Journal of

Scientific & Industrial Research

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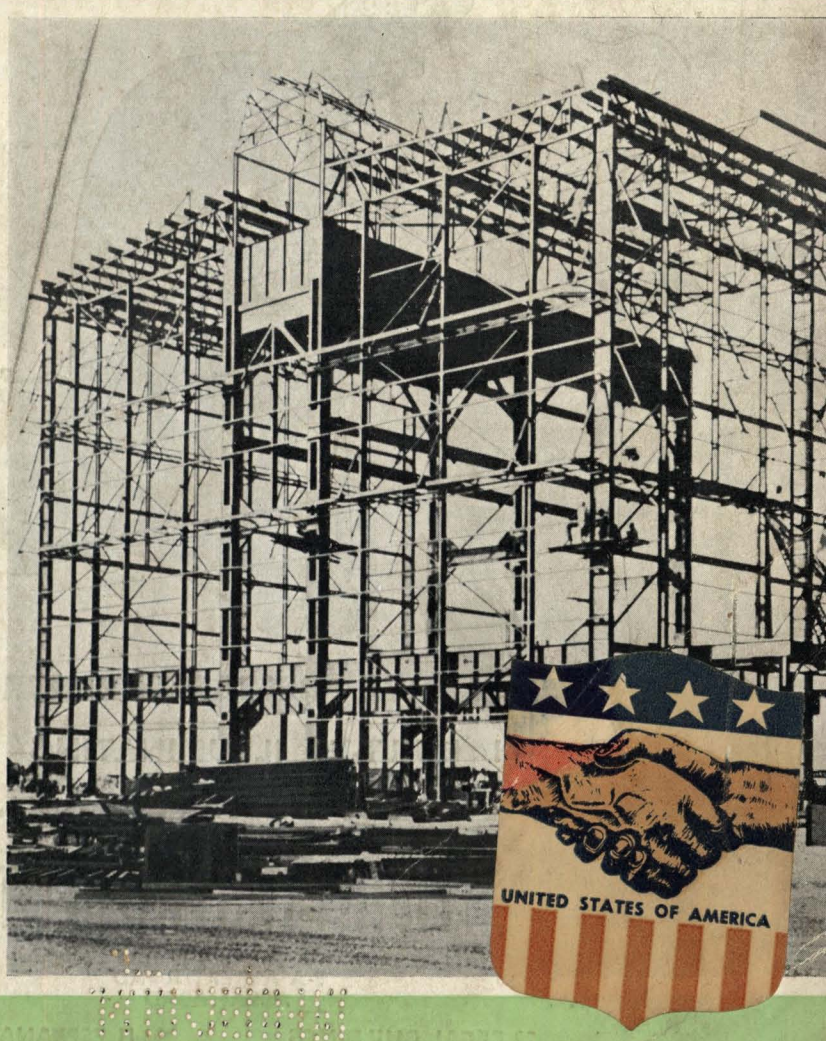

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Journal of Scientific & Industrial Research

Vol. VIII **JANUARY 1949** **No. 1**

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COVER PICTURE

The giant fertilizer project at Sindri, the biggest yet planned in Asia and estimated to cost Rs. 17 crores, has a rated annual output of 350,000 tons of ammonium sulphate. Picture on the cover shows the Boiler House under construction.

Editorial communications and books and periodicals for review should be addressed to the Editor, JOURNAL OF SCIENTIFIC & INDUSTRIAL RESEARCH, *'P' Block, Raisina Road, New Delhi.*

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GOVERNMENT OF INDIA

ANNOUNCEMENT

PATENTS ENQUIRY COMMITTEE

THE Central Government (as already notified in the *Gazette of India*) having appointed a Committee to examine and report upon the Patent Law of India and the working of the existing Patent System created by the Indian Patents and Designs Act 1911, the Committee, before taking oral evidence, has compiled certain Questionnaires, in the first place, to be addressed to chambers of commerce, research institutions, prominent industrialists and patentees.

In view, however, of the large public interests involved, the Committee would welcome suggestions from any member of the public desirous of expressing an opinion on any of the questions formulated by the Committee.

Copies of the Questionnaires referred to above may be had free on application from :

THE SECRETARY
PATENTS ENQUIRY COMMITTEE
MINISTRY OF INDUSTRY & SUPPLY
JAISALMER HOUSE, MANSINGH ROAD
NEW DELHI

ISSUED BY THE MINISTRY OF INDUSTRY & SUPPLY
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INDEX TO ADVERTISERS

Expansion of University Education

THE appointment of a University Commission consisting of eminent educationists from India and abroad " to inquire into, and report on, the conditions and prospects of university education and advanced research in India, and to recommend a constructive policy in relation to the problems they present and the needs of the country ", meets an important national need. It is more than three decades ago that a University Commission (The Sadler Commission, 1917) held an inquiry into university and higher education in India, and the vast changes that have taken place since then adds urgency to the detailed examination of the whole field of higher education and research in the country. The preamble to the Government resolution on the appointment of the Commission stresses the need in the following words :

" The importance of primary and secondary education in a democracy is obvious. Their quality, however, depends in the ultimate analysis on the quality of educational leaders, and these can be produced only by a suitable system of higher and university education. Provision of extended facilities for higher education is, therefore, necessary for the satisfactory functioning of a democracy. A vast change has taken place in the country with the achievement of independence. New vistas have opened which necessitate a survey of education at all stages. The interests of the country require vast programmes of expansion in agriculture, industry and commerce, which, however, can be carried out only if a sufficient number of highly trained executives and artisans, craftsmen and skilled labour of all grades and types are available. The problems of defence cannot be satisfactorily solved without the existence, within the country, of all facilities for technological and scientific studies of the highest order. Extension of the boundaries of knowledge and research is also essential if we are to improve the quality of education which is now available to us."

The 16-page questionnaire issued by the Commission covers 26 different aspects of education and seeks information on such topics as : structure, jurisdiction and administration ; admission to courses ; medium of instruction ; conditions of service of teachers ; libraries, laboratories and museums ; extra-curricular activities ; health and physical education ; finances ; inter-university relations and attitude to organizations like the U.N.O. and the UNESCO. The composition of the Commission presided over by the distinguished Indian educationist and philosopher, Dr. S. Radhakrishnan, compels confidence, and the very thorough inquiry initiated by the Commission under its comprehensive terms of reference may be expected to lead to results of lasting benefit to higher education in India.

Inquiry Should Precede Expansion

There has been lately a persistent and unanimous demand for the expansion of university education in India. It has been pointed out that the total demand for graduates called for by the Scientific Manpower Committee, and those required by the expanding administrative and social services, cannot be adequately met by the present output of graduates from universities, and that an expansion in the facilities for teaching and research is essential. A quantitative assessment of the demand for graduates is not available, and this renders difficult the determination of the extent and direction of expansion. The real obstacles to any expansion, however, are the material and manpower shortages, and these shortages preclude any great increase in the output of

graduates, at any rate, in the immediate future. The problem of expansion, moreover, needs a good deal of critical thinking as regards both the purpose and content of university education, and the pause necessitated by the material shortages need not be a serious disadvantage, if the opportunity is utilized for investigation, experiment and discussion of the issues involved. The problem should be examined with vision without which " education may settle down to uncreative mediocrity ". The temptation to resort to *ad hoc* expedients to increase the number of graduates will have to be resisted in favour of a properly conceived plan of expansion deliberately formulated as a result of fundamental and creative thinking.

Fundamental Objectives Must Be Fostered

The recognition of the important rôle, which science plays in the promotion of national welfare, has led to a scrutiny of the extent of attention accorded to science in university education. This is to be welcomed. But the view, which seems to be widely prevalent, that universities should be expanded to enable them to provide the trained personnel required for putting into operation " the vast programmes in agriculture, industry and commerce " needs critical examination. This view will have to be considered in relation to such questions as the task of universities in technology, balance of subjects in the faculties, basis for the selection of students and academic standards, and the all-important question of the freedom of universities to formulate their policies and programmes in accordance with their fundamental aims and objects.

" The modern doctrine that the primary function of a university is the supply of experts in the spheres of science, business, administration and social services, can become both dangerous and heretical — ", writes Dr. J. Mackay-Mure in *Nature* (1947, March 22, p. 392), " not because it advocates any single thing which ought not to be done, but because it represents an idea of a university which is out of focus. It pushes into the background that conception of it as a centre of cultural life and cultural progress, which makes freedom not merely desirable but a first essential. Without freedom such a centre ceases to be a university, a community of scholars within which every man may open his mind to a total engagement in the struggle for truth... The maintenance of this freedom has today acquired a new significance. As the State system of education is reformed and developed, there is the assurance of that technical and vocational training on which the efficiency of the community depends. But the quality of the community depends primarily on its standards and its ideals, on the defence and promotion of fundamental values in life and progress. Although standards and values are by no means the monopoly of those who are brought into association with the life of a university, it is doubtful whether they can be maintained if the true idea of a university is allowed to decay." " It is not ", says Plato, " the life of knowledge, not even if it includes all the sciences, that creates happiness and well-being, but a single branch of knowledge — the science of good and evil ... Science, economics and sociology provide the frames of contemporary society and satisfy its material needs, but unless we have the knowledge of good and evil, their use and excellence will be found to have failed us."

It is our conviction that once the conditions propitious to the furtherance of the fundamental objectives of university education are provided and secured, the universities would be enabled to exert their beneficial influence on society and contribute their due share to the progress of the nation and to the elevation of contemporary civilization. The first responsibility of a university, not only for its own sake, but for the sake of the community, is to *be* a university. It should, in Miss D. M. Emmett's words, be a place where criticism and evaluation of ideas is continually carried forward, where " nonsense " can be exposed for what it is, and where " intellectual virtues " of sincerity of mind are being fostered and transmitted. It should inculcate a sense of values and the power to distinguish what is first rate from what is not. If this sense of values is inculcated and propagated, a proper solution for the many complex problems confronting society would become possible.

Universities & the State

The rôle of the universities is primarily to impart a liberal education and to instil high ideals of citizenship in the minds of the members of the younger generation and to endow them with the ability to devote their mental and physical powers to constructive ends. University education is a preparation for life and not merely for employment. On this view, the training of experts required for agriculture, industry and commerce

is not the *primary* responsibility of the universities. The State schemes for the development of technological and vocational institutions provide the means for securing " the trained executives and artisans, craftsmen and skilled labour of all grades and types ". The Government has the right and the duty to satisfy itself that every field of study which is in the national interest is cultivated in the university system, also that the resources placed at the disposal of universities are properly and efficiently utilized. The Government has the right also to satisfy itself that the universities are under the charge of men who can think imaginatively and creatively and who can be trusted to uphold and carry forward the ideals of higher education. Beyond these, the universities ought to be given the freedom to device and execute policies in pursuance of their accepted aims and objects.

The universities in India are of diverse types and patterns. Their origins and ages are also diverse. The problems that confront them in their day-to-day working and those that influence their future may be expected to be also diverse. Judging by the questionnaire issued by the Commission, all the aspects which affect the efficiency and progress of the universities are being subjected to scrutiny and inquiry. The conditions now prevailing in India are extremely propitious for the growth and development of university education. There is a vast reservoir of intelligence in the country which is awaiting to be tapped and which would enable the setting up of high academic standards, provided the crippling disabilities such as lack of means and, in some instances, even caste, which hamper the entry of intelligent youths who have proved their ability to profit by university education, are removed. The constitution of free India provides equal opportunities for all irrespective of caste, creed or sex. A favourable atmosphere for the propagation of the highest ideals of liberal education obtains in India today, thanks to the exalted position which truth and peaceful ideals have attained, largely as a result of Mahatma Gandhi's all-pervading influence. The universities themselves are fully alive to their responsibilities and have shown a readiness to discuss standards of intellectual discipline and their maintenance and propagation. These are healthy signs. In the important task of assessing the present position of university education in India and in determining its future development, the Commission, we feel confident, will have the full co-operation of university teachers, research scholars, administrators and, in fact, of all those who have the vision to see what is at stake and realize how much depends on the universities in providing the nation not only with educated intellectuals but also of men and women of personality and character.

The Indian Chemical Society—Twenty-five Years' Service to Chemistry

THE *Indian Chemical Society* was established in 1924 as a result of the deliberations held during the annual sessions of the Indian Science Congress, due chiefly to the initiative and foresight of the late Sir P. C. Ray, doyen of chemistry and leader of the Indian school of chemists. He was enthusiastically supported in this venture by the late Dr. E. R. Watson, Dr. J. N. Mukherjee, Dr. J. C. Ghosh, Sir S. S. Bhatnagar, and other leading chemists of the country. The *Society* was registered on the 9th of May 1924, with Sir P. C. Ray as the first President, Dr. G. J. Fowler and Dr. J. L. Simonsen as Vice-Presidents, (the late) Dr. E. R. Watson and Dr. N. R. Dhar as Hon. Editors, Dr. J. N. Mukherjee as Hon. Secretary and Dr. P. C. Mitter as Hon. Treasurer.

The object of the *Society*, broadly speaking, is to cultivate and promote the cause of chemical science and allied branches of learning by holding meetings to discuss papers of scientific interest, arranging lectures on scientific topics, co-operating with other

organizations having similar objects, and publishing original memoirs in chemistry and related branches of science through the medium of the *Society's* publications. These objects the *Society* has fostered zealously, and the status which the science of chemistry has attained in India is in no small measure due to its efforts.

The administration of the *Society* vests in a *Council* consisting of the President, the Vice-Presidents, the Hon. Secretary, the Hon. Treasurer, the Hon. Editors and twenty ordinary members of the *Council* elected by votes from among the Fellows on a regional basis. There are at present nearly 400 Fellows on the rolls. Since 1938 a new class of membership, the Associate membership, was instituted to admit research scholars and post-graduate students. Its membership has been characterized by a continuously upward trend and it enjoys today the support of chemists engaged in every branch of this science and has attained the status and prestige of the premier national organization for the promotion, propagation and cultivation of chemistry in this country.

The *Journal of the Indian Chemical Society*, which was started as a quarterly at its inception, became a bi-monthly in 1927. Since 1934 it is being published every month. Since 1938 the *Society* has been publishing every quarter the *Industrial & News Edition* of the *Journal*. The adjudication of the publishable matter is entrusted to a Board of Associate Editors consisting of sixteen members including the two Hon. Editors.

The office of the *Society* at Calcutta has attached to it a comprehensive reference library consisting of journals of chemical and allied branches of science and dissertations on scientific subjects. The *Society* at present receives more than 180 scientific publications in exchange, and the holdings of the library include some 2,000 bound volumes of journals dealing with chemical and allied sciences, and 1,200 dissertations. The *Society* supplies to its Fellows, at a nominal cost, typewritten extracts and transcriptions from journals which are either possessed by it in its library or are available elsewhere in Calcutta.

The *Society* awards research grants in pursuance of its objective to promote chemical research in the country. Due to financial stringency, however, the awards have been kept in abeyance at present. The *Society* awarded during the years 1933-38 the Sir P. C. Ray 70th Birthday Commemoration Medals to research workers selected among the junior chemists on the basis of their merit. In memory of the late Mr. J. M. Das Gupta, a Fellow of the *Society*, the award of a second gold medal has been instituted since 1934.

International Civil Aviation Organization (I.C.A.O.) South-East Asia Regional Conference

THE South-East Asia Regional Air Conference held under the auspices of the International Civil Aviation Organization was inaugurated by the Prime Minister of India, Pandit Jawaharlal Nehru, on November 16, 1948 at New Delhi. Some 225 delegates and representatives from 16 countries attended the Conference. The countries represented were : Burma, India, Indonesia, Iran, the Netherlands, Pakistan, Siam, United Kingdom, United States of America, France, Belgium, Phillipines and Australia. Several members of the Secretariat, I.C.A.O. were also present. Dr. Edward Warner, President of the Council of the I.C.A.O., was present to guide the work of the Conference. The presence of the delegates and experts from countries in other regions is evidence of the great significance attached to the Asian continent in the future of world aviation.

Pandit Nehru in his address spoke of the remarkable progress of aviation in India and its major rôle in the history of mankind. This rapid progress, he said, was natural because India is ideally placed and has vast areas where air travel becomes almost necessary and essential. The climate for the

great part of the year was suitable for aviation. He emphasized the central position India occupied in the geographical set-up of South-East Asia and the world. The I.C.A.O. which enjoys the actual support of 51 nations of the world, in the words of Dr. Edward Warner, " is an association of National Governments which have recognized the need for working together for the good of civil aviation and for the healthy development of international relationships ". The present Conference, which is the ninth of the first series of regional meetings, is to examine the problems of air navigation in South-East Asian region and prepare a regional plan of aids to navigation and usages.

An idea of the development of civil aviation in India during the past 2 decades may be had from the fact that while the total expenditure on civil aviation during 1947-48 was Rs. 10,11,000, the figure for 1948-49 is expected to be Rs. 6,22,82,000. The rapid strides in civil aviation has been mainly due to the expeditious way the 10-year post-war plan drawn up some 3 years ago has been implemented. According to this plan, the Civil Aviation Department would maintain and develop the already existing 45 aerodromes in India; 21 aerodromes in the Indian States are being maintained and developed by the States concerned. In addition, the plan provides for the construction of 21 new aerodromes mainly for local communications. The aerodromes at Santa Cruz (Bombay), Dum Dum (Calcutta) and Palam (New Delhi) are being developed with a view to bring them to the standard of international aerodromes.

Training facilities for pilots, engineers and other technical personnel to man civil aircraft in India are available at 7 subsidized flying clubs at Bombay, Madras, Delhi, Barrackpore, Patna, Bhubaneswar and Lucknow, and at 3 other non-subsidized clubs at Jodhpur, Trivandrum and Hyderabad. 3 more are being planned at Jullundur, Nagpur and Gauhati during 1949. The Communication School at Saharanpur is training radio-operators and technicians and a new school is to be established at Allahabad for training students in flying, flying control and administration. The Government of India, in this connection, have deputed 6 experienced pilots for training in the United Kingdom as instructors. The Allahabad school is expected to turn out 300 control operators during the next 3 years.

During the first two quarters of 1948 there was a 25 per cent increase in air-traffic as compared with the preceding half year, the miles flown being 58,74,380 and the total number of passengers carried were 1,75,734. A 27 per cent increase in the weight of freight mails and newspapers carried was recorded — the figures being: air freight, 1,421 tons; newspapers, 743 tons; and mails, 286 tons. An improvement of 3·8 per cent in the factor of regularity was recorded which was 99·7 per cent—a record for India. The number of aircraft registered rose from 551 to 614 and the number of B class pilots increased to 296, A class pilots to 333, A-1 class to 15 and ground engineers to 343.

The Conference elected Rai Bahadur N. C. Ghosh, Director-General of Civil Aviation in India, as *Chairman*. Mr. Md. Ismail, leader of Pakistan delegation and M. Haguenan, leader of the French delegation, were elected first and second *Vice-Chairmen*.

The Fact-finding Committee, which met earlier during the month, submitted its report to the Conference on the basis of which the Conference will formulate its decisions. The Committee assembled factual data relating to air routes, aerodromes and ground sites, air traffic control, communication, meteorology and search and rescue organizations for South-East Asian region comprising of Afghanistan, Burma, Ceylon, Indonesia, India, Pakistan, Siam and portions of U.S.S.R., Australia and the Phillipines.

The Conference will study, in particular, the allotment of high-frequency radio channels for aircraft use. There is a great dearth of such channels and the International Tele-communications Union has asked the I.C.A.O. to prepare a plan for meeting the needs of international civil aviation with the greatest possible economy, having regard to the needs of civil aviation in all regions.

The Conference appointed 5 sub-committees to deal with aerodromes and air-routes, air traffic control, communications, meteorology and search and rescue. The allocation of radio frequencies was left to the consideration of the sub-committee on communications.

Characteristics of the Ionosphere at Calcutta (October 1948)

S. S. BARAL, S. N. GHOSH, D. C. CHOUDHURY, R. K. MITRA & (Miss) T. K. PAL

Wireless Laboratory, University College of Science, Calcutta

THE following are the ionospheric data collected at Calcutta for the month of October 1948. The observations were made at each hour of the day for 5 days a week.

Fig. 1 presents the mean hourly values of the virtual heights and critical frequencies of the F_2 layer and the critical frequency of the E layer in graphical form. Fig. 2 gives the predictions of maximum usable frequencies which can be used for different distances of transmission during January 1949 by reflection at the F region over Calcutta. Table I gives the list of occasions when the E region was found to be abnormal and the corresponding penetration frequencies and heights. The occurrence of abnormal E ionization at night is a feature of the ionosphere for this month.

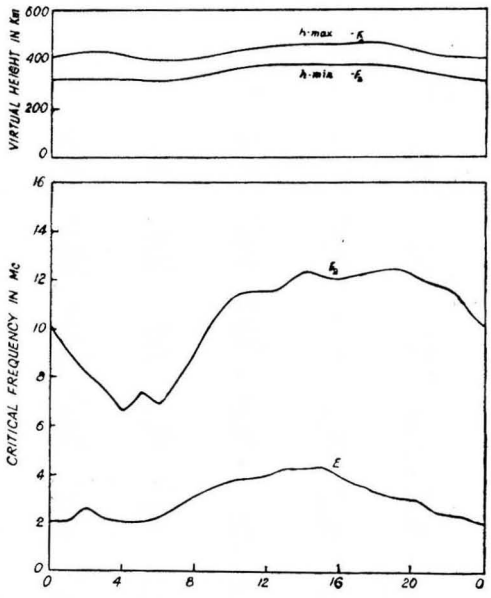
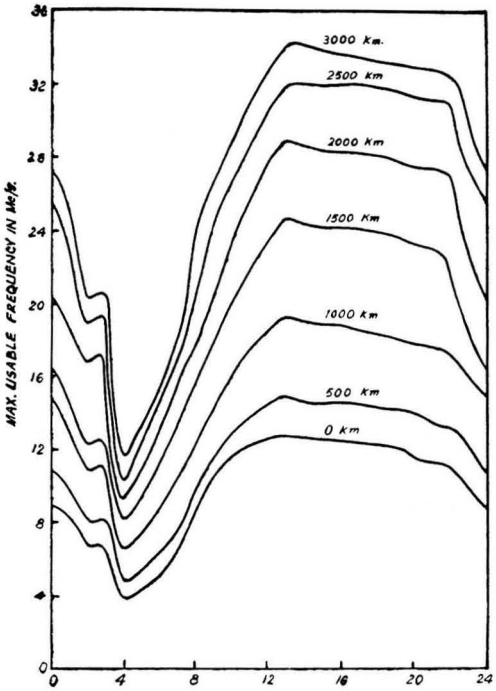


FIG. 1 — OCTOBER 1948.



