoules having a rubber cover, butyl rubber being employed as rubber material* — NOVO TERAPEUTISK LABORATORIUM A/S

54595. Recovery of the antibiotics tetracycline, chlor- and/or bromotetracycline from aqueous solutions thereof: *Adding to aqueous solution containing fermentation mash impurities, a heavy metal chelating agent whose pK for calcium is at least 7* — AMERICAN CYANAMID CO.

54717. Novel penicillin salt and process for preparing the same: *Reacting penicillin with 1-benzamido-1-phenyl-3-piperidinopropane* — ELI LILLY & CO.

52284. Fermentation process for the production of a new anti-viral substance: *By fermenting a nutrient medium under submerged aerated conditions with the organism Nocardia formica* — POLLARD

52431. Anti-viral substances and process for preparing the same: *By contacting the fermentation broth produced by organism Nocardia formica with an adsorbent material, submitting the eluted adsorbed material to chromatographic purification and then collecting fraction having a pH below about 6.0* — MERCK & CO. INC.

Fuels and lubricants

52429. Method of producing metallurgical coke: *Small coal is submitted to dedusting operation and then carbonized* — HOUILLERES DE BASSIN DE LORRAINE

Metals and metal products

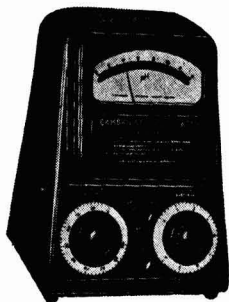
52132. Improvements in or relating to alloys: *Comprising major constituents like tungsten and/or molybdenum and a minor constituent consisting of two or more of the metals iron, nickel, cobalt, chromium, the proportion of major constituent being less than 75 per cent and proportion of chromium, if present, being not greater than 15 per cent by weight of the alloy* — THE GENERAL ELECTRIC CO. LTD.

54035. Separating and purifying zirconium and hafnium: *Placing in contact with each other aqueous and acidic solution of Zr and Hf with acidified or not solvent comprising alkyl phosphate or acetate* — COMMISSARIAT A L'ENERGIE ATOMIQUE

54703. Treatment of cast iron: *Injecting a powder-laden gas into molten cast iron; an inoculant is entrained in the gas simultaneously with the nodulizing agent* — UNION CARBIDE & CARBON CORP.
54705. Mixture for treating cast iron: *Injecting a comminuted mixture-laden stream of inert gas into molten cast iron, the mixture comprising a nodulizing agent, an inoculant and a refractory diluent* — UNION CARBIDE & CARBON CORP.
53979. Manufacture of metal oxides and of ferrites: *Heating iron powder in a current of steam at a temperature between 400° and 650°C., milling the resultant product in water, calcining the milled product in air at a temperature between 150° and 1,000°C.* — STANDARD TELEPHONES & CABLES LTD.
54062. Production of titanium or zirconium: *Consisting in lining the reaction vessel with titanium or zirconium before passing the reactant vapours of sodium or potassium and titanium or zirconium* — THE NATIONAL SMELTING CO. LTD.
54846. Low alloy steel for sub-zero temperature application: *Containing 0.02-0.15 per cent C, 0.2-1.2 per cent manganese, 0.05-0.6 per cent Si, 1.2 per cent Cu, 0.25-1.5 per cent Cr, 1.5 per cent Ni, 0.03-0.3 per cent Al, 0.01-0.025 per cent nitrogen, and 0.04-0.25 per cent tantalum, the remainder being iron* — UNION CARBIDE LTD.
55042. Production of pure aluminium: *Decomposing an aluminium compound (RR'-CH-CH₂)₂AlX, R and R' being saturated aliphatic radicals and X representing either the group RR'CH-CH₂ or hydrogen atom* — ZIEGLER
55385. Recovery of gold and silver from cyanide solutions: *Recovering gold and/or silver adsorbed on an anion-exchange substance as the corresponding cyanide comprising eluting the acid and/or silver by means of an organic solvent containing a minor proportion of an inorganic acid, the organic solvent and inorganic acid used are distilled, then precipitated gold or silver is separated* — WILLIAM BOBY & CO. LTD.
55463. Desulphurization and desiliconizing of pig iron: *Reacting molten pig iron with elements suitable for constituting a desulphurizing slag, except a quantity of silica corresponding to the quantity of silicon which it is proposed to eliminate from pig iron, and with one or more oxidizing agents* — SOCIETE D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE ET DES ACIERIES ELECTRIQUES D'UGINE
- Leather and leather products**
53651. Synthetic tanning materials: *Sulphonating salicylic acid with sulphonic acid and condensing the product with formaldehyde* — COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
53574. Improving the water-repellency of leather: *Treating leather with a complex chromium compound* — I.C.I. LTD.
- Building materials and methods**
54371. Building structures: *Connecting beams at varying angles of inclination of their horizontal axis with connector therealong, that perpendiculars therefrom intersect both on horizontal and inclined beams* — DEX (PREFABRICATIONS) LTD.
54629. Improvements in or relating to tile suspended wall construction: *Comprising a support, a hanger tile, means for suspending the hanger tile from the support in forwardly extending relation, and a plurality of wall tiles individually suspended from hanger tile* — LACLEDE-CHRISTY Co.
55015. A process for the manufacture of white cement and a rotary kiln for use in said process: *The hot cement clinker is cooled by a cooling agent and the agent is subjected to suction independent of the draught through the kiln* — F. L. SMIDTH & Co. A/S
- Miscellaneous**
53039. Anti-foam process in paper making: *By mixing an anti-foaming agent with water and spraying it upon the stock while on the wire of the paper machine to eliminate air bells* — BOWATERS DEVELOPMENT & RESEARCH LTD.
54446. Manufacture of pressure-sensitive adhesive tape: *Applying to a pliable base having parallel strands of cotton bonded together in side by side relation, a coating of adhesive solution* — P. P. PAYNE & SONS LTD.
- 51476 and 55219. Improvements in the extraction of coal from the earth: *Comprises the step of transmitting a blasting effect through a column of water under hydrostatic pressure free from air in a sealed borehole* — I.C.I. LTD.
52125. Improvements in mixing and agitating machines: *Wherein the drive imparts to the stirrer a combined bodily sweeping movement and axial rotational movement which will differentially vary automatically according to the loads encountered in making said movements* — TORRANCE & SONS LTD.
52758. Curing of the masseccutes in the manufacture of white sugar or refined sugar: *The process comprises subjecting masseccutes to electric current, whereby the electrical resistance of masseccutes is utilized for heating the same* — DOSS & VISHNU
54125. Improvements in evaporators: *Wherein each heating element includes at least two deeply convoluted walls each representing a plurality of parallelly disposed troughs* — G. & J. WEIR LTD.
54147. Production of solid or semi-solid compositions and detergent compositions so made: *Forming a mixture of calcium lactate in water and incorporating a dispersible liquid or solid* — KRAUS & KRAUS
54268. Thermal insulation for electronic vacuum tubes: *Mount comprising a cathode sleeve rectangular in cross-section and coated with emissive material, a pair of loop supports affixed to the sleeve* — PENNSYLVANIA ELECTRIC PRODUCTS INC.
54859. Ball or like grinding mills: *Classifying lining is provided only over a part of the grinding chamber* — F. L. SMIDTH & Co. A/S