AT POINT OF REFLECTION.

FIG. 2 — PREDICTED M.U.F. FOR TRANSMISSION VIA F_2 LAYER, JANUARY 1949.

TABLE I

MONTH & YEAR	DATE	HOUR	$f°E_s$ Mc.	h_{E_s} Km.
Oct. 1948	4	1800	4·00	120
		1900	3·75	120
		2000	4·25	120
		2100	5·70	120
		2200	6·10	120
		2300	5·70	120
	5	0000	5·25	120
		0100	4·90	120
		0200	4·55	120
		1700	4·20	120
		1800	3·85	120
		1900	3·70	120
		2000	3·55	120
		2100	3·25	120
		2200	3·00	105
		2300	4·00	105

TABLE I — *contd.*

Month & Year	Date	Hour	$f^{\circ}E_s$ Mc.	h_{E_s} Km.
Oct. 1948	6	0000	5·00	120
		0100	4·80	120
		0200	3·00	105
	7	2200	5·45	120
		2300	5·05	120
	8	0000	4·95	105
		0100	4·50	105
		0200	4·25	105
		0300	4·00	90
		0400	3·05	90
	9	2300	3·20	105

TABLE I — *contd.*

Month & Year	Date	Hour	$f^{\circ}E_s$ Mc.	h_{E_s} Km.
Oct. 1948	10	0000	4·50	105
		0200	4·65	105
	21	1400	4·75	135
		1500	5·90	135
		1600	6·20	135
		1700	6·30	135
		1800	6·45	135
		1900	6·55	135
		2000	7·00	135
		2100	7·00	133
		2200	6·85	135
		2300	6·65	120
	22	0000	5·90	120
		0100	4·10	120
		0200	3·90	105

Utilization of Chlorine

KRISHNA GOPAL MATHUR
National Chemical Laboratory, C.S.I.R., India

IT is estimated that about 54,000 tons of caustic soda are needed in India annually for various industrial purposes[1]. If produced electrolytically, this would result in the simultaneous production of about 48,000 tons of chlorine. Large quantities of chlorine will thus become available in India for industrial purposes as soon as new plants for production of caustic soda (some of which are now under erection) start functioning. Fears have been expressed that such quantities of chlorine may not find markets in India.

Chlorine is an important industrial chemical, and an increase in the production of chlorine should be welcomed by everybody interested in the development of chemical industries. The importance of chlorine as a raw material will be obvious from the fact that in 1940, in America[2] alone, production of chlorine rose to 5,00,000 tons a year. This quantity found consumption as follows:

	%
1. For the manufacture of chlorinated hydrocarbons, solvents, glycols, chlornaphthalenes, etc.	60
2. For bleaching operations in	
(a) Paper industry	21
(b) Textile industry	5
3. Sanitation	6
4. Other uses	8

During the war large quantities of chlorine were consumed by the military for the production of smoke screens and for various chlorine compounds used in chemical warfare.

The above analysis may be found instructive as it indicates the spheres in chemical industries which consume large quantities of chlorine in other countries. It is noteworthy that 60 per cent of the total quantity produced in America was consumed in the manufacture of chlorinated hydrocarbons and allied solvents, a fact that should be helpful in planning for the consumption of chlorine that is expected to be available in our country.

Almost the entire quantity of chlorine that is produced at present is consumed in the manufacture of bleaching powder or of bleach liquors. Some quantities are consumed in the treatment of water and for sanitation purposes, but little attention has so far been paid by Indian manufacturers to the numerous chlorine compounds that can be manufactured with chlorine and other materials which either exist or can be produced in India. It is proposed to consider the possibilities for the utilization of chlorine with this end in view in this paper. For the sake of convenience,

production of chlorine compounds may be considered under the following heads :

(1) Chlorohydrocarbon solvents.
(2) Chlorine compounds needed for military operations.
(3) Chlorine compounds (inorganic) needed for industrial purposes.
(4) Chlorinated oils, resins and rubber.

Chlorohydrocarbon Solvents

Production of cheap solvents in India may result in rapid developments in various fields of chemical industry. For instance, modern methods for the extraction of vegetable oils from oil seeds are based on solvent action, and developments in oil mills may soon follow the availability of cheap solvents. Use of solvents has led to remarkable developments in lacquer industry in other countries, and old methods involving the use of linseed and other vegetable oils in lacquer and paint industries in India may have to give place to different methods as soon as solvents are available at economic prices. Extraction of essential oils, of alkaloids and active principles of drugs, preparation of insecticides, degreasing of bones and metals and dry-cleaning operations are other instances of industrial processes which may develop rapidly if solvents are available.

According to McGovern[3] the following chlorohydrocarbons are manufactured in America, and find use as solvents in industries : methyl chloride, methylene chloride, chloroform, carbon tetrachloride, dichlorethylene, trichlorethylene, perchlorethylene, ethyl chloride, ethylene dichloride, 1, 1, 2-B trichlorethane, 1, 1, 2, 2, tetrachlorethane, pentachlorethane, hexachlorethane and propylene dichloride. In India, however, the production of solvents has so far been very limited on account of the difficulties in the availability of raw materials. The following chlorohydrocarbons may be manufactured in India from chlorine and hydrocarbons that are either available or can be produced from alcohol. The materials that will be needed for the production of chlorohydrocarbons are mentioned against each :

Solvents	*Raw materials*
Carbon tetrachloride	Chlorine and natural gas
Chloroform	Chlorine and alcohol
Ethylene chlorohydrin and glycols	Chlorine and ethylene
Trichlorethylene and perchlorethylene	Chlorine and acetylene (or alcohol)
Dichlorethane	Chlorine and ethane

Natural gas occurs in India, and ethylene, ethane and acetylene can be produced from alcohol. Processes for their manufacture from alcohol are simple, but no distillery in India has so far attempted to manufacture these hydrocarbons. The raw materials needed for the production of the above solvents, references to methods of their production, and their important industrial applications are briefly as follows :

(a) *Carbon Tetrachloride* (*Raw material : Natural Gas*) — Natural gas has been tapped at Jagatia and Gogha in Kathiawar and at Baroda[4]. In smaller quantities it is reported from wells in Saharwiel[5] (Mymensingh District). According to Barton[6] who investigated the resources for natural gas in Burma, on Indaw oil-fields alone 12 million cu. ft. of gas are produced per day, and in Thryetmyo District, gas is liberated at a depth of 2,525 ft. in quantities estimated at 39 million cu. ft. per 24 hr.

If natural gas is collected from these fields and chlorine from the new caustic soda chlorine plants, production of carbon tetrachloride may be started according to the methods described below. Sources of natural gas in India are considered poor, but it may be pointed out that the requirements are such that even if 10,000 cu. ft. of gas are available per day, an economic unit can be set up.

Tollocz-ko and Kling[7] prepared carbon tetrachloride by chlorinating natural gas at 400°C. in the presence of catalysts. Jones, Allison and Meigham[8] chlorinated natural gas containing 88·5 per cent methane, 10·1 per cent ethane, 0·4 per cent nitrogen. Baskeiville Reiderer[9] chlorinated natural gas containing 50-90 per cent methane by subjecting the mixture to silent electric discharge. Tizard, Chapman and Taylor[10] passed methane over pumice impregnated with copper chloride at 435°C. and obtained chlorinated hydrocarbons with carbon tetrachloride and chloroform as the main products.

Technical Applications — Carbon tetrachloride is known industrially under different names — " Tetra ", Tetracal ", " Asordin ", " Phoenixine " are some of the trade names under which it is sold in large quantities in America and in the U.K. One of the most important applications of carbon tetrachloride is as a fire extinguisher, particularly for fires involving volatile organic solvents. Industries which consume large quantities of tetrachloride include petro-

leum refineries (where it is used as a solvent for gasolene, paraffin and petroleum), and rubber factories where it is consumed as a constituent of solvents. During the war large quantities of carbon tetrachloride were needed for the manufacture of smoke screens. Other industrial operations for which carbon tetrachloride may be considered as a solvent are (a) dry cleaning ; (b) degreasing of bones in glue plants ; (c) extraction of atropine, strychnine and other alkaloids in pharmaceutical works ; and (d) degreasing of metal parts preparatory to plating, galvanizing, etc. It may also be used as a refrigeration medium, as an ingredient of shoe polishes, and as a constituent in the preparation of insecticides. The demand for a cheap solvent, particularly for dry cleaning and degreasing, has increased considerably during recent years.

(b) *Chloroform (Raw material : Alcohol)* — Alcohol is produced in large quantities in India, and its production is likely to increase in the future. The industrial importance of some of the compounds that can be produced from alcohol (e.g. acetone, ether, hydrocarbons, acetic acid, etc.) is so great, that it may be more profitable for some of the distilleries to utilize the alcohol for the production of these industrial chemicals.

When alcohol is distilled with bleaching powder, chloroform is produced. The method is an old one and is still used. Acetone is now more commonly used in other countries, but in view of the fact that Indian distilleries produce alcohol, the older method may be advantageous. A variation consists in chlorinating absolute alcohol with anhydrous chlorine gas and treating the chloral hydrate thus formed with alkali[11].

Production of chloroform from alcohol should be a matter of special interest for such firms as have their own distilleries and are planning for installation of caustic soda plants.

Technical Applications — Like carbon tetrachloride, chloroform is extensively used for the extraction of oils, fats and waxes ; and for degreasing bones, metal surfaces, furs and wools. One of its most important uses is in the pharmaceutical industry where, besides its well-known use as an anaesthetic, it is employed as a constituent of antiseptic preparations, inhalents, lineaments, and as a preservative for various vegetable drugs. With carbon tetrachloride and gasolene, it finds use in dry-cleaning operations. Paper mills consume large quantities of chloroform for degreasing paper stocks. Chloroform has recently been used in the manufacture of several food preparations, particularly in making food flavours and in the manufacture of vitamins. During the war, large quantities of chloroform were consumed in the manufacture of hexachlorethane needed in the production of smoke screens.

(c) *Ethylene Chlorohydrin & Glycols (Raw material : Ethylene)* — Production of ethylene from alcohol is a simple process. Number of catalysts have been developed that effect almost a quantitative conversion of alcohol into ethylene. Sprent[12] described the production of ethylene by passing alcohol vapour over amorphous alumina at 310°C. According to Sanderens[13], the following catalysts have proved highly efficient :

Catalyst	Temperature °C.	% ethylene in gas
Al. phosphate	320	99·5
Al. silicate	270	99·5
Kaolin	270	97·5
Al. sulphate (anhydrous	265	99·5
Ppt. alumina	250	99·5

Ethylene, ethane and acetylene are raw materials for many important industries and in the absence of large quantities of natural gas, their production from alcohol deserves every consideration from those interested in the planning of new industries.

The production of ethylene chlorohydrin and glycols can be accomplished according to the following processes :

Chlorine and ethylene are agitated in water. The solution is neutralized with lime and ethyl chlorohydrin distilled over[14]. According to a British Patent[15], water is circulated through a tower where it is treated with chlorine gas, forming a solution of hydrogen oxychloride and hydrogen chloride. It then passes to a second tower where it comes into contact with ethylene which at 0°-20°C. combines with hydrogen chloride to form ethylene chlorohydrin. The latter decomposes on boiling with water directly into glycols which find numerous applications as industrial solvents.

(d) *Trichlorethylene & Perchlorethylene (Raw material : Alcohol) Ethylene & Acetylene* — Starting with 90 per cent industrial alcohol, it is possible to manufacture trichlorethylene and perchlorethylene, two chlorohydrocarbons which have acquired considerable importance as solvents. According to the scheme for their manufacture

described below, chlorination is involved at three stages.

Production of ethylene from alcohol for industrial purposes is well known, but that of acetylene (which is really the raw material for the above solvents) is usually carried out from calcium carbide. Carbide is not manufactured in India at present, but the Heavy Chemicals and Electrochemical Industries Panel have recommended[16] 7,000 tons as the target, and the Government of India have granted an import licence for a 5,000-ton plant to be installed in Bihar. The absence of this basic industry has retarded the development of a large number of chemical industries in India. When the carbide industry is established, the manufacture of trichlorethylene and perchlorethylene will be easy, as the first three stages, which represent production of acetylene from alcohol may in that case be completely eliminated. But as long as carbide is not available, production of these solvents may be considered from alcohol.

The series of chemical reactions that are involved in the production of trichlorethylene and perchlorethylene from alcohol (or acetylene) and chlorine are briefly as follows:

1. $C_2H_5OH \longrightarrow C_2H_4$
2. $C_2H_4 + Cl_2 \longrightarrow C_2H_4Cl_2$
3. $C_2H_4Cl_2 \xrightarrow{\text{alkali}} C_2H_2 + 2HCl$
4. $C_2H_2 + 2Cl_2 \longrightarrow C_2H_2Cl_4$
5. $C_2H_2Cl_4 \xrightarrow{\text{alkali}} C_2HCl_3$ (Trichlorethylene) $+ HCl$
6. $C_2HCl_3 + Cl_2 \longrightarrow C_2HCl_5$
7. $C_2HCl_5 \xrightarrow{\text{alkali}} C_2Cl_4$ (Perchlorethylene) $+ HCl$

Technical Applications—Trichlorethylene is mainly used for the extraction of oils and fats, and for degreasing fish scrap, textiles, and metals. In India, trichlorethylene is likely to find use in dry cleaning, oil mills, paper mills, electroplating, and pharmaceutical works.

Perchlorethylene is sold in other countries under the names "Etdine", "Perwin", and "Tetralex". Its main uses are: (i) in textile mills as an ingredient of compositions used for waxed cloth, for treating fibres and fabrics for producing various designs; and (ii) in the manufacture of photographic films where it is used as a solvent for cellulose acetate, or nitro-cellulose. During the war large quantities of perchlorethylene were used for the manufacture[17] of smoke screens.

(e) *Dichlorethane (Raw material: Ethane)*—Like ethylene, ethane is produced by the catalytic dehydration of alcohol. Boomer and Morris[18] obtained ethane by the catalytic decomposition of alcohol at 300°-500°C. with silica gel. When heated at 615°C. at a pressure of 170 atm. in the presence of aluminium-copper catalysts, the proportion of ethane in the resulting gases was found to be as high as 74·8 per cent[19]. When ethane and chlorine are led over activated charcoal at 100°-300°C., dichlorethane is produced[20].

Dichlorethane is extensively used as a solvent for rubber. It readily dissolves bakelite, camphor, rosin, vinyl and glyceryl phthalates resins, bees-wax and carnauba wax. It has found numerous applications in the manufacture of plastics and varnishes, as a medium in refrigeration plants, and as a solvent in dry-cleaning operations.

Chlorine Compounds in Military Operations

Two types of chlorine compounds have been used during the war: (i) those used in the preparation of smoke screens; and (ii) those used for the manufacture of lachrymatory agents, vesicants and toxic gases.

(i) *Smoke Screens* — Berger mixture, popularly known as "BM", consists of carbon tetrachloride 41 per cent, zinc dust 35·4 per cent, sodium chlorate 9·3 per cent, ammonium chloride 5·3 per cent, and magnesium carbonate 8·3 per cent[21]. This mixture was used in large quantities in World War I. Improvements over BM have since been reported. The H.C. mixture consists of solid hexachlorethane 50 per cent, zinc dust 28 per cent, and zinc oxide 22 per cent. Hexachlorethane, the chief constituent in the mixture, is prepared either by heating chloroform in a red-hot tube[22], or by heating carbon tetrachloride to 160°C. with arsenic[23].

Another type of smoke screen is represented by titanium tetrachloride and silicon tetrachloride. Tin tetrachloride has been used in certain countries, but as tin is not available in India in any considerable quantity, it may not be possible to manufacture this tetrachloride on a commercial scale. Titanium tetrachloride ($TiCl_4$), popularly known as "FM", can be manufactured in India when required. The process consists in mixing titanium ore with carbon and heating the mixture to about 650°C. in a current of chlorine.

Silicon tetrachloride ($SiCl_4$) is prepared by treating silicon carbide with chlorine.

(ii) *Lachrymatory & Vesicant Agents & Toxic Gases :*

(a) Chloracetone, $CH_3.CO.CH_2.Cl$, also known as " Tonite " is produced by passing chlorine through acetone. It lachrymates the eyes in concentrations as low as 0·018 mg. per litre[24].

(b) Chloropicrin, $C.Cl_3.NO_2$, also known as " Aquinite ", " Klop ", " PS " and " NC ", produced by the action of chlorine on picric acid or its salts, induces lachrymation at as low a concentration as 0·002 mg. per litre ; and at 2·00 mg. per litre it is lethal.

(c) Chloracetophenone, $C_6H_5.CO.CH_2.Cl$, known under the name " CN ", is prepared by chlorinating acetic acid, followed by chlorination of chloracetic acid in the presence of sulphur chlorides. The chloracetyl chloride is finally treated with benzene in the presence of anhydrous aluminium chloride.

Chloracetophenone is solid and resistant to heat and moisture, and on account of these qualities it was used in large quantities during the last war. Its production in India will depend on the availability of benzene and acetic acid. Benzene is produced by certain coke works in Bihar, but acetic acid is not manufactured in sufficient quantities in India at present.

(d) Mustard Gas — According to the process that was employed by the Germans in Great War I, mustard gas is obtained from ethylene chlorhydrin.

The production of ethylene from alcohol on an industrial scale has already been considered. For distilleries producing ethylene, the production of mustard gas should be possible.

(e) Chlorvinyldichlorarsine — This compound was developed in America at the close of World War I and is described as " America's principal contribution to the *Materia Chemica* of the World War ". This was an improvement over mustard gas or ethyldichlorarsine, and large quantities were manufactured during the war. The main raw materials were acetylene and arsenic chloride.

The production of acetylene from chlorine and alcohol has been discussed in connection with the preparation of chlorohydrocarbon solvents. Arsenic, the other raw material, occurs in India. Deposits of orpiment and realgar are known in Shankalpa glacier in Kumaon[25]. Mallet[26] has described the occurrence of arsenical pyrites on Sampthar hills (Darjeeling). Arsenic is also obtained as a by-product in the metallurgical treatment of several ores. Thus, if necessary, it would be possible to take up the production of such dangerous chemicals as ethyldichlorarsine and chlorvinyldichlorarsine and other compounds of the series.

Chlorine Compounds (Inorganic) Needed for Industrial Purposes

The demand for bleaching powder from the paper and textile mills in India has increased considerably during recent years. Since lime, which is the only other raw material needed for the production, is available, the manufacture of bleaching powder has been started in most of the factories producing chlorine. Potassium chlorate can be manufactured from lime and potassium carbonate. Sulphur chlorides, mainly used in the rubber industry, may be manufactured with imported sulphur even as sulphuric acid or other sulphur compounds are being manufactured at present. Chlorides of tin, mercury and phosphorus are produced by the interaction of chlorine with the respective elements, but these are not produced in India. It may, however, be noted that chlorides of tin, phosphorus and mercury are important materials, and their production, even from imported materials, may be considered on account of the large number of new industries that are likely to develop if these chemicals are produced.

Chlorination of minerals has led to the production of important salts of metals on a commercial scale. Maier[27] chlorinated chromite ore (mixed with carbon and quartz, and reduced to 100 mesh) at a temperature of 900°C. On sublimation chromium chlorides were obtained. India produces about 60,000 tons of chromite annually[28], and only a part of this is worked up for the production of chromium compounds. The chlorination process of Maier may be adopted for production of chromium salts required in the tanning and plating industries and for the manufacture of chromium pigments.

The chlorination of pyrites has been investigated by Ezdakov[29] who used pyrites containing 49 per cent sulphur and obtained 82 per cent conversion. Ezdakov has shown that the chlorination resulted in the production of ferric chloride and sulphur chloride both of which are compounds of

considerable industrial importance. It may be noted in this connection that quantities of iron pyrites exist in India particularly in Simla hills, and they have not been utilized so far, as their use in the manufacture of sulphuric acid has not been found economically feasible. According to Pristonfil[30], treatment of zinc blende with ferric chloride results in the formation of zinc chloride and separation of sulphur. Zinc ores are known to occur near Udaipur in Rajputana. Combining, therefore, the results of Ezdakov and Pristonfil, it may be possible to utilize chlorine (from alkali plants), iron pyrites (from Simla hills) and zinc blende from Udaipur, and work out schemes for the production of sulphur chlorides, zinc chloride, iron chloride and sulphur. The industrial importance of these chemicals is well known.

Chlorination of titanium ores has been investigated by a number of workers. The methods employed consist in mixing the ore[31] with 30 per cent carbon, and heating the mixture to about 650°C. A fused mass consisting of titanium carbonitride ($Ti_5C_4N_4$) and titanium carbide is formed which can be converted into $TiCl_4$ by heating in a current of chlorine. Muskat and Tylors[32] have described an apparatus for the preparation of titanium chloride by a continuous process, in which conditions are so regulated that chlorine and the ore react at 600°C., attained as a result of the heat of reaction. In another process described by Taggent[33], briquettes are made by bonding rutile and charcoal, and chlorinated at 700°C. The condensate obtained contains titanium tetrachloride 99 per cent, silica 0·5 per cent, and iron 0·002 per cent.

Chlorination of bauxite has been investigated by Finke and Marchi[34], who worked out details of a process for the production of aluminium chloride from bauxite.

Chlorination of Oils, Resins & Rubber

Considerable work has been done on the chlorination of mineral oils in other countries, but oils of mineral origin may not be available for the preparation of chlorine compounds in India. Vegetable oils are available, but their chlorination has not led to any useful results so far. Chlorination of animal fats in some cases has yielded valuable products. Whale oil, on chlorination, yields products which according to a British Patent[35] are used as bonding agents for abrasives, plastics, rubber goods and composition leather substitutes. Chlorinated sardine oil has found use in germicidal preparations. Fish oil is produced in large quantities in Madras and Bombay, and its industrial possibilities have not been fully explored. It may be mentioned in this connection that owing to the scarcity of mineral oils in India, difficulties are experienced in finding substitute oils which may be used for larvicidal purposes, and chlorinated fish oils may be investigated as possible substitutes for mineral oils for anti-malarial operations.

Chlorination of hydrocarbons has resulted in the development of a large number of resins of industrial importance. Chlorinated diphenyl resins or "Arochlors", for instance, are obtained on chlorination of diphenyl. They are extensively used for the manufacture of insulating compositions. Tung oil or linseed oil varnishes prepared with "arochlor" are known to be highly resistant to water and alkalies. Wood and textiles when treated with "arochlors" are rendered flame-proof.

Diphenyl, the only material needed for this preparation, is not manufactured in India, but its production from benzene is simple enough. According to certain American Patents[36] benzene vapour when led at 600°-800°C. through a lead bath is converted into diphenyl. Magnetic oxide of iron is used as catalyst at 800°-950°C. in large-scale manufacture.

Chlorination of naphthalene results in the production of a mixture of chlornaphthalenes with a melting point ranging from 60°-125°C. "Seekay" wax (*I.C.I.*), and "Halowax" are two well-known chlorinated naphthalenes. On account of their non-inflammability, chloronaphthalenes are used as binding agents in the manufacture of condensers, and for insulating and sealing compositions for electric goods. During the war, chloronaphthalenes were in great demand for the production of smoke screens and for the damp-proofing of explosives. Emulsified preparations of some of the chloronaphthalenes are extensively used as insecticides[37]. In recent years chloronaphthalenes have found use as substitutes for camphor in the production of nitro-cellulose films, and in the production of polishes. The manufacture of chloronaphthalenes is, therefore, likely to be a profitable industry in India. There are other chlorinated hydrocarbons which have found industrial applications in other countries (e.g. resins from chlorinated cymene);

but they are not likely to be of importance in India on account of the difficulties involved in obtaining suitable hydrocarbons.

Chlorinated Rubber — Raw rubber is produced in Madras, Mysore, Travancore and Cochin. During 1936-40 India exported 23,327,653 lb. of raw rubber[38]. When chlorine is passed into solutions of raw rubber, chlorinated resins employed in the preparation of wrapping sheets, moulded products, etc., are obtained. Varnishes produced from chlorinated rubber have been extensively used as coatings for aircraft and automobiles. " Tonsite ", a chlorinated product used in Germany during the war, is a non-inflammable powder highly resistant to the action of acids, alkalis or salts. Transparent sheets, laminated products, and waterproof cloth have been obtained by Karimullah and Uma Shankar[39] by chlorinating cyclized rubber.

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Indian Standards for Refractories

THE *Engineering Division Council* OF THE *I.S.I.* has brought out three Draft Indian Standards on Fireclay Refractories. They are concerned with Moderate Heat Duty Fireclay Refractories, Group ' A ' ; Moderate Heat Duty Fireclay Refractories, Group ' B ' ; and High Heat Duty Fireclay Refractories. These have been prepared by an expert Sectional Committee composed of representatives of manufacturers and consumers of refractories in India. The Committee is headed by Dr. H. K. Mitra of the *Tata Iron & Steel Co. Ltd.*, Jamshedpur.

The Drafts consist of standard specifications for different types of refractories produced in India, and the methods for chemical analysis, determination of pyrometric cone equivalents under load for full-size bricks as well as for sections of bricks, the porosity, and resistance to spalling. The object of the specifications and tests is to provide an agreed method of evaluation for the three different types of refractories.

These Drafts on fireclay refractories have been widely circulated to industrialists and technologists in the field. Comments will be received till 29th February 1949 by the Director, *Indian Standards Institution,* ' P ' Block, Raisina Road, New Delhi.

Scope for the Cultivation of Medicinal Plants in India

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(*Continued from Dec. 1948 issue*)

11. Claviceps purpurea Tulasne (Ergot)

THE sclerotium of this fungus arising in the ovary of rye, *ecale cereale* Linn., is known as "Ergot". The drug is specially cultured in Russia, Poland, Spain and Portugal. It is the only oxytocic or uterine tonic drug known which is effective on administration by the oral route. It is largely used in India where proper medical aid at child-birth is often beyond the reach and means of the bulk of rural population.

It is observed by R. Tyller[8] that barley in the upper province of India was often affected with a disease similar to, if not identical with, ergot. The same or apparently the same disease was observed on rice and oates during recent years. No effort was, however, made to develop ergot from Indian sources and the entire supply comes from Europe.

A good deal has been written on the poisonous properties of barley, wheat and millet which, to outward appearance, seem to be of good quality but which contain a fungus most probably resembling ergot. Recently a fungus, most probably ergot, was observed on the grasses in Simla hills[9] and on sugarcane and on *Cynon dactylon* in Mysore State. This has been confirmed.* In fact ergot has been successfully produced in India.

Ergot production was taken up by Mr. M. K. Thomas[10] in 1942 in Madras. The exploratory field experiments were conducted over 2 acres of rye raised in the Government Research Station in the Nilgiris. The botanical, chemical and pharmacological examination of ergot grown in the Nilgiris satisfies all the requirements laid down in the *British Pharmacopoeia*[11].

The water-soluble alkaloid of ergot, ergometrine and the water-insoluble ergotoxine-ergotamine present in Indian ergot have been determined. The results are as follows:

	%
Total alkaloids (calculated as ergotoxine)	0·1213
Water-insoluble alkaloids (calculated as ergotoxine)	0·1169
Water-soluble alkaloids (calculated as ergometrine)	0·237

Pharmacological Examination — Using Broom and Clark's method of assay with rabbit uterus, the ergotoxine content in the liquid extract (*B.P.* method) lies between 0·085 and 0·145 per cent (mean, 0·115 per cent). This would not probably be far from the true value of ergotoxine content in the liquid extract.

It is evident that ergot artificially produced on rye in India is of good quality. It is in certain respects better than many of the imported batches of ergot.

Since the exploratory field experiments on the production of ergot in the Nilgiris have proved successful and ergot of standard quality has been produced, the Director of Agriculture, Madras, prepared a scheme for the production of ergot on a large scale. The following extract from the personal communication of the Government Mycologist of Madras Presidency show the pro-

* *Botanical Examination* — Length of sclerotia — 2 to 3 cm.; smallest size 1 cm. Some sclerotia are cylindrical with a thick base and nearly pointed tip, others are markedly curved. Appearance, dark-coloured hard structures 4 to 5 mm. thick with a yellowish core. The length of the sclerotia imported from Europe varies from 1 to 3 cm. These are nearly cylindrical, slightly curved with longitudinal furrows, extensively dark brown with a pinkish core.

Transverse Section — The outer portion consists of small dark-coloured cells, the colour of which is changed to brownish red on the addition of sulphuric acid. The rest of sclerotia consists of nearly colourless, closely compacted, very small oval or round cells. Imported sclerotia of ergot also shows more or less similar appearance, odour and taste which are characteristic.

Chemical Examination — Total alkaloids of ergot 0·13014 per cent (130·14 mg. per 100 gm.) *British Pharmacopoeia* specifies 0·05 per cent (50 mg. per 100 gm.).

gress of the culture and production of ergot carried out in the Nilgiris :

" Ergot of rye is being produced on the Nilgiris from 1943 onwards. Rye is specially grown for this purpose, as it is not one of the cereals cultivated by the local people. The total area put under rye for this purpose does not exceed 100 acres.

" The production of ergot is at present limited to meet the requirements of the province and the surplus, if any, is offered for sale to private pharmaceutical firms. The target of production is at present kept at 2,500 lb. of ergot per annum. But the locality is well suited for large-scale production of ergot to meet the entire requirements of India as it has favourable climatic conditions.

" The quality of the ergot is being improved progressively by continuous selection of the strains exhibiting high alkaloid contents. Thus it has been possible to raise the total alkaloid content of this bulk produce from 0·19 per cent to 0·4 per cent calculated as ergotoxine. Further work on these lines is in the progress."

Shillong (Assam) is also suggested to be a suitable place for culturing ergot[12]. It enjoys a temperate climate and heavy rainfall. The physical features and some of the meteorological conditions of Shillong compare well with those of New South Wales in Australia where, during recent years, culture of ergot has attained remarkable success. Besides Shillong experiments for culturing ergot may be undertaken in Simla Hills and Mysore State where locally growing grasses have shown to be infected with a similar fungus.

12. Digitalis purpurea Linn. (Foxglove) — This plant is a native of Western Europe but is now being extensively cultivated in many parts of the world, particularly in England, Germany, Austria, etc. Digitalis leaves are largely used as a heart tonic. Large quantities of digitalis preparations used in India are imported from abroad. It has been observed that preparations of digitalis, especially the tincture, lose 20 to 40 per cent of their potency within a few months under climatic conditions prevailing in India and are rendered useless for therapeutic use.

So far as is known, none of the species of digitalis is indigenous to India. The cultivation of *Digitalis purpurea* was started on an experimental scale many years ago. Regular crops now grow in some of the hill stations, particularly in Kashmir. The Forest Department of Kashmir State is cultivating the plant on a large scale at Tangmarg and in Kishtwar. Regular crops of leaves are obtained every year which, on biological assay, have been found to be of excellent quality.

Digitalis was also grown in Mungpoo near Darjeeling and in the Nilgiris, but as the leaf matures in these places during the rainy season, drying and curing of the leaf is difficult under natural conditions ; artificial means of drying, e.g. by heat, involves the risk of the glucosides being decomposed and becoming toxic. Tinctures prepared from the leaves obtained from different places were biologically assayed and clinically tried[13] with good results.

The tinctures made from Darjeeling leaf varied a great deal in their activity as revealed by biological assay and clinical trials ; they were not nearly so good as tinctures made from the Kashmir leaf. The tinctures made from the Nilgiri leaf were toxic, and were not therapeutically effective. The leaf grown in the Nilgiris could possibly be improved by better methods of cultivation and drying.

Digitalis grows well in open spaces at altitudes of 6,000′ above sea level. Suitable localities can be selected in the Western Himalayas and the plant can be cultivated with success. Its cultivation on a large scale in India has a good future.

Digitalis lanata Ehrh. also grows well in Kashmir and leaf of excellent quality is obtained. This species is preferred by many as it is less cumulative in action, rapidly slows the pulse and its glucosides are more stable. Its preparations, therefore, deteriorate less in the tropical climes than *D. purpurea*. This variety grows well in Tangmarg (Kashmir) at an altitude of 7,000′ above sea level and it could be cultivated in other suitable localities in India.

13. Ephedra gerardiana Wall. — The official source of ephedrine is the plant *Ephedra sinica* Stapf. and *Ephedra equisetina* Bunger. and other species which are indigenous to China. *E. gerardiana* Wall. and *E. nebrodensis* Tineo also contain the alkaloid and these plants are indigenous to India both in Northwest Himalayas and in the Sikkim area. Many species of ephedra grow in Northern India, e.g. in Bushahr Division, Chakrata, Kangra, Kulu, Baluchistan, Kashmir, Hazara, Kagan, Trans-Frontier territory and Wazirastan. Specimens from various places

have been analysed and it has been shown that ephedras growing in the drier regions of North-west India contain a high percentage of alkaloids ; in many cases higher than the alkaloidal contents of the Chinese species recorded by Read and Feng[1]. Among the Indian species *E. nebrodensis* is the richest and *E. intermedia* the poorest so far as its ephedrine content is concerned. The Indian species also contain a larger percentage of pseudo-ephedrine than those growing in China.

In the present political set up of the country, India has limited sources of ephedra falling short of estimated requirements. Ephedra grows in the proximity of Kashmir valley only in very small quantities. It is, therefore, necessary either to extend its cultivation in the areas where it is known to grow, or to introduce it into suitable localities in Northern Himalayas where the plant is reported to be growing in a state of nature.

14. Eugenia aromatica (Linn.) Baill. (Clove) — The dried flower buds of this plant are known as " Clove ". It is an evergreen tree indigenous to Malacca Islands and is cultivated in Zanzibar, Pemba, the Amboyan Islands, Penang, Madagascar and, to a lesser degree, in the Seychelles, Reunion, Mauritus and Ceylon. The plant has been cultivated in Government gardens in South India and Central Travancore with success[8].

Cloves are aromatic, stimulant and carminative and are largely used in medicine and as a spice and flavouring agent also. They are used in perfumery and in the manufacture of " Vanillin ". The demand for clove oil has increased, particularly, for aromatizing cigarette tobacco. 90 per cent of the world supply of cloves is obtained from two islands, Zanzibar and Pemba, where it forms the chief industry. India is one of the most important consumer of cloves and large quantities of clove oil are imported into India annually. The tree thrives in tropical climate and prefers volcanic soil in a sloping position and a certain amount of sand. It thrives in places with an annual rainfall of about 75" or more[14]. There is no reason why clove plantations should not flourish in South India if systematic cultivation is undertaken on scientific lines.

15. Eucalyptus—There are about 25 species of eucalyptus which yield the oil of commerce, chief amongst which are *E. globulus* Labill. and *E. dumosa* A. Cunn. Australia may be said to be the home of eucalyptus inasmuch as it comprises 75 per cent of the vegetation of that continent. Eucalyptus oil is distilled from the fresh leaves and terminal branches of the tree and is an important article of commerce in this country. Large quantities of the oil are employed in scenting soaps and also in separating mineral sulphides from their ores by flotation. The oil is used in medicine for its powerful antiseptic and disinfectant properties. Of the constituents of the oil cineole (eucalyptol) is the most important ingredient from the medicinal point of view.

Eucalyptus trees are not indigenous to India but many species are grown in the Nilgiris. The tree is valuable on account of the essential oil and the dye, perfumes and kino which originate from it and these are all very valuable products. Attempts have been made during the last 50 years to cultivate it in many parts of the globe, e.g. California, Spain, South Africa, Algeria, East Africa, Mauritania, Java, Malaya. In India Eucalyptus was introduced before 1870 and the most successful results were obtained on the Nilgiri Hills where at present there are several large plantations covering an area of over 2,000 acres at altitudes of 4,000' to 8,000'. About 24,000 lb. of oil is distilled annually from these plantations which is not even a fraction of what the country needs. Large quantities are, therefore, imported.

The oil obtained from the leaves growing in the Nilgiri plantations was studied by Puran Singh[15]. It contains pinene, cineole, sesquiterpene and free alcohols in small amount. Phellandrene is present in the Australian oil in fair quantity ; it is very irritating to the bronchial mucosa, especially when inhaled. Butyric and valerianic aldehydes also are present in the Australian oil. Both these constituents are absent from the Indian oil and, therefore, it should be preferred for medicinal purposes. The constants of the oil are : specific gravity, 0·9065 to 0·9155 ; optical rotation, +5° to 10° ; refractive index, 1·463 to 1·466 ; saponification value, 8·9 to 20 ; cineole 60 per cent.

The properties of the Indian oil compare favourably with the standards laid down in the *British Pharmacopoeia*, and the medical department of the Madras Government has used the Nilgiri oil with satisfactory results.

In Dehra Dun *E. terebaormis* and *E. creebra* have been cultivated, but the oil

obtained from their leaves does not come up to the standard of the *British Pharmacopoeia* and is not used in medicine. It is, therefore, important to cultivate the proper species, and if this is done, there would be a large demand for this oil in the country. Extensive trials in the cultivation of Eucalyptus were carried out in various places in Northern India, i.e. Saharanpur, Lucknow, Kulu, Kangra valley, Chamba and Ranikhet[8]. As a result of these trials the places most suited for the cultivation of *E. globulus* in Northern India have been found to be Ranikhet, Kangra, Kulu and Chamba, and economic propagation of the plant can be undertaken in these localities.

16. Glycyrrhiza glabra Linn. (Liquorice) — Liquorice is cultivated in Italy, France, Germany, China, Siberia, Asia Minor and Turkistan. It grows in the Andamans and other places but the main bulk of the drug is imported into India from the Persian Gulf, Asia Minor and Siberia.

Preparations of liquorice are popular in Western medicine as a mild laxative and in the treatment of cough. It is used as a basis for throat lozenges and for concealing the acrid taste of many nauseating medicines. It is also used in the indigenous medicine.

The plant is easy to grow in river valleys in a warm climate and requires a deep and moderately rich loamy soil. Experimental cultivation was undertaken in the forest nursery at Baramulla at an altitude of 5,500′ above sea level in Kashmir and also at the *Indian Institute of Agricultural Research*, New Delhi with success. It will grow well in the temperate regions of the Himalayas, e.g. Himachal Pradesh and in the hill districts of South India.

17. Hyoscyamus niger Linn. (Henbane) — It is a well-known medicinal plant which is extensively used for its sedative and other properties. It grows wild at an altitude of 5,000′ to 9,000′ in the temperate Himalayas. The supply of the drug from the wild plants is insufficient and irregular, and the need for its cultivation has been recognized since 1839. It was successfully grown at the *Royal Botanical Gardens*, Calcutta, Lyallpur, Saharanpur, Agra, Ajmer and Bombay, but the alkaloidal content was found to be low and the drug did not come up to the standard required by the *British Pharmacopoeia* ; the cultivation of the plant thus dwindled down. The warm climate of Saharanpur and other places was entirely different from that which the plants enjoy in a state of nature[8].

Hyoscyamus grows wild throughout the Kashmir valley. Its experimental cultivation was started at suitable places at Yarikah and Drang forest nurseries in Kashmir, 7,000′ above sea level. An analysis of the hyoscyamus leaves collected from the wild and cultivated plants from the Kashmir valley showed that they contained 0·071 and 0·079 per cent total alkaloids as compared to 0·035 per cent contained in leaves of cultivated plants from Saharanpur[7].

The results of artificial propagation in Kashmir are encouraging and the Forest Department of Kashmir is planning to extend the cultivation of the drug at suitable altitudes. Attempts to cultivate the plant in other places in the Himalayas such as Kulu Valley and Simla Hills need attention.

H. muticus Linn. — The leaves of *Hyoscyamus muticus* Linn. contain a higher percentage of total alkaloids than *H. niger*. The plant is not indigenous to India but can be successfully propagated under the climatic conditions suitable for *H. niger*. In fact, successful experimental cultivation of *H. muticus* has been reported from various places, i.e. Saharanpur, Lyallpur. Seeds of *H. muticus* have been tried in the nurseries of the Forest Department of Kashmir with success.

18. Hyssopus officinalis Linn.— *Hyssopus officinalis* is indigenous to countries bordering the Mediterranean Sea and also in Central and Eastern Europe. In India the plant grows wild in the Western Himalayas at altitudes ranging from 8,000′ to 10,000′ from Kashmir to Kumaon. The leaves of the plant are used for flavouring purposes and it is said to be an ingredient of some of the French liquors. The collection of the plant from natural occurrences is not easy, and it would be worthwhile cultivating the plant in suitable places. The plant has been successfully raised in the forest nursery at Baramulla at 5,500′. The fresh and dry herbs collected from the nursery, on steam distillation, gave the following results[4] :

	Local product		*Foreign product*	
	Fresh	Dry	Fresh	Dry
Oil yield, %	0·36	0·7	0·07-0·39	0·3-0·9
Sp. gr. of oil, 15°C.	0·9375		0·9270-0·9450	
Ref. index of oil, 20°C.	1·4778		1·4730-1·4860	

The cultivation of the plant can be extended in Kashmir and other regions of the temperate Himalayas such as Himachal Pradesh, Kulu, Kangra valley and other places with altitudes of 4,000′ to 6,000′.

19. Ipomoea purga Hayne — It is a climbing plant indigenous to the eastern slopes of Mexican Andes. The dried tubers of the plant are known as *jalap* and are extensively used as a purgative in medicine.

It has been observed that the resinous substance obtained from the root of *I. turpethum* forms an excellent substitute for the official drug. The plant grows throughout India up to an altitude of 3,000′. The local supply is limited and large quantities of *jalap* are imported from abroad.

The cultivation of the plant was tried in Bengal and the Nilgiris as long ago as 1870. Though the experimental cultivation was not successful in Bengal, it gave very good results in the Nilgiris. Since then it has been cultivated on a commercial scale in Ootacamund and other parts of the Madras Presidency by Government and private agencies. Locally grown *jalap* tubers when extracted after 4-5 years weighed from 5 to 10 lb. and on analysis were found to be as rich in the purgative principles as the best imported tubers from America.

There is a great demand for this drug in India, and its further propagation can be taken up in areas where potatoes flourish. It has been observed that conditions necessary for potato cultivation are equally suitable for *jalap* cultivation. The cultivation of this plant could be tried in the Eastern Himalayas at an altitude of 3,000′ to 6,000′ in Himachal Pradesh where potato is cultivated on an extensive scale and forms the major cash crop.

20. Lavandula officinalis Chaix (Lavender) — The plant is a native of South Europe and grows on the shores of the Mediterranean Sea extending into Western Africa. It is extensively cultivated in England and U.S.A. Lavender oil is a constituent of a large number of pharmaceutical preparations and is extensively used in perfumery. It is not indigenous to India and the entire quantity of about 1288 gallons valued at more than a lakh of rupees is imported from abroad annually.

Experimental cultivation of the plant in the Government Botanical Gardens in the Nilgiris has not given very promising results. It has been successfully grown in the forest nurseries at Baramulla and Chattarnar in Kashmir valley at altitudes of 5,500′ above sea level.

The analytical data of the oil obtained from the Kashmir plants are comparable to those of the English oil :

	Local grown	*English*
Yield of oil, %	2·4 (dry flowers)	0·8-1·7 (fresh flowers)
Sp. gr., 15°C.	0·919	0·882-0·90
% of ester	24·8	7-14

Large-scale cultivation of the plant such as is being planned by the Forest Department in Kashmir will be a commercial success. The plant should also do well in the Northern Himalayas, e.g. Simla Hills. There is a large demand for this oil in the soap industry.