CRAFTSMAN

Season's Arrivals



*** Cambridge Bench Pattern pH Meter (0.14 pH)**

12-volt storage operation eliminating mains fluctuations, readings to 0.01, and 0.005 pH, reproducibility of readings unsurpassed by anything else on the market suitable for research as well as routine use

*** Cambridge Mains Operated pH Meter (0.14 pH)**

For general work a better instrument, easy and quick to handle, readable to 0.05

*** Lumetron Model 402-EF**

And 402-E model for quick photoelectric and photofluorometric analysis with standard accessories; over thirty units supplied to the laboratories

*** Beckman Spectrophotometers**

The last word in efficient, quick and accurate colorimetric analysis, readings down to 180 to 1000 millimicrons; over sixteen units supplied all over the country

Address your enquiries to

CRAFTSMAN ELECTRONIC CORPN. Ltd.

Factory, Laboratory & Office

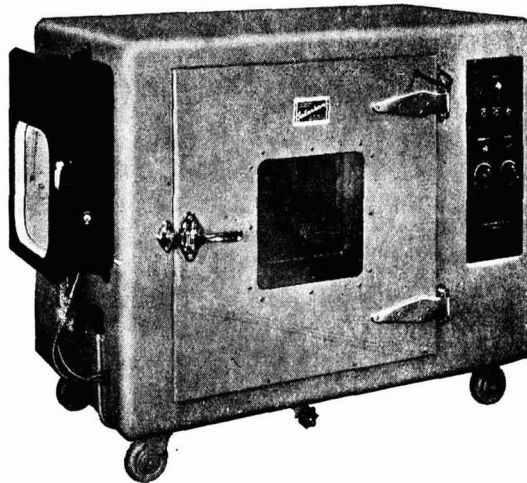
SETHNA HALL, NESBIT ROAD, BOMBAY 10

Equip your laboratory with

THE



Humidity Oven



Full details sent on request

- * Providing the test conditions required in various specifications, for example P.C.S. 11 (issue 4), K. 114 (issue 2) and R.I.C. 11, for testing electrical instruments and telecommunication equipment.
- * Testing manufactured products and materials to ascertain their suitability for tropical climates
- * Testing protective coating such as paint, lacquer, varnish, etc.
- * Testing containers, packages and packing materials.

Accredited Agents

MARTIN & HARRIS Ltd.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY I

Printed by H. JACQUEMOTTE, S.J., at the Catholic Press, Ranchi, India

Published by the Council of Scientific & Industrial Research, India. Editor: B. N. SASTRI, M.Sc.

Regd. No. P-842