21. Lobelia inflata Linn. (Lobelia) — Lobelia consists of the dried aerial parts of *Lobelia inflata* which is an erect herb indigenous to and also cultivated in the Eastern States of America. It is used as an expectorant and in the treatment of chronic bronchitis.

The plant does not grow in India but an allied species *L. nicotianifolia* Heyne grows in a state of nature in South India and Bombay and has been used as a substitute for *L. inflata*. Samples of *Lobelia nicotianifolia* collected in October and November from various parts in India, i.e. Poona, Madras, Tellicherry, etc., show that the Indian drug is even better than the official variety in so far as active principles are concerned. The lobeline content of the drug is 4 times as high (1·8 per cent) as that of an authentic sample of *L. inflata* obtained from New York. The lobeline content of the drug collected in the rainy season is low. Properly collected specimens should consist of flowering tops, slender stems and leaves[16].

Clinical trials of an ethereal tincture of *L. nicotianifolia* prepared according to the *B.P.* method showed it to be as effective as the official preparation.

There is room for the systematic cultivation of *L. nicotianifolia* in this country, and steps should be taken to introduce *L. inflata* which may well be tried in the Nilgiris and Travancore hills at altitudes of 3,000′ to 7,000′. The plant thrives well in the Eastern Himalayas, Malabar, in the Ghat regions of Bombay and in Bangalore. There is a fair demand for this drug[3].

22. Mentha species : *Mentha pulegium* (Pennyroyal) — The plant is indigenous to most parts of Europe including the United Kingdom, Chilie, and many other places with temperate climate. Pennyroyal oil is used

in considerable quantities in perfumery and soap making. *M. pulegium* is not indigenous to India, but has been successfully cultivated at the forest nursery at Baramulla (Kashmir). The essential oil obtained by steam distillation from the dry leaves of the locally grown plants gave the following result on analysis :

	Local	*Mediterranean*
Yield of oil, %	2·3	
Sp. gr., 15°C.	0·89	0·93-0·95
Ref. index, 20°C.	1·483	1·483-1·486

The cultivation of this plant can be carried out successfully at altitudes ranging from 4,000′ to 6,000′. There is a large demand for this oil from the soap industry.

Mentha piperita Linn.— This plant is cultivated on an extensive scale in North America, Germany, France and England. The leaves collected during budding and flowering stages of the plant are used for the distillation of volatile oil and manufacture of menthol. The essential oil obtained by distillation of the flowering tops and leaves of the plant is largely used as a stimulant, anti-spasmodic and as flavouring agent in confectionary. This plant is not indigenous to India but was experimentally cultivated in the Nilgiris in 1881 with some success. Experimental cultivation of the plant has also been carried out in Mysore State and at the *Forest Research Institute*, Dehra Dun, but no analytical data are available. Recently the plants were raised successfully from suckers in the forest nursery at Baramulla at an altitude of 5,500′. The dried flowering tops and leaves of the plants were steam distilled and 0·71 per cent of essential oil was obtained as against 0·7 to 1·5 per cent reported from plants grown in England and Russia[4]. There is considerable scope for the cultivation of this plant in suitable localities in India.

Mentha arvensis Linn.— This plant which yields the Japanese mint oil, occurs abundantly in Kashmir in a state of nature. The plant yielded 0·45 per cent essential oil but no crystals of menthol separated out when it was allowed to stand at 0°C. The essential oil as obtained from the wild plant did not come up to the standard laid down in the *British Pharmacopoeia*[4].

Peppermint oil has a fairly large demand in India and in the foreign markets. India imported about 2,000 gallons of the oil annually during the pre-war period but much larger quantities are now in demand. By systematic cultivation in appropriate places plants which will yield oil of the required quality can be grown. Trial cultivation is recommended in temperate Himalayan tracts at altitudes of 4,000′ to 5,000′.

23. Olea europoea Linn.— This is a small tree cultivated in France, Spain and in other countries bordering on the Mediterranean Sea and also in California and South Australia. The ripe fruits of the tree are used for expressing the oil. The plant is not indigenous to India but some species of *Olea* grow in certain parts of this country, and it would be interesting to study if the oil extracted from the fruits of these species come up to the official standards.

Attempts to cultivate *Olea europoea* in many parts of India were made long ago, but met with little success. The trees were raised as early as 1800 in the botanical gardens at Bombay, Calcutta, and at Government gardens in Bangalore. The trees attained normal height at all these places, but did not either bear fruits or the fruits did not mature. Plantations were also started in Kashmir State and fruited well but unfortunately the study was not pursued. The cultivation of this plant should be taken up again in suitable localities in the Himalayas. No experimental work has been so far carried out on grafting the European olive on the wild olive tree of India. This may be tried in Kashmir, Himachal Pradesh, etc. The plant should be manured in the same way as is done in Australia and Europe.

24. Prunus serotina Ehrh. (Wild cherry) — This tree is widely distributed over North America particularly in Northern Central States. Its bark is collected in the autumn, preferably from young stems and branches. Preparation from the wild cherry bark are used to relieve cough in phthisis, bronchitis, etc. This plant is not indigenous to India, but several other species of Prunus grow wild in Kashmir and the Himalayas and some are cultivated for their fruits. Investigations have shown that the bark from these species cannot be substituted for the official drug[17].

The official plant may well be introduced for cultivation in Kashmir, Kulu, Simla Hills and such other places where the species of Prunus are either growing wild or are cultivated. The demand for the bark is not very large.

25. Piper cubeba Linn. *f.* (Cubebs) — This plant is a native of Java, Sumatra and the Malayan Archipelego. The fruits are commonly known as cubebs and are generally used in the treatment of genito-urinary diseases

and as a condiment. Large quantities of cubebs are imported into India from Singapore.

The plant was grown successfully on an experimental scale in Mysore State. The oil distilled from the cubebs was studied by Rao, Sudborough and Watson[18] with the following results :

Yield of oil, %	11·85
Sp. gravity	0·9167
Optical rotation	−29·9°
Refractive index	1·4894
Saponification value	0·5
Saponification value after acetylation	24·1

The data reveal that it should be possible to grow cubebs of good quality in Mysore. Its cultivation may be encouraged in places with warm and moderately moist climates such as those occurring in parts of Travancore, Bombay and Bengal.

26. Rhamnus purshiana DC. (Cascara sagrada) — The dried bark of this plant collected at least one year before use is known as Cascara sagrada. Large quantities of the bark, its preparations and its active principle, emodine, are imported into India. The plant grows in North California, Oregon, Washington, and British Columbia. It is a non-irritating mild laxative.

Rhamnus purshiana is not indigenous to India but a number of species of *Rhamnus* grow wild in this country. *R. virgatus* Roxb. is one such species which grows in Kashmir and is used as a purgative in indigenous medicine. The bark of this species was investigated both chemically and biologically in order to see if it could be substituted for the official bark. Although the active principles were present, the bark did not come up to the standard of the *British Pharmacopoeia*. Other species are being investigated to determine if any of them could form a suitable substitute. The cultivation of *R. purshiana* is worth trying in temperate Himalayas and other regions with moderate rainfall, i.e. Kashmir, Bhutan, Garhwal, and Nilgiris at altitudes of 2,000′ to 5,000′, particularly in areas where the other species of *Rhamnus* are growing in a state of nature.

27. Rosmarinus officinalis Linn. (Rosemary) — It is an evergreen shrub indigenous to Southern Europe where it grows abundantly in dry rocky hills in the proximity of the Mediterranean Sea. The flowering tops of the plant are distilled to yield the oil of rosemary. The oil is imported from south of France and the Dalmation Islands. It has carminative properties and is employed principally as sprititus rosmarinus and in hair lotions. In India the plant has been cultivated as an ornamental plant in gardens in a number of places. Its cultivation may well be tried in the plains with equitable climate, and it is likely to do better in temperate Himalayas with dry to moderately moist climates.

28. Strophanthus kombe Oliver — This is an important cardiac tonic drug of the *British Pharmacopoeia*. The plant is a native of the African coast, and India imports large quantities of its preparations every year. At least 5 species of Strophanthus are indigenous to the tropical regions of India and the Malayan peninsula, but so far no attempt has been made to find out the strophanthine content of these species in order to see if they might substitute the imported variety. Strophanthus cultivation would not be difficult under conditions existing in India, and it has been tried experimentally with some degree of success in the *Royal Botanical Gardens*, Calcutta. An investigation into the possibilities of its cultivation in India would be of interest to drug manufacturers.

Some of the Strophanthus species grow in Travancore, Malabar and Khasi areas. *Strophanthus kombe* is likely to do well in the drier regions of Southern India.

29. Theobroma cacao Linn.— This tree is a native of tropical America and is cultivated in most tropical countries. The seeds are used to extract the oil of theobroma and for the preparation of cocoa powder and chocolate. The bulk of the seed is imported from the West coast of Africa, Ecuador and Brazil.

T. cacoa flourishes in a hot and moist climate ; the young plants must, however, be shaded and well watered. Though not a native of India, it has long been grown in South India and there appears to be no reason why its cultivation should not be extended in suitable places in South India.

30. Styrax benzoin Dryand — Benzoin is the balsamic resin obtained from the incised stem of *Styrax benzoin*. It is extensively used as an antiseptic for cuts and wounds, and as an inhalent in chronic inflammation of mucous membranes especially of the respiratory tract. There is a fairly large demand for this drug in India.

The plant was successfully cultivated in the Government Gardens, Bangalore and will probably do well in South India. There are several other species of Styrax which are indigenous to India ; some grow in Bhutan, Nepal and Sikkim. Attempts are being

made to procure resins from these species and examine their constituents. Cultivation of *Styrax benzoin* may be experimentally tried in these localities and also in South India where the other species of this plant grow in a state of nature.

31. Valeriana — The rhizome and root of *Valeriana officinalis* Linn. collected in the autumn and dried slowly constitute this drug. The herb grows in a state of nature, and it is also cultivated. There are two varieties, *Valeriana officinalis* var. *Mikanii* Syme and *V. officinalis* var. *sambucifolia* Mikan. The former variety is found wild on the dry calcareous heaths and pastures of Derbyshire in England. The drug is cultivated in Belgium, Holland and France.

A number of species of valerian such as *V. hardwickii* Wall. and *V. wallichi* DC. grow wild in temperate Himalayas. They grow abundantly in mountainous ranges from Kashmir to Bhutan. The plant *V. officinalis* Linn. is also found in the north of Kashmir at an altitude of 8,000′ but it is not so common as the other species.

Indian valerian roots have been recommended for use in the pharmaceutical preparations. Valerian is priced in medicine on account of its essential oil. An average specimen yields 0·5 to 0·9 per cent of the oil but the yield varies according to the locality and the season of collection. The demand for valerian has recently been on the increase as it has been found useful in the treatment of shell shock.

The collection of valerian from inaccessible places where it grows in a state of nature is difficult. The cultivation on scientific lines should be taken up in the temperate Himalayas. The drug of standard quality can be ensured by selection of the proper species, careful collection, curing and storage.

There are other less important medicinal plants which do not grow in India but are annually imported into this country. Among them are: *Physostigma venenosum* Balfour which yields physostigmin salicylate of *British Pharmacopoeia; Pilocarpus microphyllus* Stapf. which is the source of pilocarpin nitrate; *Myroxylon toluiferra* H.B. & K. and *M. pereirae* (Royle) Klotzsch which are the sources of balsam of tolu and balsam of Peru respectively and many others.

A planned programme for the cultivation of drug plants should be taken up by a Government sponsored agency such as the *Bureau of Plant Industry*. If this work is taken up in a systematic manner, India will not only become self-sufficient so far as supply of crude drugs is concerned, but she will also be able to produce these drugs in sufficient quantities for export.

We are grateful to Mr. S. C. Sen, Quinologist to the Government of India, for the valuable information on Cinchona and Ipecacuanha; to Mr. M. K. Thomas, Mycologist, for the valuable information on Ergot production in Madras.

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REVIEWS

Currents in Aerials and High Frequency Networks, by F. B. Pidduck (Oxford University Press, Bombay), 1946, pp. iii+97.

THE BOOK AIMS AT GIVING A BRIEF BUT generalized survey of the behaviour of electrical systems at radio frequencies. It is in essence an extension of Murray's theory and carries the investigation into the field of jointed networks and several other allied circuits.

It opens with an introduction to the subject starting from Maxwell's generalized electro-magnetic equations, and is followed by a summary of the theories of Pocklington and Murray. The fundamental E.M.F. equation for a conductor in a system of $(\tau+1)$ conductors with arbitrary voltages applied to them is found to be

$$29{\cdot}98 \sum_{n=1}^{n=\infty} \sum_{v=0}^{\tau} c_n^v \int_{-l^v}^{+l^v} \left[\frac{\delta^2 \Theta}{\delta p \delta q} - \mathrm{k}^2 \cos^\gamma \Theta \right]$$

$$I_n^v(q)\, dq + (1+i) R^\mu \sum_{n-1}^{\infty} c_n^\mu I_n^\mu (p) - E^\mu (p) - 0$$

This leads to $(\tau+1)$ infinite sets of equations, one set for each aerial, to solve the coefficients c_{m}^{μ} in the form:

$$\sum_{n=1}^{\infty} \sum_{v=0}^{\tau} Z_{mn}^{\mu v} c_n^v + 4\,(1+i)\mathrm{R}^\mu l^\mu c_m^\mu - U_m^\mu \quad (\mathrm{m} = 1 \text{ to } \infty)$$

where $$Z_{mn}^{\mu v} = 29{\cdot}98 \int_{-l^\mu}^{+l^\mu} \int_{-l_v}^{+l^v} \left[\frac{\delta^2 \Theta}{\delta p \delta q} - \mathrm{k}^2 \cos^\gamma \Theta \right] I_m^{\mu *}(p) I_n^v(q)\, dp dq$$

and $$U_m^\mu = \int_{-l^\mu}^{+l^\mu} E^\mu(p) I_m^{\mu *}(p) dp .$$

$Z_{mn}^{\mu v}$ is one of the mutual impedances of the μ^{th} and v^{th} aerials.

These expressions form the basis for the solution of all the problems considered in the book. The case of a single wire is treated by considering the charge on its surface to be equivalent to two parallel line charges, one along the axis and the other along the length. A number of systems are analysed including skew aerials, parallel aerials, loaded aerials, aerials above the ground, Lecher wires, loops, etc. The last article of the book contains a theory of diffraction derived from the above view-point. A very useful list of mathematical tables at the end gives values of the exponential integrals used in the body of the book for various calculations.

From the mathematician's view, the book is a well-written monograph on high frequency phenomena as far as it goes. The style is somewhat terse but most of the calculations are neatly made and detailed work is not included. A few of the minor gaps in the derivations are left to the reader to fill in. This detracts little from the value of the book.

It is when we come to the practical engineer's needs, that the book loses some of its utility. An average engineer will find the book difficult to follow. Many of the calculations and formulae have not been adequately explained physically. We have the case, for example, of the fundamental expression for $Z_{mn}^{\mu v}$. The definitions of μ, v, m and n would lead us to define this expression as the mutual impedance between the m^{th} harmonic of the μ^{th} aerial and the n^{th} harmonic of the v^{th} aerial. This is in itself obscure, but when we enter into the domain of $Z_{m,-n}^{\mu v}$, $Z_{m,n}^{\mu v}$ etc., the impedances lose all physical reality and become mere mathematical symbols.

The book does not offer much help in the solution of the daily problems of the engineer. Only special cases are treated and they are of limited scope; too much insistence has been placed on resonant lengths. The behaviour of systems at non-resonant lengths, the variation, for example, of impedance and response of aerials as the frequency is altered, is not to be found in

the book. One or two interesting points are : (a) the determination of the physical length of the resonant dipole and how this depends on the thickness of the conductor ; (b) the optimum length across which an untuned feeder should be attached to drive a half-wave aerial for maximum transfer of power. The current in a receiving resonant dipole has been shown to contain third and fifth harmonic components when it is excited by a wave of the fundamental frequency. It is, however, not understood how, in a linear network, third and fifth harmonics can be generated when the exciting voltage does not contain any of them. It has not been explained whether this would apply to a transmitting antenna too.

The printing and other features of the book leave nothing to be desired. There is only one error that is noticeable, — the summation in equation (16) p. 11 should be from $v=0$ to t and not from $v=1$ to t. On the whole, the book is a useful and concise mathematical treatment of the limited problems it seeks to solve.

N. L. S. & J. P.

Chemical Engineering Economics, by Chaplin Tyler (McGraw-Hill Book Co. Inc., New York), 1948, 3rd edition, pp. ix+321. Price $ 4·00.

THE BOOK DEALS WITH THE APPLICATION OF economic aspects of chemical engineering to the development of chemical industries. While a sound knowledge of the principles of chemical engineering is necessary for the proper design and operation of individual plant units, for the successful formulation and development of an integrated industry comprising a number of units, it is necessary to consider also other diverse aspects which are normally outside the scope of chemical engineering and to supplement such technical knowledge with additional study of a number of allied subjects. Full appreciation of the basic principles of all such subjects is required to build up sound practical chemical engineering and the author of this book has done a great service to the profession by publishing this book. In the present edition the author has laid particular emphasis on a number of economic aspects which had not been dealt with by him in the earlier editions, and the book has been almost completely re-written.

Although the outlook of the author is mainly American and conclusions are drawn from experience of operations on scales very much larger than those in vogue in our country, nevertheless the information is extremely stimulating and should considerably help our industrial chemists and chemical engineers in appreciating all the basic factors required in the planning and organization of new chemical ventures.

In the chapter on " Research and Development " interesting figures have been given in regard to the proportion of expenditure for different stages in the formulation of new projects and they should be eye-openers to many of our industrialists ; for, there are instances when research and development expenses may comprise 25 to 60 per cent of the total capital needed for the development of a chemical project, although normally even in the case of big schemes it works out to 8 to 10 per cent. Importance of continuous research and orderly development has also been correctly emphasized.

The chapter on " Plant Location " is highly informative, although we have to differ from the author in regard to some minor points. For instance, he mentions on page 52 : " sometimes cost of available skilled labour is so high that a manufacturer can afford to train unskilled workers, thus meeting his needs at lower costs ". While this may be true for a short period till the unskilled workers get trained up and realize the extent of their contribution to the success of the industry, immediately after this stage is reached, the unskilled workers trained at the cost of the factory will not be less discontent than the directly recruited skilled labour. We are sure that this is not merely our experience in India but true all over the world.

The data of process equipment costs given in the book are up to date and should enable us to evaluate the cost of equipment under present-day conditions fairly accurately.

The chapter on " Plant Design " is a brief review only of the economical aspects of design, and for detailed technical information one has to look for special treatises.

The treatment of " Heat and Power " is extremely interesting and gives a general insight into the importance this aspect plays in the proper organization of a factory.

The later chapters on plant operation and control, cost accounting, market development, research and management are those which we recommend to be read by every technical and business man in our country who has anything to do with the manufacture

and sale of chemicals. They deal with aspects which so far are very little appreciated even by some responsible persons who are today planning the development of chemical industries in India, and a proper consideration of the contents of these chapters will go a long way to helping the development of the Indian chemical industry on rational lines.

The estimates of cost of equipment and cost of production so often given by some research workers in India are extremely misleading and we earnestly request them to go through this valuable book minutely.

There are a few minor printing errors which, however, do not lessen the value of the book in any way.

We recommend this book for the intensive study of not only industrial chemists and chemical engineers, but also by business executives and research workers who have anything to do with chemical industry.

A. N. RAO

Modern Colloids, by Robert B. Dean (D. Van Nostrand Company Inc., New York; Macmillan & Co. Ltd., London), 1948, pp. xi+303. Price $3.75 or 21*s.* net.

THE RAPIDLY INCREASING VOLUME OF DIVERSE data and original papers characteristic of the recent developments in colloid behaviour has emphasized the need for a general review of the fundamentals of the subject with its recent trends of growth and applications. Professor Dean's "Modern Colloids" is, from this point, a welcome addition to colloid literature. The author presents a coherent and succinct review of the important work on such varied topics as adsorption, high polymers, colloidal ions, foams suspensions and emulsions. Special emphasis has been laid on the applied aspects of the phenomena. The chapters on adsorption, ionic adsorption, and colloidal ions are particularly informative and represent about the latest position in the subject. Chapters on high polymers, plastics, resins and rubber constitute a specially attractive feature of this book, of marked interest alike to research workers and students of general science. One would have, however, welcomed more information on the physico-chemical aspects of these topics.

The book as a whole makes very interesting reading. The numerous illustrations and particularly the molecular models greatly enhance the readability of the material. Workers in physical chemistry in general, and in colloid chemistry in particular, will be grateful to Professor Dean for providing an up-to-date account of the physics and chemistry of colloids.

S. S. JOSHI

Fundamentals of Vibration Study, by R. G. Manley (Chapman & Hall Ltd., London), 1948, 2nd edition, revised, pp. xvi+156. Price 15*s.* net.

THE FIRST EDITION OF THIS BOOK WAS reviewed in this JOURNAL in its issue of June 1944. In the second edition no fresh matter has been added, because the fundamentals of various kinds of vibration systems had been clearly explained in the first edition. The introduction of "Introductory" and "Summary" sections in each chapter are helpful additions for the study of the subject-matter. Two further appendices giving some applications of the theory to the solution of the simpler practical problems and tables of some of the quantities commonly used in vibration calculations have, no doubt, enhanced the value of this edition.

The book will prove a valuable addition to the technical library of an engineer.

K. B. K. R.

Soil Erosion — Its Prevention and Control (Superintendent, Government Press, Madras), 1948, pp. xii+184. Price Rs. 6.

THIS IS A TEXT-BOOK ON SOIL EROSION PUBlished by the Government of Madras for the use of departmental officers and for teaching the subject in the agricultural and forest colleges. It has been compiled by a committee consisting of Heads of the Departments of Irrigation, Agriculture, Forest and Public Health, appointed by the Government of Madras.

Erosion has been taking a heavy toll of the soil every year. The extent of its ravages can be judged from the vast tracts of lands that have gone out of cultivation and others whose potential fertility has been reduced to a very low level. The continued existence and prosperity of the country depends on its ability to maintain its productive agricultural land. The control and prevention of soil erosion is, therefore, a subject of great national importance. The present compilation by experts on different aspects of soil conservation will go a long way to meet the demand for a good reference book for workers

in the field of soil conservation under Indian conditions as well as for a good text-book on soil erosion for use in agricultural and forest colleges.

The book contains 18 chapters, 2 appendices, bibliography, glossary, index, and 158 illustrations.

The introductory chapter of the book deals with factors of soil formation, with a general historical account of soil erosion, and describes the problem of erosion in India in general and in Madras in particular. Chapter II deals with the causes and results of soil erosion with interesting illustrations and examples from India and the United States of America. Chapter III deals with the chief causes of accelerated erosion in agricultural soils, such as intensity of rainfall on the catchment, size and shape of the catchment, slope of the land, vegetation, etc., and the experimental technique used for the determination of run off and soil losses. The next four chapters deal with the mechanical methods of erosion control such as contour bunding, contour trenching, terracing and contour ridging. Chapters VIII and IX deal with conservation of grass land and shifting cultivation on hill slopes. Chapter X deals with the biological methods of control of erosion such as regulated forestry, regulated grazing, cover cropping, mixed farming, crop rotations, strip cropping, etc., and the experimental results at the Sholapur and Bijapur farms in Bombay, and Hagari farm in Madras are enumerated. Chapter XI, XII and XIII deal with control of gullies, check dams and permanent soil-saving dams respectively. The material has been prepared so that it may be used by individuals having a limited degree of engineering training and experience. Chapter XIV deals with the special use of vegetation in gully stabilization. Subsequent chapters deal with control of stream and river bank erosion, control of wind erosion, control of floods, and erosion in relation to the spread of malaria. The book ends with a map showing annual average rainfall in India and average monthly and annual rainfall of the Madras Presidency.

The usefulness of the book has been enhanced by the inclusion of good illustrative photographs. The get-up and print are attractive.

A chapter might have been devoted to soil conservation survey and land use classification which are very necessary before planning for maximum safe land use and for adopting wide-scale anti-erosion measures. This suggestion may be considered in revising the book for the second edition. Comparatively greater emphasis has been laid on the engineering aspects of controlling soil erosion. It is suggested that the biological methods of controlling soil erosion may be described more fully in the next edition.

The book is useful and a copy should be kept in the bookshelf of every worker engaged in soil conservation and general agricultural development.

R. J. KALAMKAR

Kuchha Pucca Houses, by Dr. D. R. Dhingra & Shri S. N. Ghatak (Harcourt Butler Technological Institute, Kanpur), 1948, pp. 21+9+iii.

THIS BOOKLET PUBLISHED BY THE *Harcourt Butler Technological Institute*, Kanpur, gives an account of the work initiated by Pt. Keshao Deo Malavia, Development Minister, United Provinces, for developing a suitable stabilized mud plaster for the construction of low-cost houses for homeless millions.

The chief ingredients of this plaster are pond clay containing about 55 per cent silica and 24 per cent sesquioxides, with a plasticity index of 25, mixed with urine-earth, molasses and fibre waste. The mass is allowed to ferment, with turnings, for a period of 30 days. The stabilizing property of the mud is attributed to the formation of a plastic mass similar to urea-aldehyde plastics. It is estimated that 100 cu. ft. of the mud would cost about Rs. 50. The booklet contains details for making the mud and the procedure for its use as a plaster. 3 types of experimental houses have been constructed at the *Institute* costing approximately Rs. 5,500, 2,000 and 1,250 using the new plaster. An antiseptic spray containing kerosene, coal-tar, creosote and copper linoleate has been recommended to protect the wood-work from white ants. Details regarding the specifications, cost estimates and plans are given for each type of house.

The booklet also contains an addendum giving the results of further work on the plaster. In addition to the ingredients mentioned above, press mud from sugar factory waste and bagasse are added after fermentation to give a stronger plaster which, according to the authors, can replace the ordinary country tile roof. The process of manufacturing the mud plaster and its use in building construction have been

illustrated by 36 photographs. Those engaged in building trade would find the booklet interesting.

N. K. P.

One Story of Radar, by A. P. Rowe (Cambridge University Press), 1948, pp. xii+208. Price 8*s.* 6*d.*

THE BOOK DESCRIBES THE GROWTH, DEVELOPment and decay of the organization which was mainly responsible for the development of radar in the U.K. Mr. Rowe was with the T.R.E. (The Telecommunications Research Establishment was a secret till the end of the war) from the beginning, and his story is full of interest to both the scientist and the administrator. The author's aim has been to use radar as an example of how scientific work could and should be organized. Much of the credit for the development of radar is due, as Lord Tedder says in his foreword, to men like Rowe and Tizard who created a real team without losing the spark of individual freedom. " They and men like them set a pattern which is not only vital for our future security, but may well, I suggest, be vital for the well-being of the world."

The administrative story of the development of radar from the first experiments of Sir W. Watt in 1935 to the development of devices like I.F.F., Gee, H2S, and " the fantastic Oboe " by a team of physicists almost actively participating in the conduct of the war, makes very interesting reading. The more so on account of such thought-provoking statements as " Some genius has said, that victory goes to the side that gets most sleep ", " The better is the enemy of the good ", etc.

In all the advanced countries, including Germany, it was realized that the scientist should be free from all personal worries, even during a war, and be liberally supplied with the withals of research. In Germany, however, " the German Air Force ruled with harder rod the scientists who sought to serve them, and even at the end of the war the German Airborne Radar was a negligible factor ". At T.R.E. not only was a method evolved of " building and maintaining a team of the largest number of first rate physicists ever to work together in the country ", but due emphasis was laid on the fact that " what most puts a stamp upon a research establishment and gives it colour, is not its special organizational features but the kind of people it possesses at the upper levels of its structure ". The *Sunday Soviets,* the democratic organization of the Establishment, and the fact that Mr. Rowe would worry even about the laundry facilities of his staff, contributed much to what was T.R.E. Also the effect of high morale which success brings, was not negligible; decay set in with the end of the era of spectacular achievements.

B. N. SINGH

Prefabricated Houses for India

ONE of the most far-sighted moves within the Commonwealth in the field of prefabricated building has been made by the Mysore State Government in India.

At the invitation of the authorities there a British firm of engineers, *Structural & Mechanical Development Engineers Ltd.*, of Slough, sent a technician to Mysore to discuss the possibilities of installing plant for the manufacture of houses.

Accompanying the firm's technician was Mr. A. F. Hare, consulting architect, who carried out extensive investigation of local conditions, availability of materials, costing, etc., and prepared designs based on the *S.M.D.* "Alcrete" construction method.

This work was carried out just over a year ago and the designs met with the approval of the Mysore Government. An Indian company was then formed for the production of "Alcrete" houses within the State.

Help from U.K.

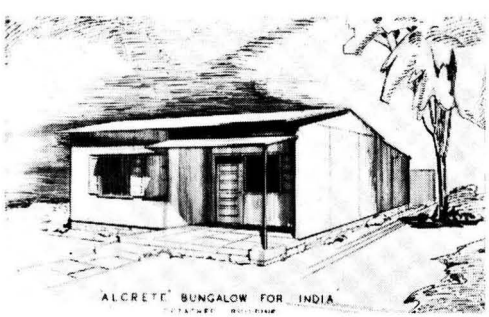
S.M.D. Ltd. are supplying all engineering drawings, production details and have designed and laid out the necessary plant and factory for production, including full specifications and details of specialist processes. They are also supplying full architectural details — including the consultant architect's advice throughout production — and any details for variations which may be produced in this factory at a later stage.

The firm are also providing to the Indian company technical personnel to assist firstly in installing the plant and later supervision of production.

The main part of the house will be produced in India, using local materials. The exports from the U.K. will consist of the small amount of aluminium alloy framework and roof sheetings and, in addition, licences and technical services for the production of the house and specialist processes to be paid for on a royalty and fee basis.

When producing houses of this type, it is most essential that each project should be specifically designed for the particular country concerned, in order that the scheme should be applicable in every way to local conditions.

The "Mysore" house has been designed to give a higher standard of insulation than is normally available there at 5 to 10 per cent lower cost. Its design allows it to be produced and erected by semi-skilled and unskilled local labour.



ALCRETE BUNGALOW FOR INDIA

Indian Government's Interest

During the investigations in Mysore, the firm's representatives were ably assisted by the State Architect, Dr. O. H. Koenigsberger. This project was then passed to the Government of India for their consideration. The Government of India have a vast programme for the provision of houses throughout the whole of the country, and it was decided that they should co-opt Dr. Koenigsberger from Mysore State and depute him to visit Europe on behalf of the Government of India to investigate methods of prefabricated housing suitable for India and, particularly, the *Alcrete Method of Construction.*

Dr. Koenigsberger visited Europe in June and July last year and carried out an extensive investigation of the various methods and types of construction, and reported to the authorities at New Delhi. Following this report, an agreement has been signed with *S.M.D.* for a 12-year period for the provision of "Alcrete" houses for India.

Six pairs of prototypes have been ordered to be manufactured and exported from the U.K., and it is the intention to commence work immediately on the installation of the first factory in New Delhi. This factory, which will cost approximately £150,000 (Rs. 19·96 lacs), will be equipped with machinery supplied from the U.K. for the manufacture of 5,500 houses per year. The cost of each house will be just under £200 (Rs. 2,662).

The firm will supply all production details and will send to India an engineer to supervise the installation of the plant and the initial production, and also a Cement Technologist to supervise the production of the "Foamed Concrete" wall panels.

This agreement covers an unstated number of factories, it being the eventual intention to have a number of production units each manufacturing 5,500 houses per year scattered throughout the country. This method of construction, which is basically a method of manufacturing wall panels and roof panels, can be applied to various types of accommodation.

First Project

The first project is for a very small standard house similar to the standard of housing built in Mysore during the last 8 years, but this system of construction is equally suitable for various sizes of houses — two-storey houses, schools, hospitals, etc., — and it is hoped to combine this system of wall panels with a pre-stressed reinforced concrete frame for multi-storey buildings in areas of high land cost such as Bombay, etc.

The accommodation provided per house is very small compared with Western standards, and comprises two rooms — one 12′ 6″×10′ and the other 10′×10′ with a small kitchen and two verandahs, and an external latrine and a bathing place are provided in traditional construction.

The houses, which were designed and planned in Mysore following the investigation of existing

buildings, are naturally very simple and no internal fittings, plumbing, etc., are included. The principle is to provide in the first scheme a basic living unit which is ideally suited to mass production on a large scale at low costs.

The Alcrete wall panels — 3′ 2″ wide × 10′ high — are made of a light aluminium alloy frame into which is cast a chemically foamed concrete ; on to the external face of this is cast a skin of dense concrete and the whole is then cured in autoclaves. The internal wall face is finished in the factory with plaster, and the panel is, therefore, a completed unit requiring erection on site only. This 4″ thick wall panel provides a higher standard of insulation than 14″ of ordinary brickwork.

The internal partitions are similar in construction to the wall panels ; the roof is made of an aluminium alloy girder supporting aluminium alloy corrugated sheeting which is lined with insulating material ; the doors and window shutters are also made from aluminium alloy, faced internally with locally produced plywood or asbestos.

Fruits of Research

A considerable amount of research has been carried out by *S.M.D. Ltd.* during the past 3 years on the provision of a suitable method of construction for tropical countries — India in particular.

The system of foamed concrete wall panels has been found ideally suitable. This light-weight material provides a high degree of thermal insulation, whilst the thickness of the panels can be varied for individual schemes to provide additional insulation, should this be required ; i.e. for India a 4″ overall thick panel is provided, but if more stringent conditions were met, this could be increased. The roof also gives a high degree of insulation. This is provided by : (a) a glass silk blanket which is fixed between the aluminium sheet and the plywood inner lining ; and (b) the reflectivity of the external aluminium sheet.

It is often not fully appreciated the value which can be obtained by the reflectivity of aluminium sheet when used as a roof covering for hot countries. Aluminium possesses the highest reflectivity value of any of the metals and is second only to silvered glass.

The materials used, aluminium alloy and foamed concrete, are both permanent to a high degree and will withstand all kinds of climatic conditions, and attacks by vermin or insects, etc.

Each country has its own special requirements as to size, shape, amenities, and wants buildings to suit local social conditions, etc. It is, therefore, necessary that each project should be started with a survey of local conditions and the house then designed specifically to suit the country or district, but fundamentally the same method of manufacture and production would apply.

Constructor's Wide Experience

The *S.M.D. Ltd.* provide a typical example of the type of organization in Britain which is prepared to initiate the production of prefabricated houses for interested overseas authorities.

It is primarily a development organization — a subsidiary of *Almin Ltd.* (*Associated Light Metal Industries*) — employing a team of mechanical engineers, structural engineers and research chemists who have been responsible for completely new and original development in many spheres of industry. During the war these technicians designed and supervised the construction of many large chemical and metallurgical plants.

In the post-war period probably their most notable project was the complete initial design, method of construction and development of insulating materials used in the Aluminium House for the U.K. Government.

By far the most highly factory-prefabricated house in the world was produced by a group of 5 large aircraft manufacturers, of which the *Bristol Aeroplane Co.* is the parent company.

The project was sponsored by the Ministry of Supply, *S.M.D.* engineers being retained as consultants to the Ministry for this project and for prefabricated housing in general. The original order placed by the Government for this house was 54,000. Of the various prefabricated single-storey houses in England, the Aluminium type alone is now scheduled as a permanent house and the initial order was increased to 70,000 — the largest contract in the world for one type of housing.

The *S.M.D.* are also manufacturing and exporting aluminium alloy " prefab " storage buildings (Alframe) for the Groundnut Scheme in East Africa and various types of transportable buildings. Alframe buildings are of 36′ clear span to any length of a multiple of 9′, and either 9′ or 14′ 6″ in height to the eaves.

These " Alframe Storage Buildings " are manufactured in Britain and exported as simple units ; being constructed entirely of aluminium alloy they are extremely simple for erection. These buildings are also fully demountable without any new materials or fixings being required. They can be easily erected on a site, used for a period of 6 months, or any number of years, and then demounted, transported to another site, erected and re-used. — (*Courtesy*, British Information Services, New Delhi)

NOTES & NEWS

New Radio Isotopes

2 IMPORTANT NEW RESEARCH AIDS, hydrogen-3 and helium-3, have been added to the radio isotopes distributed by the *Atomic Energy Commission*, and are available in limited quantities for research purposes.

Hydrogen-3, also called tritium, is a radioactive gas with a half-life period of approximately 12 years. As the only radioactive isotope of hydrogen, it should prove of special value as a tracer in medical, biological and chemical research. Combined with oxygen it forms heavy water, a valuable research tool. Tritium is isolated after the bombardment of a lithium compound by slow neutrons in a nuclear chain-reacting pile, and helium-3 is obtained as the end product of the decay of radioactive tritium.

Helium-3, a stable isotope, is only one-millionth as abundant in nature as ordinary helium, and is expected to provide valuable clues to the still largely unknown properties of the helium nucleus (*Chem. Age*, 1948, **59**, 513).

Dielectric Lenses for Microwaves

ARTIFICIAL DIELECTRIC LENSES for the development of an antenna capable of passing a very wide band of frequencies have been developed at the *Bell Telephone Laboratories* (*Sci. Prog.*, 1948, **36**, 715). This development will be of great value in the future when radio relay circuits make full use of the broad band widths available.

Lenses made of dielectrics, such as polystyrene, had good focussing properties over very broad bands and were in many ways superior to the other types of antennae for concentrating the beam in the direction of the receiving station. Unfortunately, their great weight for 10′ lenses precluded their adoption in place of metallic plate types. The recent development is the construction of what might be termed a *metallic dielectric* which possesses the same characteristics as a true dielectric but which can be made much lighter. Such a metallic dielectric is obtained by building up a lattice of insulated, conducting, metallic spheres similar to the molecular lattice of a dielectric. For microwaves whose wavelengths are longer than the spacing between the spheres, the artificial dielectric behaves in a similar way to a true dielectric. Provided the lattice spacing requirement is met, the refracting properties of these artificial dielectrics do not vary with wavelength and a lens built up with small conducting elements has broad frequency band characteristics.

The conducting elements can be in the form of spheres or discs made of copper foil to reduce the weight and mounted in light-weight polystyrene foam. For use in radio repeater circuits the lenses are made 10′ square, and as only vertically polarized waves are used, the conducting elements are in the form of thin metal strips mounted horizontally. The lengths of strips are varied to give the final assembly a shape similar to that of a convex optical lens, and are mounted between slabs of polystyrene foam. This new type of lens will first be used in the New York to Chicago link.

New Source of Industrial Alcohol

ETHYL ALCOHOL FROM PETROLEUM refinery processes, instead of the usual fermentation method, is to be obtained from ethylene in a new plant of the *Shell Chemical Corporation* at Houston, Texas (*Chem. Age*, 1948, **59**, 423). The output from this plant will be about 18 million gallons annually. It is estimated that to produce a similar quantity of alcohol by fermentation processes would require 45 million bushels of grain.

The basic raw material for the *Shell* process is ethylene, which is obtained with other olefins in the stream of gases from the catalytic oil-cracking plant at the adjoining refinery of the *Shell Oil Co.* After careful separation and purification, the ethylene is converted by direct hydration into ethyl alcohol. The product is to be sold under the trade name " Neosol " as a proprietary solvent.

Synthetic Resins in Paper-making

THROUGH THE USE OF A SYNTHETIC resin timbers, which have hitherto found limited application in paper-making, can be employed to yield satisfactory printing paper. The new development, which is the outcome of a comprehensive research programme at the *National Bureau of Standards*, U.S.A., on offset printing papers, does not involve either appreciable increase in costs or any important change in manufacturing methods (*J. Franklin Inst.*, 1948, **246**, 252).

Deciduous woods, such as maple, birch, beech and poplar, give only short-fibred stock which does not lend itself to hydration by the conventional beating process, and the addition of resins will materially help in increasing the use of short-fibred pulps in making printing paper.

The beating process, employed in pulp-making, provides necessary bonding strength but promotes some of the troublesome behaviour of paper in printing, viz. high expansion, excessive curling, slow oil absorption and show-through of images. The new technique substitutes resin bonds for the gel-like bonds of the hydrated fibres, and gives optimum strength for paper with only a fraction of the beating required to develop comparable strength by beating alone, and provides a superior paper by eliminating all the adverse effects of hydration.

Widely different combinations of commercial wood pulps have been investigated with controlled variation in beating and with and without resin bonding, and in all instances resin-bonded paper was found to be superior with respect to curling, oil absorption, folding endurance, resistance to surface pick and expansivity. Sulphate-cooked aspen pulps and sulphite-cooked birch pulps have produced excellent printing papers with the aid of resin bonding, whereas they can be used only in small amounts as fillers by conventional processing.

Several types of synthetic resins have been employed, with melamine-formaldehyde resins giving the best results. Small amounts, usually less than 3 per cent by weight, are required.

For normal commercial fibre combinations, it was possible to develop as much strength with 2 per cent of resin and no beating as with 9·5 hr. beating without

resin. Far better strength and resistance to surface picking were obtained with 3 per cent of resin than could be achieved by hydration alone even with the most drastic beating. The addition of 1 to 3 per cent of melamine-formaldehyde resin increases the resistance to surface picking and folding endurance, more than 10 times in some instances. All of the resin-bonded papers showed low expansivity, essential for example, in the printing of maps which may run through the press as many as 15 times.

Starch Syrup Manufacture

THE PRODUCTION OF SYRUPS FROM starches by the batch acid hydrolysis process is described (*Can. J. Res.*, 1948, **26**, 284). Syrups prepared in semi-pilot plant equipment from wheat, corn, waxy corn and tapioca starches of low protein content were almost identical in taste and appearance. The starches employed had the following composition :

	Ash %	*Fat* %	*Protein* %
Wheat	0·26	0·63	0·38
Waxy corn	0·05	0·64	0·32
Potato	0·32	0·12	0·11
Tapioca	0·08	0·27	0·14

It has been found economical to employ starch slurries having a density only slightly below the limit imposed by dilatancy, i.e. 22° to 24°Be. Heavier suspensions result in poor heat transfer of pastes, and charging of the converter becomes difficult. Even with starch of the highest quality, improper technique at the filling stage leads to off-flavour and after-taste.

The method of adding hydrochloric acid is important. With glass-lined equipment it is conveniently introduced with priming water, but with copper converters it is best introduced along with the slurry. A concentration of 0·2 per cent hydrochloric acid based on the dry weight of starch provides adequate acidification for 22° to 24°Be slurries. This method of expressing the acidity ensures uniformity in the sodium chloride content of the final product when slurries of fluctuating starch content are employed.

At the outset of each conversion, sufficient priming water is placed in the empty converter to cover the open-type steam coil ; with converters of 2,000 gal. capacity approximately 100 gal. of water are required for this purpose. The water is brought to

Forthcoming International Congresses — 1949

Date of Conference	*Title of Conference*	*Sponsored by*	*Place*
Feb. 2	7th Pacific Science Conference	Royal Society of New Zealand	Auckland & Christchurch
Feb. 8	International Civil Aviation Organization ; Air Line Operating Practices, Operations Division	International Civil Aviation Organization	Montreal
Feb. 22	International Civil Aviation Organization ; Airworthiness Division	International Civil Aviation Organization	Montreal
May 16	U.N. Scientific Conference on Conservation & Utilization of Resources	ECOSOC	U.S.A.
May	International Railway Congress	International Railway Congress Assoc., Brussels	Lisbon
June 14	Committee on Science & its Social Relations	ICSU	Paris
June 20	International Conference on Science Abstracting	UNESCO	Paris
July 9	4th Empire Mining & Metallurgical Congress	Empire Council of Mining & Metallurgical Institutions	London & Oxford
July 21	2nd International Congress of Crop Protection	International Union of Chemistry	London
July	Commonwealth & Empire Conference on Tuberculosis	National Assoc. for the Prevention of Tuberculosis	London
July	Congress of Psychotechnics	National Institute of Industrial Psychology	Berne
Aug. 15	12th International Dairy Congress	International Dairy Federation	Stockholm
Aug. 19	1st International Biochemical Congress	Biochemical Society	Cambridge
Aug. & Sept.	Specialist Conference on Plant & Animal Nutrition in Relation to Soil & Climatic Factors	C.S.I.R., Australia	Australia
Sept. 6	15th General Conference	International Union of Chemistry	Amsterdam
Sept. 14	General Assembly ; International Council of Scientific Unions	ICSU	Copenhagen
Oct.	5th International Animal Husbandry Conference	...	Paris

boiling by steam injection before the starch slurry is let in. During the filling operation, which must proceed continuously, slurry addition and steam injection are integrated so that boiling of the converter contents proceeds vigorously, with steam escaping freely from the air vent. After the converter has been filled and swept out thoroughly with steam, the pressure is raised to 35 lb./sq. in. The progress of hydrolysis is followed by iodine test until the hydrolysate having a *D.E.* (Dextrose equivalent) value of 45-50 is obtained when they are immediately removed from the converter. A *D. E.* value of 55 is regarded as the upper limit for the acid hydrolysis process because of the off-flavour and crystallization tendency of more completely hydrolysed products. The hydrolysates are neutralized with sodium carbonate which is added with continuous agitation as rapidly as the foaming tendency will permit. Gradual additions are then made with periodic *p*H measurements, until a *p*H value of 5·0 to 5·1 is attained.

In industrial practice, fatty impurities are skimmed off, and protein and other impurities flocculated by the addition of Hyflo Super Cel (0·1 to 0·2 per cent on the weight of liquid) and filter-pressing the syrup. Activated carbon (0·2 to 0·5 per cent on liquid weight) is added, heated for 20 min. at 80°C., filter-pressed and evaporated to 30°Be *in vacuo* or at atmospheric pressure. A further 20 min. treatment at 80°C. with 0·5 per cent carbon and 0·1 per cent flocculating agent on 30°Be syrup weight removes the colour developed during the first evaporation. The final filtration at this density must effect complete removal of suspended impurities. In evaporating the heavy syrup *in vacuo* to the final density of 42°-43°Be control density measurements are conveniently taken at the evaporation temperature of 140°F., a correction of 1·0°Be being added to obtain the conventional density value at 100°F.

In decolourizing with bone char, the neutralized hydrolysate is defatted, freed of flocculated proteins by filtration with diatomaceous earth before percolation through gravity filters. After evaporation to 30°Be the syrup is again decolourized with bone char and filtered if necessary before its evaporation to final consistency. Bone char has been found to be superior to activated carbon with respect to adsorption of copper and iron traces as well as salts in industrial waters. It was also found necessary to extract fresh bone char exhaustively with hydrochloric acid before use, otherwise decolourization is slow and the syrup turns dark during evaporation.

Syrups prepared from starches that were heavily contaminated with protein were consistently objectionable in taste and appearance, and bitterness could not be removed by repeated passage through bone char filters. Nitrogenous impurities cause troublesome frothing in evaporators and affect the usefulness of the syrup in the confectionary and soft drink trades. Considerable haze also develops in finished syrups of high nitrogen content. The haze can be largely corrected by diluting to 25°-30°Be filtering off the flocculated impurities and concentrating. Purification of starch before it enters the converter appears to be the only practical measure that can be taken to provide a satisfactory syrup.

Tap water promoted colour development in the evaporator and inhibited colour removal by activated carbon. Colour and fluorescence development in stored syrups was promoted by protein impurities, light and tap water and was strongly inhibited by sodium bisulphite. Syrups which remained colourless almost indefinitely were prepared from prime quality starches by using distilled water in the process and either acid-extracted activated carbon or bone char as decolourizing agents.

Deodorization of Shark Liver Oil

THE DEODORIZATION OF SHARK liver oil under different conditions has been described (*Nature*, 1948, **162,** 494). The deodorization has to be effected in such a manner as to retain vitamin A intact. The methods tried are: (1) steam distillation of the oil under normal and reduced pressures; (2) agitation of the oil with fermenting milk and toddy; and (3) selective hydrogenation of the oil in the presence of a nickel catalyst. Steam-treated oils are fairly free from odour when freshly prepared but revert in course of a few days to their original character. Oils deodorized by agitation with fermenting milk or toddy, have been found to remain bland for several months and show very little change in their potency or chemical constants.

Controlled hydrogenation of fish liver oils using 0·1, 0·25 and 0·4 per cent concentrations of nickel catalyst has given promising results. 0·25 per cent of the catalyst effected fairly complete deodorization of the oil at 120°C. within 30-45 min. The percentage loss of vitamin A by this process was about 7 and stability studies have shown that the keeping quality of the oil improved considerably.

Contact Acid from Arsenical Pyrites

THE MODIFICATIONS INSTITUTED in the contact sulphuric acid plant of the *Nitrogen Fertilizers Ltd.*, Flixborough, to deal with arsenical pyrites as raw materials are described (*Chem. & Ind.*, 1948, **67,** 595). The ore employed normally contains 0·4-0·5 per cent of arsenical impurity by weight.

On the basis of the factory practice and experience, the following tentative specification of the pyrites to obtain burner house efficiency has been drawn up: size, $\frac{1}{32}$" to $\frac{3}{8}$"; copper, not more than 0·5 per cent; zinc, not more than 1·7 per cent; arsenic, not more than 0·15 per cent.

The gases from the burners after passing through the electrostatic precipitators still contain appreciable amounts of arsenic and lead. In the 2 wash towers, the normal practice is to use 60 to 70 per cent sulphuric acid in the first and 40 to 50 per cent acid in the second. The impurities remain suspended in the wash acid of the first tower, and settle down as sludge in the cooling towers which have to be periodically desludged. In addition, hard scales are formed in the cooling coils which adversely affect the efficiency of heat transfer. Studies on the solubility of arsenic in sulphuric acid have led to the conclusion that operating the first wash tower with 30 to 40 per cent acid and the second with 10 to 15 per cent acid, the wash tower systems remain clear for several weeks. The weaker acid has a greater capacity to hold arsenic and iron in solution resulting in a cleaner circulation acid and lesser possibility of scale formation in the cooling coils.

The use of weaker acid is attended with certain difficulties so far as its use for ammonium sulphate manufacture is concerned. A greater amount of soluble iron is added to the saturator system requiring increased consumption of expensive phosphoric acid.

A New Aluminium Alloy

A NEW ECONOMICAL DIE-CASTING aluminium alloy has been developed at the *Federated Metals Division of the American Smelting & Refining Company*, New York. The alloy is made of copper, silicon and aluminium and is said to overcome former problems of drilling, tapping and machining of castings made from other alloys. The new alloy will be known as *F*-4110, under a nomenclature system developed by the *Division*, which reveals the composition of the alloy. It contains 4 per cent copper, 11 per cent silicon, no magnesium and the balance aluminium. There is less tendency for castings to weld to the die during the casting process. It has higher tensile strength, yield strength and proportional limit and higher hardness. The castings assume a whiter finish after casting and the final cost of casting is lower because the alloy is generally cheaper than the primary 12 per cent silicon alloys (*Chem. Age*, 1948, **59**, 356).

New Process for Pig Iron

A NEW PROCESS FOR THE PRODUCTION of pig iron, stepping up the production of existing furnaces by at least 20 per cent, has been perfected by the *Republican Steel Corporation*, of Cleveland, Ohio. A "pressure blowing" technique is employed which, under certain conditions, is claimed to give an increase of 50 per cent in output. The method has been tested in converted blast furnaces of the company. The furnace is partially sealed by a system of valves to retain the hot gases and the incandescent atmosphere thus resulting builds up a high pressure permitting the production of higher temperatures in a shorter time (*Chem. Age*, 1948, **59**, 481).

The cost of converting the furnace is reported to be much less than the cost of erecting a new furnace. Apart from increased production, other advantages cited are increased efficiency in burning coke, more uniform quality of iron, and less flue dust.

"Solder" Glasses

A GROUP OF VERY SOFT GLASSES have recently been developed at the *B.T.H. Research Laboratories* by means of which 2 pieces of glass can be "soldered together without distortion" (*Sci. Prog.*, 1948, **36**, 714). These solder glasses, as they are popularly termed, are lead borate glasses whose resistance to weathering has been improved by the addition of zinc oxide. By comparison with other types of glasses, the temperature at which they become soft is low, usually well below 460°C. A solder glass with a suitable coefficient of expansion has been successfully employed to join the soda-lime-silicate bulb in miniature radio valves to the lead glass base without distorting either.

The solder glasses can also be employed to seal mica to metal or glass, as well as metal to glass. With the aid of this technique, a piece of soda glass tubing has had a mica window sealed on to one end, a glass plate on to the other, and a sheet of nickel-chrome-iron alloy sealed across the middle to form a diaphragm.

Identification of Formaldehyde-resin Finishes

A METHOD FOR THE IDENTIFICATION of formaldehyde-resin finishes on cellulose fibres and wool is described (*C.T.J.*, 1948, **123**, 409). 1 gm. of the material to be tested is extracted by boiling twice for 5 min. with 50 cc. of pure alcohol and rinsing 3 times with 50 cc. of distilled water for each rinse. The cleansed sample is heated with 1 per cent solution of pure hydrochloric acid, the distillate filtered, and 3 cc. of it introduced into a freshly prepared solution of 0·005 gm. pure carbazole in 5 cc. chemically pure sulphuric acid. The presence of formaldehyde is indicated by the development of a blue-green colour in the region of contact between the distillate and the test solution.

The hydrochloric acid extract is tested with 5 per cent solution of ammonium molybdate for resins. A white flocculent precipitate indicates melamine resins or proteins. If this test is positive a further portion of the acid extract is mixed with 1 per cent solution of picric acid when melamine resins produce a pronounced turbidity. Proteins do not cause a turbidity unless they are in a very high concentration. If the above 2 tests are inconclusive, the extract is treated with a 5 per cent solution of potassium ferrocyanide, when melamine resins alone produce a turbidity; proteins and urea resins are inert.

Electron Microscopy of Natural Cellulose Fibres

3 NEW DEVELOPMENTS IN THE technique of preparing specimens for electron microscopy,—metallic shadow casting, surface replicas, and electron stains, have been employed for the study of the sub-microscopic structure of natural cellulose fibres (*Ind. Eng. Chem.*, 1948, **40**, 1711). The results of this investigation offer additional evidence in support of a fibrillate structure for natural cellulose.

The coarse fibrils commonly observed by optical and electron microscopy are shown by metallic shadow casting to consist of still finer unit fibrils, whose diameter varies from 90 to 400 Å depending on the sample. Although the diameters of these fine fibres vary somewhat in a single sample, greater differences in this respect are observed among fibres of different origins. The diameters of the fibrils in ramie, cotton and wood pulp are found to decrease in the order named. Similarly, the variations in straightness follow the same order. These differences suggest a correlation between the character of the fibrils and the chemical and physical properties of the fibres. Ramie fibrils, for example, are found to be highly crystalline and oriented with marked tensile strength but with low elongation and poor reactivity. The properties of wood-pulp fibres are in some respects opposite to those of ramie, whereas cotton is, in general, intermediate.

Preservative Treatment for Bamboos

EXPERIMENTS ON THE TREATMENT of green bamboos with inorganic preservatives are described in the *Indian Forest Bulletin*, No. 137 (1947). The species tested were *B. arundinaceae*, *B. nutans*, *B. tulda*, *Melocanna bambusoides*, *D. strictus* and *D. hamiltonii*. The bamboos were normally about 15 ft. long. The preservatives tried were zinc chloride, "Ascu", copper sulphate, boric acid and borax. 3 processes were investigated: (a) the original Boucherie process, where fresh bamboos were allowed to stand in a container of

preservative; (b) the normal Boucherie process, where the preservative solution is held in an old cycle tube attached to the pole and held at a higher level than the crown; and (c) modified Boucherie process which consists in using the basal internode as the reservoir for the solution and standing the bamboo in a vertical position. The preservative is introduced through an incision at the node.

Bamboos treated with a 16 per cent solution of zinc chloride for 5 to 6 days gave satisfactory results by all the 3 methods and provided adequate protection against termites, borers and fungi. Felled and stored bamboos can be treated similarly after they are kept immersed in a log pond for 2 to 3 days.

Technological Developments in Japan

THE PROGRESS IN THE JAPANESE chemical and textile technology is described in Summation No. 32 of Non-Military Activities in Japan, issued by SCAP (*Chem. Age*, 1948, **59**, 486).

Among the developments described are experiments to determine new uses for a synthetic fibre made from polyvinyl alcohol. Polyvinyl acetate is saponified by alcoholic caustic soda and the resulting solution is spun in a bath containing zinc sulphate and Glauber's salt. The fibre is rendered insoluble in the presence of formalin, Glauber's salt and sulphuric acid. The new fibre is claimed to have many advantages over other synthetic fibres. It is resistant to acid, alkali and oil; it is stronger and more resistant to abrasion than ordinary fibres. Because of its exceptional strength it can be used for fish lines and nets.

A process for the production of coke of a quality suitable for large blast furnaces has been developed by the *Fuel Research Laboratory* of the Japanese Ministry of Commerce and Industry. Indigenous coal, which does not yield coke of a sufficiently high calorific value with normal coking processes, is used as the raw material. In the new process, which has already reached the pilot-plant stage, pulverized coal is mixed with an equal amount of creosote oil and heated to 350°C. for 10 hr. From the resulting pitch-like substance, a coke of high calorific value can be made by the usual high temperature process of coke manufacture. Both non-caking and caking coals have been successfully employed. The product can be used for blending with light caking coals to supplement the supply of imported coking coal.

To relieve the critical shortage of caustic soda, a direct method of electrolysing sea water is being experimented with at the *Teikoku Rayon Co. Ltd.* 8 small electrolysers are producing approximately 15 kg. of caustic soda per day. The purity of the product is reported to be 99·8 per cent and it is recovered at 15-20 per cent concentration. Chlorine and bromine are obtained as by-products. The process requires 12,000 kW. for the production of each ton of caustic soda as compared with 3,000 kW. necessary using ordinary electrolytic methods. This is largely offset by the saving in power, fuel and labour required to produce and purify salt.

Of the recent inventions in Japan, the following offer good prospects for industrial development: the use of waste middle oil (*B.P.*, 250°-300°C.) after repeated use in the separation of benzene and heavy oil from coal gas until it possesses no longer any absorbing power, as a basic vehicle for printing ink. The simultaneous manufacture of white phosphorus and phosphate of potash fertilizer has been accomplished by mixing limestone and potassic felspar or other potassium-containing minerals with phosphate rock, adding a small amount of carbon as a reducing agent. The yield and purity of phosphorus is said to be high.

A New Mass Spectrometer

A SIMPLIFIED AND FLEXIBLE radio-frequency mass spectrometer has been designed by Dr. W. H. Bennet of the *U.S. National Bureau of Standards* for the detection, separation, identification and measurement of negative atomic ions of heavier metallic elements (*Chem. Age*, 1948, **59**, 420). The instrument has a specially developed vacuum tube. The spectrometer not only provides a new means of exploring the little known fundamentals of negative ions, but its special characteristics make it widely applicable for other uses including the mass spectrometry of positive ions and for ionization studies.

This two-stage instrument consists of a multigrid tube in which an adjustable radio-frequency is applied to 2 grids, while all other electrodes are held at the proper direct current potentials and the ion current is measured at the plate. The limitations of the ordinary mass spectrograph using magnetic deflection are overcome in this instrument as the voltage of the ions can be increased to any required value for which insulation can be provided.

The simplicity and low cost of the radio-frequency mass spectrometer, the *Bureau* holds, should make it attractive not only in those applications in which its special characteristics make it superior to other kinds of mass spectrometer, but also in those laboratories where the expense of other types of equipment is prohibitive.

A New Glass Pump

AN IMPORTANT DEVELOPMENT IN pump design has been introduced by *Tungstone Products Ltd.* Made of pyrex-borosilicate glass, it makes practicable the safe conveying of all acids and alkalis with the exception of concentrated hydrofluoric acid and glacial phosphoric acid. The use of glass is made possible by the absence in the pump of all centrifugal and reciprocating stresses. The pump has the additional advantages of visibility cleanliness, and a capacity for withstanding temperatures up to 200°C. It can be flushed with steam or hot acid solutions. With a capacity (4′ inlet head) of 300 gal. per hr., up to 50 lb. per sq. in. delivery pressure, and requiring 1·5 to 4·5 cu. ft. of free air per min., the pump weighs only 54 lb. and measures 13″×13″ by 30″ — overall height.

Antibiotics in Onion & Disease Resistance

THE RELATION OF ANTIBIOTIC substances in the scales of different varieties of onions to disease resistance characteristics of the bulbs has been recently investigated on a field scale (*J. Agr. Res.*, 1948, **77**, 115). White, red, yellow and brown varieties have been investigated for their resistance to infection by *Colletotrichium circinans*, *Aspergillus niger* and *Botrytis alli* which cause the diseases popularly known as black smudge, black mould and neck rot respectively. The investigations were conducted on crops during 4 seasons.

The investigations revealed that while coloured varieties were in

general more resistant to smudge, there were some notable and rather consistent exceptions. Strongly pungent varieties in red, yellow and white groups tended in some seasons to have significantly lower smudge incidence than mildly pungent varieties. In *F2* progenies from crosses between white strong × yellow mild and between white strong × yellow strong, the heterozygous class from the latter cross had a consistently lower smudge index. These facts indicated that pungency had an effect on the varietal resistance to smudge, but it did not explain some outstanding cases where a coloured strong variety had a smudge index not significantly different from those of mild varieties.

The character of the outer scales of varieties varied greatly in number and in tendency to split so as to expose the fleshy scale. The poor outer scale character is a factor intimately related to high smudge incidence. The outer scale character is regarded as the most important condition modifying the smudge resistance of coloured varieties which is due primarily to the phenolic antibiotics in the outer scales.

During one season when neck rot was severe, a distinct correlation was found to exist between pungency and disease resistance. There is also a positive correlation between resistance and toxicity of the volatile and non-volatile antibiotics in fleshy scales. In one season the deeply coloured Australian brown showed high incidence of black mould. The extract of dry outer coloured scales was distinctly stimulative to germination and growth of *A. niger*. It appears that the same phenolic substances which are the major factors for resistance to smudge and neck rot may be the ones which contribute to black mould susceptibility in coloured varieties.

Australian Cotton Hybrids

COTTON HYBRIDS GROWN AT THE *Biloela Regional Experimental Station*, Queensland, have shown promise of high yielding quality, high ginning percentage and high *jassid* resistance, together with large bolls. Some of them yielded 2,240 lb. of cotton to the acre under irrigation compared with 1,700 lb. from commercial varieties now in use. The staple length of the hybrids approximates to that of the Miller variety.

Chemical Research in Britain, 1938-46

THE REPORT OF THE *Chemistry Research Board, D.S.I.R.*, London, for the period 1938-46, published recently, reviews the work of the *Chemical Research Laboratory*, Teddington, during the war period and the period since the cessation of hostilities.

The work of the *Corrosion Section* acquired additional importance during the war, particularly as regards naval craft and armament. The *CRL* rotor test, designed primarily for fundamental studies of immersed corrosion, gave valuable service in assessing the relative values of a variety of protective coatings. Research into corrosion inhibitors has led to the discovery of the inhibitive properties of sodium benzoate, both as an addition to aqueous solutions and as an impregnant into wrapping materials.

Considerable effort was devoted to the alleviation of war-time shortages by the development of processes for the production of materials normally imported. An example of this is the work on carbon black. It has been shown, that suitable carbon blacks can be prepared from indigenous materials, particularly coal-tar products. Highly successful foam fire extinguishers were developed for fighting petroleum fires. As an insurance against protein shortage during the war, the development of a food yeast from *Torula utilis* was given considerable attention and pilot plant studies were completed. On the basis of this development a full-scale plant was erected in Jamaica for the production of food yeast. A shortage of *derris* for insecticidal purposes led the *Laboratory* to collaborate with the *Agricultural Research Council* in the development of effective materials for the control of animal parasites, and a satisfactory DDT emulsion was finally formulated for the control of blow-fly.

A few selected topics have been proposed for investigation during the post-war period. They include : (1) isolation and identification of tar products ; development of technical methods for the isolation of tar components and the determination of physical and physico-chemical constants of hydrocarbons ; (2) studies on corrosion of metals under immersed and atmospheric conditions, and also of soil corrosion and development of accelerated tests and of new surface treatments for protection against corrosion ; (3) a study of the processes by which ore deposition occurs in nature and of the methods of recovery of semi-rare metals particularly in low-grade materials ; (4) development of new high polymers and a study of the relation between chemical structure and physical and mechanical properties of plastics ; (5) preparation of organic intermediates capable of polymerization and a study of organic reactions under pressure ; (6) microbiological investigations relating to the transformation of carbohydrates and the production of chemical substances by micro-organisms. Study of the reactions of sulphur-reducing and sulphur-oxidizing organisms. The studies may be limited to microbiological problems connected with corrosion.

The work on these problems made substantial progress during 1946. Research on more fundamental aspects of metallic corrosion has been resumed. The rotor test has been employed in the study of immersed corrosion. Work on electrode potential measurement as a means of detecting breakdown of painted surfaces was started. A method of stripping oxide films on copper, iron and other metals, originally discovered by Dr. Ulick R. Evans, has been improved by the exclusion of water and oxygen to give quantitative removal of the films so that its thickness and composition can be determined. Recently the invisible oxide film responsible for the protection of stainless steel has been separated and analysed. An enrichment of chromium in the film has been established. Accelerated corrosion tests are being explored, using conditions which reveal the known superior corrosion resistance of phosphated and painted surfaces as compared with painted but untreated surfaces. Strains of anaerobic bacteria (*V. desulphuricans*) are being intensively studied in relation to the general mechanism of anaerobic corrosion. New methods of extracting germanium and gallium from low-grade sources have been worked out. A preliminary investigation on the separation of isotopes by base exchange methods have been commenced.

A study of the chemistry of functional groups of high polymers has been initiated with the

object of disclosing new techniques for the elucidation of chemical structure and for the preparation of special polymers. Considerable progress has been made towards a clearer understanding of the relationships existing between the properties of reinforced plastics and those of other components. An investigation is being made on the influence of fat and wax, as impurities, on the adhesion between cotton fibre and phenolic resin. The commercial development of synthetic adhesives for wood has enabled high joint strength to be maintained under most severe climatic conditions but these glues are expensive and require great care in handling. A neutral cold-setting glue which overcomes the latter disadvantage has been developed from resorcinol and formaldehyde. Certain special applications of ion-exchange resins are being investigated.

The work now initiated on coal-tar includes a study of newer separation processes, the preparation of tar constituents in the purest attainable state and the determination of physical and physico-chemical constants with high accuracy. As an example of recent work on the isolation of pure components is the recovery from coal-tar base fraction of β-picoline. Among its 3 constituents, 2 : 6-lutidine, γ-picoline and β-picoline, the last compound has a current importance as an intermediate for the production of nicotinic acid. The separation of the 3 individual bases was effeced by azeotropic fractional distillation, using acetic acid as azeotropic former. A method for recovering the acid for reuse has been developed. Attention is being paid to find large-scale industrial uses for higher aromatic hydrocarbons of coal-tar. Acenaphthene, present in coke oven tar to the extent of 1 per cent, and readily extractable in pure form, shows promise of yielding industrially valuable plastics with high softening point and good electrical properties.

The high pressure equipment in the *Chemical Research Laboratory* has been used in 2 important lines of investigation, one leading to an improved process for converting phenols into corresponding aromatic amines, and the other for producing higher fatty alcohols from the corresponding acids.

At the request of the *Board of Trade* an investigation on the methods of preventing the caking of mixed fertilizers has been commenced.

Other matters receiving attention are : development and production of acetylene and its utilization as an intermediate product in chemical industry ; field trials with phenanthridium compounds in the control of *Nagana* in Africa.

Co-ordination of Cartographic Services

THE *United Nations Organization*, early in 1948, approached interested international organizations to submit relevant information and comments upon the Brazilian Resolution on " Co-ordination of Cartographic Services ". Accordingly, a meeting of the experts and representatives of a few international organizations was convened during June 2-3, 1948 in Washington under the joint sponsorship of the *Pan American Institute of Geography & History* and the *International Council of Scientific Unions*.

The members of the Conference were satisfied that the term " Cartography " in the Resolution was employed in its fullest sense, i.e. all types of surveys and of maps and their attendant by-products and the graphic portrayal of economic, social and cultural factors.

The three basic ideas contained in the Resolution are : (a) that the Council recommend to the Member Governments the stimulation of the accurate surveying and mapping of their national territories ; (b) that the U.N. Secretary-General take appropriate action to further such efforts by specific means including the advancement of the science itself ; the preparation of an up-to-date study on modern cartographic methods ; and the development of uniform international standards ; and (c) that the cartographic services of the United Nations and the specialized agencies be co-ordinated, taking into account the work of the various inter-Governmental and international non-Governmental organizations.

The concensus of the group as to the most practical way to undertake an appropriate study of the Resolution would be the calling of a meeting of experts and representatives of the interested agencies and international organizations.

Attention was drawn to the concrete contributions which existing international organizations and specialized agencies can make by providing available reports on (a) their achievements to date in the development of a body of uniform international standards, including their proposals for the future, and of (b) their past accomplishments, present programmes and future plans in the field of cartography.

The urgency of an early meeting of experts and also of adequate documentation, therefore, was stressed by the group so as to enable the proposed meeting to come off early in 1949. The specific interests of various participating organizations were considered, and it was felt that it would be desirable to give an idea of the nature of discussion on the subject which the several organizations might wish to take under advisement. The following draft was submitted by the President of the *International Council of Scientific Unions* to facilitate other organizations in their consideration of action to be taken at the forthcoming meeting :

" The *International Council of Scientific Unions* desires to stress to the Secretary-General of the United Nations its urgent sense of the need for a full realization of the general import of the Resolution on ' Co-ordination of Cartographic Services of Specialized Agencies and International Organizations ', particularly, with reference to the scientific and technical aspects of cartography. Besides national and international interests and other scientific and technical interests, such as hydrographic, aerological, geological, surveying and mapping, and similar fields of scientific endeavour, those of the *International Council of Scientific Unions* bear significantly on this subject as evidenced by its autonomous member Unions of Geography, Geodesy, Geophysics, Astronomy, Scientific Radio and Scientific Biology (and eventually Mathematics, now being reorganized).

" At present, there exists duplication of effort and of personnel in these varied and related fields. A considered co-ordination of these overlapping activities must perforce result in the economical use of funds and in advantage to future advance in the cartographic science and its application to human welfare.

"Some indication of the interest of the *International Council of Scientific Unions* in the suggested International Cartographic Orga-

nization was set forth by Professor E. de Martonne in his communication to the U.N. Secretary-General. It was stated that such an organization would help : (1) to expedite the survey of the world and propagate the results of this survey ; (2) to unify cartographical methods and processes ; and (3) to support and promote cartographical works of the type of the National Atlas. The propagation of the progress of cartography in each country would not only be a boon to all the theoretical and research bodies depending upon geographical knowledge, but would also serve as a stimulant for the progress of this knowledge.

" This progress could be achieved by the publication of an international cartographical bibliography, mentioning not only the maps published by national cartographical services, but large- and small-scale maps representing the extent of physical and economic phenomena . . . " Scientific and practical advances in the studies of the earth sciences and phenomena thereof involve cartographic matters of first importance in geodesy, meteorology, seismology, geology, geomagnetism, oceanography, vulcanology and hydrology. Other Unions undoubtedly have similar interests, such as scientific biology, scientific radio, astronomy and mathematics.

As complementary to co-ordination activities in the field of cartography and related sciences, and of cartographic services internationally, the group invited attention to the polar regions as an area of the world in which the co-ordination of cartographic operations would yield immediate and fruitful results.

Inter-University Relations

THE QUESTION OF INTER-UNIVERSITY relations was discussed at a recent *Congress of Universities of the Commonwealth*. The problems discussed covered both administrative and academic aspects such as, business arrangements between universities as will enable a student or a teacher to move from one university to another without academic loss of standing or financial embarrassment, and to make such an exchange sufficiently attractive from an academic point of view as to research and other facilities. The *Congress* agreed to recommend that the universities of each country should be encouraged to form an agency which should act as an instrument of communication with universities elsewhere. Further, since the *Congress* meets only every 5 years, it was suggested that, in the years between such meetings, vice-chancellors and senior members of staff should visit each other as frequently and as regularly as possible.

The *Congress* passed several resolutions designed to make the traffic between universities easier and less hazardous. They were : (1) to set up a *Central Office of the Universities Bureau* to announce and advertise vacancies. Such a *Bureau* will arrange for candidates to be interviewed by a panel of experts in that particular field and the successful candidate to be supplied with information relating to the facilities at the university he is to work in ; (2) the question of superannuation benefits to be taken up so that a worker is not made to suffer financial loss if he goes to other universities ; a *Committee* was set up to enquire into this question ; (3) foundations and other bodies to be approached for financial help to meet travelling expenses of scholars (*Nature*, 1948, **162,** 585).

Industrial Research in France

THE SETTING UP OF INDUSTRIAL research centres to serve the needs of industries is facilitated by a recent legislation enacted in France. Certain industries had, prior to this legislation, set up representative research bodies, of which the *Centre Technique des Industries de la Fonderie* is an example. This body derives its income from a levy consisting of obligatory contributions from firms in all branches of the founding industry, ferrous and non-ferrous, and supplemented by payments for specific investigations undertaken at the request of firms. The aim of the present legislation is to define the status, and regularize the methods of inaugurating new industrial research bodies without materially affecting the position of those already in existence.

Under the new Act, research centres may be created to serve any industry, provided that a sufficient degree of agreement and support is forthcoming from appropriate trade associations and organizations representing the industry. The approval of the Minister for Industry and Commerce must then be secured. The aims of industrial research centres are to further technical progress, to take part in increasing production, and to ensure the quality of products of the industry with which they are associated. These centres are to engage themselves in experimental research work and to take part in the framing and adoption of rules to enable the control of quality in production. Each centre is to be controlled by an administrative *Council* whose constitution must be approved by the Minister of Labour.

The income of these centres is to be provided by a compulsory levy from firms within the industry concerned, and from payments made for investigations sponsored by individual firms. The method of collecting these obligatory contributions from the industry is to be arranged by consultation between the *Council* and the Minister of Labour, and the appropriate Ministries responsible for finance.

Provision is also made for the setting up of industrial research centres which may cover a sphere of activity overlapping more than one industry. Such a research centre would be supported, not by contributions from individual firms as in the case of other centres, but by sums contributed by the research centres representing the different industries concerned.

Any research body already in existence and associated with a particular industry may, under the present legislation, make application to assume the status and privileges of an industrial research centre provided that sufficient support is forthcoming from the industry. A research centre which is considered no longer to have the support and confidence of its parent industry may be dissolved with the approval of the Minister (*Bull. British Cast Iron Res. Assn.*, 1948, **9,** 251).

UNESCO Grants

THE *UNESCO* HAS ASSIGNED £60,000 to its work of educational rehabilitation in war-devastated countries. The beneficiaries will be Austria, Czechoslovakia, Greece, Hungary, Italy, Poland and devastated British Colonies.

A grant of $7,500 has been made to the *International Council for Philosophy & Humanistic Studies* to help the *Council* in the early stages of its work. The *Council* is to co-ordinate the dissemination of information regarding works published or begun in the field of philosophy, human-

istic studies and related branches of study and to encourage the setting up of international organizations in fields in which no such organizations exist.

F.A.O. Liaison Committee

To assist the Government of India in the discharge of the obligation accepted by them as members of the *F.A.O.* of the United Nations and to co-ordinate the collection of information required by the *F.A.O.* from India, and, in general, to act as a clearing house for the exchange of information between the *F.A.O.*, the Ministries of the Central Government, Provincial Governments and Indian States, it has been decided to set up a *National Food & Agriculture Organization Liaison Committee*. It will consist of the Agriculture Secretary to the Government of India as *Chairman* and 16 other members. Of these 5 non-officials will represent the Central Legislature, 2 will be representatives of the *Federation of Indian Chambers of Commerce & Industry*, 3 of the rural peoples' interests to be nominated by the Agriculture Minister, and one representative each from the Ministries of Agriculture, Food, Health, Commerce, External Affairs and Commonwealth Relations. The Vice-Chairman of the *Indian Council of Agricultural Research* will also be a member of the *Committee*.

Indian Institute of Chemical Engineers

The *Indian Institute of Chemical Engineers* (*President* : Dr. Hiralal Roy) was inaugurated in December 1947 at Patna. At the first session of the *Institute*, also held at Patna in January 48, 11 technical papers were read by members and discussed. Since then, a number of meetings have been organized at Calcutta for the discussion of papers on chemical engineering topics. The *Institute* has over 100 members on its rolls, and its officers are temporarily located at 5/2, Garlick Place, Calcutta.

The first general meeting and the second annual session of the *Institute* will be held at Allahabad in January 1948 during the *Indian Science Congress* Week.

ANNOUNCEMENTS

Dr. M. S. Krishnan, Superintending Geologist, *Geological Survey of India, Southern Circle*, has been appointed Director, *Bureau of Mines*, Government of India, in place of Dr. D. N. Wadia who has retired from December 1, 1948.

The *Council of the Institute of Engineers* (India) have nominated Dr. D. R. Malhotra as a member of the recently constituted Advisory Council for the *School of Mines & Geology*, Dhanbad, for a period of 3 years.

The Government of India have decided to raise the standard of the *School of Mines & Geology*, Dhanbad, to that of the *Royal School of Mines*, London.

The United States Medal for Merit, the highest award made by the President of the United States of America, has been presented this year to Sir Alexander Fleming and to Sir Howard Florey for their work on penicillin.

Universities Commission : The Education Ministry of the Government of India have appointed a *Universities Commission* to study the existing system of higher education in India and to submit a plan for its expansion and improvement. The *Commission* will consist of 9 members with Dr. S. Radhakrishnan as Chairman. Two of the members are from U.S.A. — Mr. Arthur E. Morgan, lately President of the Antioc College and Chairman of the *T.V.A.*, and Dr. John J. Tigert, lately Commissioner of Education in the U.S.A. and President of the Florida University. A third member, Dr. Duff, is from Britain. The Indian members, besides the Chairman, are Dr. Zakir Hussain, Dr. Meghnad Saha, Dr. Birbal Sahani, Dr. A. Lakshmanaswami Mudaliar and Dr. Tara Chand.

German Scientific Books : Books published in Germany may now be ordered through a book-seller who may apply directly to the publisher in Germany. The transaction is administered through the *Joint Export & Import Agency of Military Government* and payment can be made in the currency of the country in which the original order is placed. Many publishers in Germany who forsee a demand outside for a book in Germany generally obtain the required licence soon after the appearance of the book in Germany.

The publication of a new book, *Neure Probleme der Abstammungslehre* by Dr. Berhard Rensch (Published by Ferdinand Enke Verlag, Stuttgart) has been announced (*Nature*, 1948, **162**, 562).

Scientific journals available in India : Dr. Alexander Wolsky, Principal Scientific Officer, Science Co-operation Office for South Asia, University Buildings, Delhi, writes as follows : " It has been suggested that a list of scientific periodicals available in different institutions in India would be very useful for the scientific workers. On account of lack of information as to the availability elsewhere within the country of particular scientific literature, progress in work is often hampered. It has been proposed that the work of compilation of a list of periodicals and journals, which one may consult at a short notice from the libraries in India, may be taken up by this Office. This information will also be very welcome and useful for workers outside India in the region of this office, like Burma, Malaya, Siam, as also the regions of Middle East and East Asia where *UNESCO* is keeping similar offices."

Dr. Wolsky will be glad to have lists of journals and periodicals available in the libraries of various institutions, grouping them under the following heads : (i) for consultation on the spot, i.e. not to be taken outside, and (ii) for loan (on pre-payment of postage for sending the journals).

Reports from States & Provinces

MADRAS

Technical Training Establishments

THE AUTO SCHOOL FOR TRAINING technicians in automobile technology, the first of its kind in the Province, was recently declared open by the Hon'ble Minister for Industries in Madras. The school will impart training in all branches of automobile engineering and technology. The school is situated in General Patters Road, near Mount Road, Madras.

There are 8 polytechnic centres working in different parts of the Province. A trades school is attached to the polytechnic at Mangalore, and industrial schools are attached to other polytechnics except those at Coimbatore and Vuyyuru. Subjects such as cabinet-making, carpentry, general mechanics, book-binding and blacksmithy are taught in these schools. The courses vary from 2 to 3 years at the end of which certificates are awarded to successful candidates.

A scheme for special training for textile workers is being examined by the Director of Industries.

Irrigation Project for Malabar

THE FIRST MAJOR IRRIGATION project for Malabar, the Malampuzha Scheme, has been sanctioned by the Government. The main object of the project is to stabilize the existing irrigation facilities afforded to 40,000 acres in Palghat taluk and its surrounding areas. At a later stage, this scheme will be developed into a hydroelectric project. The scheme will cost Rs. 3·8 crores in its first stage, of which Rs. 135 lakhs will be paid by the Government of India.

The scheme will enable 5,800 additional acres to be brought under cultivation; 7,100 acres of single-crop land can be converted into double-crop land, and on 11,350 acres of double-crop land, a third crop can also be cultivated. As a result of this project, 15,000 tons of rice, in addition to what is already grown in the area, will be available.

Another project, the Cherumangalam Irrigation Project, estimated to cost about Rs. 8 lakhs and irrigate 1,800 acres, has been sanctioned by the Government.

Phosphate Deposits

A SURVEY OF THE MINERAL deposits of the Trichinopoly district, carried out in 1940 by the *Geological Survey of India*, reported the occurrence of phosphatic nodules over an area of 11 to 12 square miles. The reserves, occurring to a depth of 50′, were estimated at 2,000,000 tons.

The Government have examined the question of utilizing these phosphatic nodules for the production of superphosphates. 3 methods have been suggested for trial: (1) conversion of the ground nodules into superphosphate by treatment with sulphuric acid; (2) calcination of the ground nodules with felspar, quartz and magnesite in a rotary kiln to yield a sintered product in which part of the phosphate in the original mineral is rendered soluble; (3) fusion of nodules with silica and magnesia in electric furnace to yield a product in which all the phosphate is converted into a soluble form.

NEW DELHI

Asian Regional Commission of the I.M.O.

THE 11-DAY SESSION OF THE first *Asian Regional Commission of the International Meteorological Organization* concluded in New Delhi on 27th November, 1948, after passing 44 resolutions and recommendations for the better co-ordination and utilization of meteorological services in the region.

The Conference resolved that sub-continental broadcasting centres should be established at New Delhi, Tokyo and Kahbrosk (USSR). These broadcasts are intended for the meteorologists of the respective countries and will be in codes approved by the *I.M.O.* It was recommended that all countries in the region should organize their own national broadcasts on proper standards so that the sub-continental transmissions are facilitated. The Conference also recommended that national broadcasting centres be established in Afghanistan, Arabia, Iran, Saudi Arabia and Syria. Some of the other recommendations made by the Conference relate to the co-ordination of the national and sub-continental broadcasts, data to be included, codes to be used and standards of transmission. Area for meteorological reports from ships and for shipping forecasts were also allotted.

It was resolved to establish Standing Sub-Commissions for agricultural meteorology, hydrology, meteorological transmission and development of mechanical statistical methods. These sub-commissions will function in close collaboration with the *I.M.O. Commissions* and co-ordinate and develop the work of the various organizations in the region.

Other resolutions and recommendations passed by the Conference were in respect of improvement of the existing network of meteorological stations and their working. It was decided that the countries in the regions should adopt 4 international synoptic hours of observation for surface observations. It was recommended that 03·00 and 15·00 (G.M.T.) should be adopted for radio-sonde observations (with a tolerance of ± one hour), and 15·00 G.M.T. and 00·00, 09·00, 15·00 and 21·00 hours for pilot balloon observations. The adoption of these hours is to come into force from January 1, 1949 and, if that is impossible, by January 1, 1950.

The Conference also recommended that countries in the region should individually or jointly arrange for the establishment of island weather stations, stationary weather ships and meteorological reconnaissance flights and for the securing of weather reports regularly from transport air-craft.

It was found that the international system of storm-warning signals was not adequate for tropical regions and the Conference accordingly recommended a review of the existing system. It was also decided that four countries should be selected for the maintenance of standard barometers to facilitate intercomparisons.

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section I, for November 1948. Patents from the *Council of Scientific & Industrial Research* are indicated by an asterisk.

Chemical & Allied Products

Paints, Varnishes & Lacquers

*38062. SIDDIQUI : Conversion of Bhilawan Shell liquid to a non-vesicating drying product for the manufacture of air-drying varnish compositions : *Copolymerizing Bhilawan Shell liquid with turpentine.*

*38064. SIDDIQUI & DHAR : Conversion of Bhilawan Shell liquid to a non-vesicating drying product for the manufacture of lacquer varnish, stoving enamels, waterproofing or like materials : *Copolymerizing vegetable oils, Bhilawan Shell liquid, turpentine or rosin.*

Inorganic Chemicals

39320. SUTAONE, SALETORE & MENE : Activation of bauxite for bleaching vegetable oils and fats : *Finely powdered bauxite is dehydrated at a temperature of above 300°C., cooled, treated with acid, washed and dried.*

Organic Chemicals

39593. N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ : Extractive crystallization process : *Contacting mixture of organic compounds with urea in presence of water, separating the slurry of complex compound formed and decomposing it.*

38939. CIBA LTD. : Manufacture of new amines. (Addition to No. 36267) : *Reaction a 1 : 2-dihydrofluoranthene with an alkyl halide containing a basic group in the presence of an agent capable of eliminating hydrogen halide.*

39476. MEAD JOHNSON & CO. : Process of preparing 2-sulfanilamidopyrazine : *Reacting 2-aminopyrazine with p-acetaminobenzene-sulfonyl chloride and removing acetyl group from the product.*

37345. WILLIAMSON : Method for producing 5, 6-dimethoxy-8-amino quinoline : *Comprises of reacting 4-acetamino-5-nitro-veratrole, glycerine, arsenic acid and sulphuric acid.*

40090. I.C.I. LTD. : New quinoline derivatives : *Reacting pyrimidulamino quinoline with a quaternary salt-forming agent.*

Miscellaneous Chemicals

38823. RAO & SREENIVASAYA : Production of distillery washes having alcohol concentration of 10 to 14 per cent by volume : *Fermenting sugar solution by yeast of the species of Saccharomyces cerevisiae.*

36961. UNIVERSAL OIL PRODUCTS CO. : Process for producing hydrogen : *Reacting catalytically gaseous hydrocarbon and steam.*

40111. KLOPPENBURG : Process for winning sugars from the molasses from a cane and/or beet sugar factory : *Alcohol-water solution of molasses treated with lime to form monocalcium salt of the sugar which is thereafter treated with carbon acid to get free sugar and calcium carbonate precipitate.*

31398. I.C.I. LTD. : Construction of aircraft runways, roads, floors, and like surfaces and manufacture of water-repellent materials therefor : *To the earth's surface is applied an aqueous solution of ammonium or other water-soluble salt of a water-insoluble carboxylic acid and an aqueous solution of a water-soluble multivalent metal salt.*

31610. I.C.I. LTD. : Manufacture and application of water-repellent constructional materials : *Preparations are intimate mixtures in powder form containing at least two ingredients from the following, viz. (a) water-soluble salts of water-insoluble carboxylic acids ; (b) water-soluble salts of polyvalent metals ; (c) water-insoluble polyvalent metal salts of carboxylic acids obtainable by interaction of (a) and (b) ; (d) water-insoluble carboxylic acid ; (e) salts of acidic polyvalent metal oxides, which salts are either water-soluble or decompose on contact with water into a water-soluble base and a water-insoluble polyvalent metal hydroxide, subject to certain provisions.*

36682. KHORANA & BHUNVARA : Mucilage of plantago as an emulsifying or thickening agent. *Emulsifying paraffin or vegetable oils with extract of plantago seeds.*

37604. ANGLO-IRANIAN OIL CO. LTD. : Synthesis of hydrocarbons and oxygen-containing compounds from mixtures of carbon monoxide and hydrocarbon. *Reacting carbon monoxide hydrogen and olefine in presence of catalyst.*

39388. N. V. VEENENDAA'SCHE SAJET — EN VIJFSCHACHTFABRIEK VOORHEEN WED. D. S. VAN SCHUPPEN & ZOON : Process for the production of sterols and of their additions products from material containing sterols. *Treating sterol containing material with compounds containing NH_2-groups and decomposing the addition product.*

Fuels & Lubricants

38266. N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ : Mineral greases containing barium and/or strontium soaps : *Comprises of using oxy-fatty-acid in mineral oil.*

37719. STANDARD OIL DEVELOP. CO. : Process for the gasification of carbonaceous materials and for the manufacture of water gas : *Withdrawing a portion of carbonaceous material from the reaction zone and contacting it with air under combustion condition.*

Medical Research & Practice (INCLUDING CLINICAL APPLICATION OF DRUGS & PHARMACEUTICALS)

38479. GHOSH : Process for the preparation of cinchonine ethyl carbonate and dichinconine carbonate : *Condensing cinchonine with car-*

bonyl chloride or ethyl chlorocarbonate or diethyl carbonate.

37354. CAMPBELL : Antimalarial compounds, intermediates and process of producing them : *Condensing O-nitro-p-alkoxy aniline with methyl-vinyl ketone to form 6-alkoxy-8-nitrolepidine and condensing the lepidine after reduction with alkylaminoalkyl halides or their hydrohalide.*

39684. DIRECTOR, HAFFKINE INSTITUTE : A process for the preparation of 2-(para-aminobenzene-sulphonamido)-thiazole : *Condensing p-acetamino-benzene-sulphonyl chloride with 2-amino-thiazole in the presence of alkali carbonate and heating the condensation product with a further amount of 2-amino-thiazole.*

Metals & Metal Products

37018. JOHN MILES & PARTNERS (LONDON) LTD. : Improvements in and relating to the refining of metals : *By projecting oxidizing fluids into the molten metal.*

37606. UNITED ANODISING LTD. : Production of anodic films on metal surfaces : *Current passed through metal articles disposed between anode and cathode but not connected to them.*

38302. UNITED ANODISING LTD.: Electrolytic treatment of metals : *Bath containing orthophosphoric acid, organic inhibitor, water and sulphuric acid, used for polishing metal put as anode.*

39720. REPUBLIC STEEL CORPN. : Refining of ore in blast furnaces : *Ratio of charge maintained between 2·45 and 2·8, blast rate kept above normal, and discharge gases thrattled to maintain furnace top pressure at least 5 lb. per square inch gauge.*

Miscellaneous

38633. CHLORIDE ELECTRICAL STORAGE CO. LTD. : Level indicating devices for electric accumulators : *Of the type comprising a float with a stem projecting upwards with marking thereon.*

37448. BOOTH : Aeration or flotation machines and methods of froth flotation : *Setting in motion an axial current of aqueous pulp, intercepting the pulp flow along on imperforate plane having a trailing edge and sweeping a current of aerating fluid over and aerors the trailing edge into the pulp flow.*

38424. BAKE : A method and an apparatus for withering tea-leaf : *Tea-leaf is conveyed by means of an air current through one or more withering rooms, and subjected to a movement opposite to the direction of said current.*

39767. APTE & SENGUPTA : An improved type of gas and air filter : *An air filter for internal combustion engines in which saw dust is used instead of coir, felt, etc.*

38046. FREYSSINET : A method of manufacturing pre-stressed concrete articles particularly railway sleepers and articles : *Placing in the rounded end portions of hoops two members capable of resisting the tension exerted by these hoops, incorporating the said members in the interior portions of a mould and housing concrete into the mould.*

39930. M. KONECNY : Manufacture and application of insulating material for buildings and the like : *Consisting of bands made by binding corncobs.*

Journal of
Scientific & Industrial Research

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Stabilizers for Fats Used in Baking

D. C. DHAR & J. S. AGGARWAL
Chemical Laboratories, C.S.I.R., Delhi

FAT is an essential ingredient of most classes of baked goods. It plays an important rôle in the development of flavour and in determining the physical structure of the product. The amount of fat in baked products varies from 3 to 50 per cent and as they are usually packed in containers which do not protect them from air, there is a possibility of the fat turning rancid. The problem of fat stability in baked goods is quite distinct from the stability of fats in their original form. Very little correlation between the keeping qualities of different fats and the stability of baked products made from the same fats has been found to exist. Thus Triebold, Webb and Rudy[1] found that rancid lards produced crackers of better keeping quality than did lards of good quality.

Bohn and Olson[2] observed that the stability of crackers decreased with the increase in the unsaturation of fats. This effect has been attributed to the destruction of anti-oxidants in baking. Mckinney and Bailey[3] found that biscuits made with hydrogenated lard are nearly as stable as those prepared from hydrogenated oil although the concentration of natural anti-oxidants in lard is much lower than that in vegetable oils.

Besides factors such as baking temperature, ingredients, metallic contamination during baking, moisture content and condition of storage, the nature and quality of fat are important factors determining the stability of baked goods. Animal fats such as lard and tallow are seldom used in Indian bakeries. Hydrogenated vegetable oils (*Vanaspati*), clarified butter (*ghee*), coconut oil and vegetable oil shortening are generally employed. The natural anti-oxidants present in oils and butter are largely eliminated during the refining and hydrogenation processes, and even if present, they are inactivated during baking. It is necessary, therefore, to stabilize the fats by anti-oxidants which are stable under the conditions obtaining in the baking process.

The comparative merits of a series of non-toxic anti-oxidants which may find application in the baking industry in India have been studied in these laboratories as a preliminary to the study of fat stability during the baking process. The fats were subjected to "swift stability test"[4] with and without additives and the acid and peroxide values (Wheeler's method[5]) of the resulting products examined. The additives which are found effective as a result of these tests will be selected for further study under actual baking conditions.

Experimental

The fats were examined and their characteristics are given in Table I.

TABLE I

Fat	Acid value	Saponification value	Iodine value
Vanaspati I	0·63	188·7	85·9
Vanaspati II	0·35	190·9	62·4
Ghee	5·80	245·3	32·2
Vegetable oil shortening	0·52	189·6	16·4
Coconut oil	6·07	249·7	8·1

The "swift stability test" on the fats was carried out as follows: 20 gm. of the fat were taken in each of 6 test tubes (1″×8″) and immersed in a thermostat at 210°F. Air washed with potassium permanganate solution was bubbled through the fat in each of the test tubes at the rate of 2·33 cc. per second. The acid value, peroxide value and smell were determined at noted intervals. The results obtained are given in Table II (Fig. 1).

TABLE II — SUSCEPTIBILITY OF FATS TO OXIDATION

Fat	Aeration time, hr.	Acid value	Peroxide value	Smell
1. *Vanaspati I*	0	0·63	1·20	Good
,,	1·5	3·60	3·40	Good
,,	2·5	0·41	4·14	Good
,,	3·5	0·26	9·24	Good
,,	5·5	0·35	18·50	Good
2. *Vanaspati II*	0	0·35	0·73	Good
,,	1·5	0·45	5·80	Good
,,	2·5	0·42	10·90	Good
,,	3·5	0·43	42·80	Slightly rancid
,,	5·5	1·56	93·30	Rancid
3. *Ghee*	0	5·80	0·28	Good
,,	1·5	5·24	8·23	Good
,,	2·5	5·17	26·8	Slightly rancid
,,	3·5	6·21	44·50	Rancid
,,	5·5	10·10	80·10	Rancid
4. Vegetable oil shortening	0	0·52	1·30	Good
,,	1·5	0·30	1·60	Good
,,	2·5	0·64	2·10	Good
,,	3·5	0·40	3·01	Good
,,	5·5	1·30	6·82	Good
5. Coconut oil	0	6·07	0·07	Good
,,	1·5	4·08	0·16	Good
,,	2·5	3·93	0·16	Good
,,	3·5	2·6	0·42	Good
,,	5·5	1·6	0·78	Good

The effect of adding anti-oxidants was next studied. All the anti-oxidants, except N.D.G.A. (nordihydroguairetic acid), were incorporated in the fats by direct addition with gentle warming and stirring. N.D.G.A. (0·1 gm.) was dissolved in 10 gm. of refined groundnut oil and an aliquot of the solution incorporated into the fat. The results obtained are given in Tables III-VI. As coconut oil keeps well as such, no attempt was made to study the effect of anti-oxidants on its stability.

TABLE III — VANASPATI I

Anti-oxidant	Aeration time, hr.	Acid value	Peroxide value
1. ...	nil	0·6	1·2
2. ...	3·5	0·2	9·2
3. Alcoholic extract of *anis* seed (solid 0·1%)	3·5	0·2	8·9
4. Sesame seed powder (0·1%)	3·5	0·2	7·3
5. Egg lecithin (0·1%)	3·5	0·1	7·5
6. Soya-bean lecithin (0·1%)	3·5	0·3	7·2
7. *Kamala* dye (0·1%)	3·5	nil	8·1
8. *Kamala* dye (0·1%) + tartaric acid (0·02%)	3·5	0·3	7·4
9. *Kamala* dye (0·1%) + citric acid (0·02%)	3·5	0·1	7·7
10. N.D.G.A. (0·01%)	3·5	0·1	9·0
11. N.D.G.A. (0·01%) + citric acid (0·02%)	3·5	0·2	8·1
12. Wheat germ oil (0·1%)	3·5	0·2	8·5
13. Wheat germ oil (0·1%) + citric acid (0·02%)	3·5	0·1	1·4

TABLE IV — VANASPATI II

Anti-oxidant	Aeration time, hr.	Acid value	Peroxide value
1. ...	nil	0·3	0·7
2. ...	3·5	0·4	42·8
3. Alcoholic extract of *anis* seed (solid 0·1%)	3·5	0·1	27·0
4. Sesame seed powder (0·1%)	3·5	0·1	24·0
5. Oat powder (0·1%)	3·5	0·2	18·0
6. Egg lecithin (0·1%)	3·5	0·1	19·2
7. Soya-bean lecithin (0·1%)	3·5	0·5	16·0
8. *Kamala* dye (0·1%)	3·5	0·2	33·0
9. *Kamala* dye (0·1%) + tartaric acid (0·02%)	3·5	0·2	32·0
10. *Kamala* dye (0·1%) + citric acid (0·02%)	3·5	0·3	32·8
11. N.D.G.A. (0·01%)	3·5	0·4	28·2
12. N.D.G.A. (0·01%) + citric acid (0·02%)	3·5	0·1	7·6
13. Wheat germ oil (0·1%)	3·5	0·1	31·7
14. Citric acid (0·02%)	3·5	0·3	20·2
15. Wheat germ oil (0·1%) + citric acid (0·02%)	3·5	0·3	4·8

TABLE V — GHEE

Anti-oxidants	Aeration time, hr.	Acid value	Peroxide value
1. ...	nil	5·8	0·3
2. ...	3·5	6·2	43·5
3. Alcoholic extract of *anis* seed (solid 0·1%)	3·5	4·7	8·5
4. Sesame seed powder (0·1%)	3·5	4·9	7·6
5. Egg lecithin (0·1%)	3·5	2·5	26·7
6. Soya-bean lecithin (0·1%)	3·5	5·5	1·9
7. *Kamala* dye (0·1%)	3·5	4·9	2·7
8. *Kamala* dye (0·1%) + tartaric acid (0·02%)	3·5	4·5	2·2
9. *Kamala* dye (0·1%) + citric acid (0·02%)	3·5	5·4	2·5
10. N.D.G.A. (0·01%)	3·5	6·1	37·3
11. N.D.G.A. (0·01%) + citric acid (0·02%)	3·5	3·8	20·0
12. Citric acid (0·02%)	3·5	4·2	25·1
13. Wheat germ oil (0·1%)	3·5	5·2	30·3
14. Wheat germ oil (0·1%) + citric acid (0·02%)	3·5	5·0	0·7

TABLE VI — VEGETABLE OIL SHORTENING

Anti-oxidant	Aeration time, hr.	Acid value	Peroxide value
1. ...	nil	0·5	1·3
2. ...	3·5	0·4	3·0
3. Egg lecithin (0·1%)	3·5	0·3	2·7
4. Soya-bean lecithin (0·1%)	3·5	0·3	1·5
5. *Kamala* dye (0·1%)	3·5	0·3	2·1
6. *Kamala* dye (0·1%) + tartaric acid (0·02%)	3·5	0·4	1·3
7. *Kamala* dye (0·1%) + citric acid (0·02%)	3·5	1·3	1·4
8. N.D.G.A. (0·01%)	3·5	0·5	2·3
9. N.D.G.A. (0·01%) + citric acid (0·02%)	3·5	1·1	1·3
10. Wheat germ oil (0·1%)	3·5	0·4	1·7
11. Citric acid (0·02%)	3·5	1·2	1·8
12. Wheat germ oil (0·1%) + citric acid (0·02%)	3·5	0·3	1·7

Discussion

From the data in Table II it will be seen that aeration affects the acid values of different fats to varying extents, while the peroxide values increase continuously during the aeration period. This is in accordance with the finding of Kaloyereas[6]. The peroxide value has, therefore, been taken as a measure of rancidity in this investigation. The fact that the peroxide value after $5\frac{1}{2}$ hours' aeration of *Vanaspati II* increased much more than that of *Vanaspati I*, although the iodine value of the former was less than

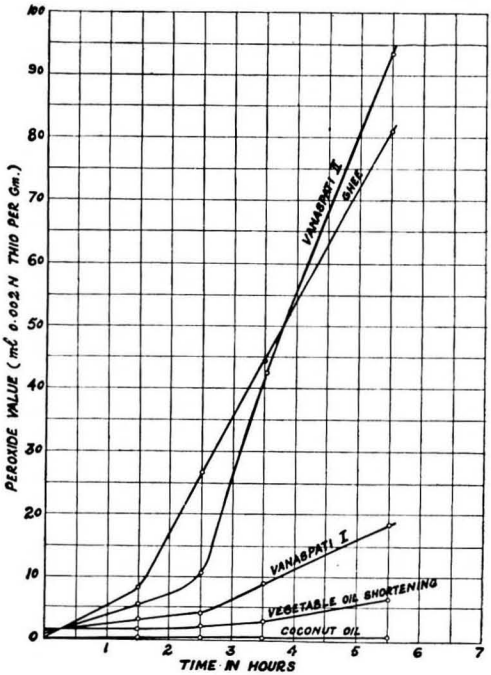

FIG. 1 — A COMPARISON OF THE RATE OF OXIDATION OF FIVE FATS SELECTED FOR TESTS.

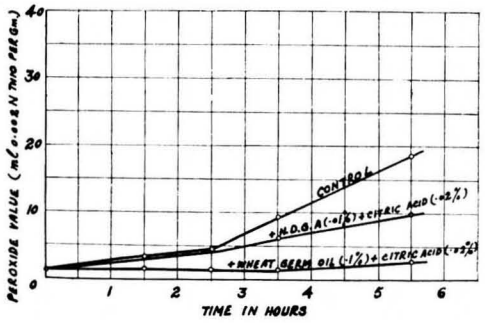

FIG. 2 — CHANGE OF PEROXIDE VALUE OF VANASPATI I WITH SOME EFFECTIVE ANTI-OXIDANTS.

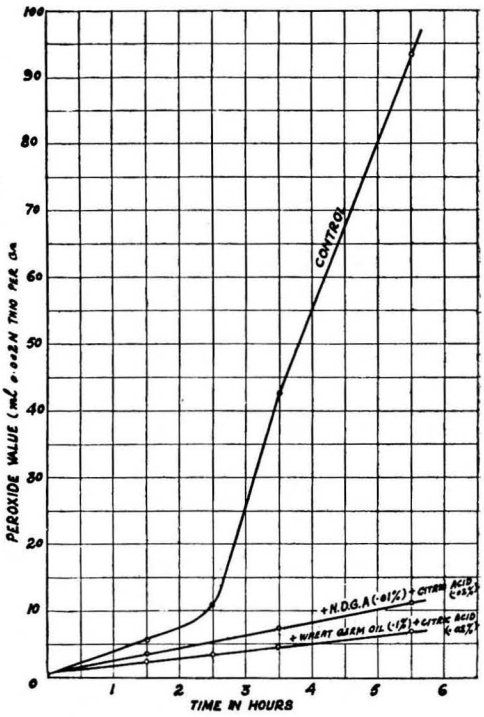

FIG. 3 — CHANGE OF PEROXIDE VALUE OF VANASPATI II WITH SOME EFFECTIVE ANTI-OXIDANTS.

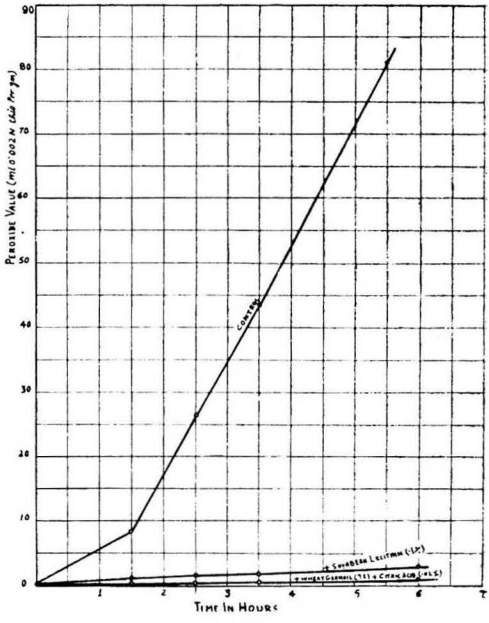

FIG. 4 — CHANGE OF PEROXIDE VALUE OF GHEE WITH SOME EFFECTIVE ANTI-OXIDANTS.

that of the latter, goes to show that besides iodine value, other factors such as the fatty acid composition and the pre-treatment of the fat also influence the development of rancidity.

Five anti-oxidants have been selected for further tests as a result of the investigation. They are :

1. Wheat germ oil (0·1%) + citric acid (0·02%).
2. N.D.G.A. (0·01%) + citric acid (0·02%).
3. Soya-bean lecithin (0·01%).
4. *Kamala* dye (0·1%) + tartaric acid (0·02%).
5. *Kamala* dye (0·1%) + citric acid (0·02%).

The order of their effectiveness against *Vanaspati I* and *II*, *ghee* and vegetable oil shortening are recorded in Table VII. The changes in peroxide values of the fats as a result of aeration in presence of the selected anti-oxidants are represented in Figs. 2-5.

TABLE VII

	Order of effectiveness		
Vanaspati I	(1)	(2)	(3)
Vanaspati II	(1)	(2)	(3)
Ghee	(1)	(3)	(5)
Vegetable oil shortening	(2)	(4)	(5)

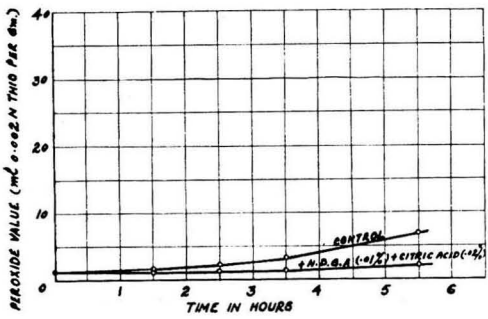

FIG. 5 — CHANGE OF PEROXIDE VALUE OF VEGETABLE OIL SHORTENING WITH N.D.G.A. + CITRIC ACID.

From the above it will be seen that wheat germ oil is the most effective anti-oxidant for *vanaspati* products and *ghee*. N.D.G.A. and soya-bean lecithin follow wheat germ oil in their effectiveness. *Kamala* dye has been found quite effective for *ghee* and vegetable oil shortening. As a matter of fact, vegetable oil shortening can be protected equally well by N.D.G.A., *kamala* dye and wheat germ oil with various synergists. This may be due to the different constitution of the shortening as compared to natural fats. If the colour of the *kamala* dye is not objectionable, it can be employed as an effective anti-oxidant for these fats. All the anti-oxidants except soya-bean lecithin have to be reinforced by synergists such as citric and tartaric acids.

From Fig. 1 it will be clear that there is little increase in the peroxide value of coconut oil after 5½ hours' aeration. The increase is very slight in the case of vegetable oil shortening. This is due to the very low iodine values of these two products. The peroxide value of *ghee* increases rapidly after the initial 1½ hours period. In the case of the two *vanaspati* products an increase is obtained only after 2½ hours. *Vanaspati* products are refined fats, and are sometimes protected by anti-oxidants before they leave the factories.

Acknowledgement

The authors record their grateful thanks to Dr. S. Siddiqui for his keen interest in this investigation.

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A Gene-Determining Growth Rate in Yeast

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THE essential criterion for the selection of a suitable strain for compressed yeast manufacture is the growth rate. Is it possible to plan a breeding programme for continuous improvement? Necessarily, the method of approach for production of improved strains for compressed yeast should be different from that for brewing and distillery industries. No programme of investigations could be planned on the basis of published work on yeasts. Is the growth rate of a strain determined by specific genes or by particular chromosomal or genic constitution? The genetical investigations on yeast by Winge[1] and Lindegren[2] were with strains whose chromosome numbers were unknown. The demonstration of polyploidy in yeast[3,4] has invalidated some of the assumptions of the earlier investigators. The terms "haploid" and "diploid" that one comes across in the literature on yeasts have no relation to the actual chromosome constitution, since the "haploid" of an autotetraploid is really a diploid. Any conclusion based on the assumption that all "haploids" have only one set of genes are necessarily inexact. It appears, therefore, that the earlier investigators had no criteria to distinguish between chromosomal and gene mutations.

Investigations in this laboratory indicated that the viability and growth rates of the various mutants differed from season to season[5], that even strains homo- and heterozygous for the same allele show differences under the same environmental conditions[6], and that doubling of the chromosomes results in a shortening of the generation time and the complete suppression of the second cycle of growth[7]. These investigations never gave an idea that growth rate may be determined by specific genes. The discovery that such growth genes exist was, therefore, of considerable significance.

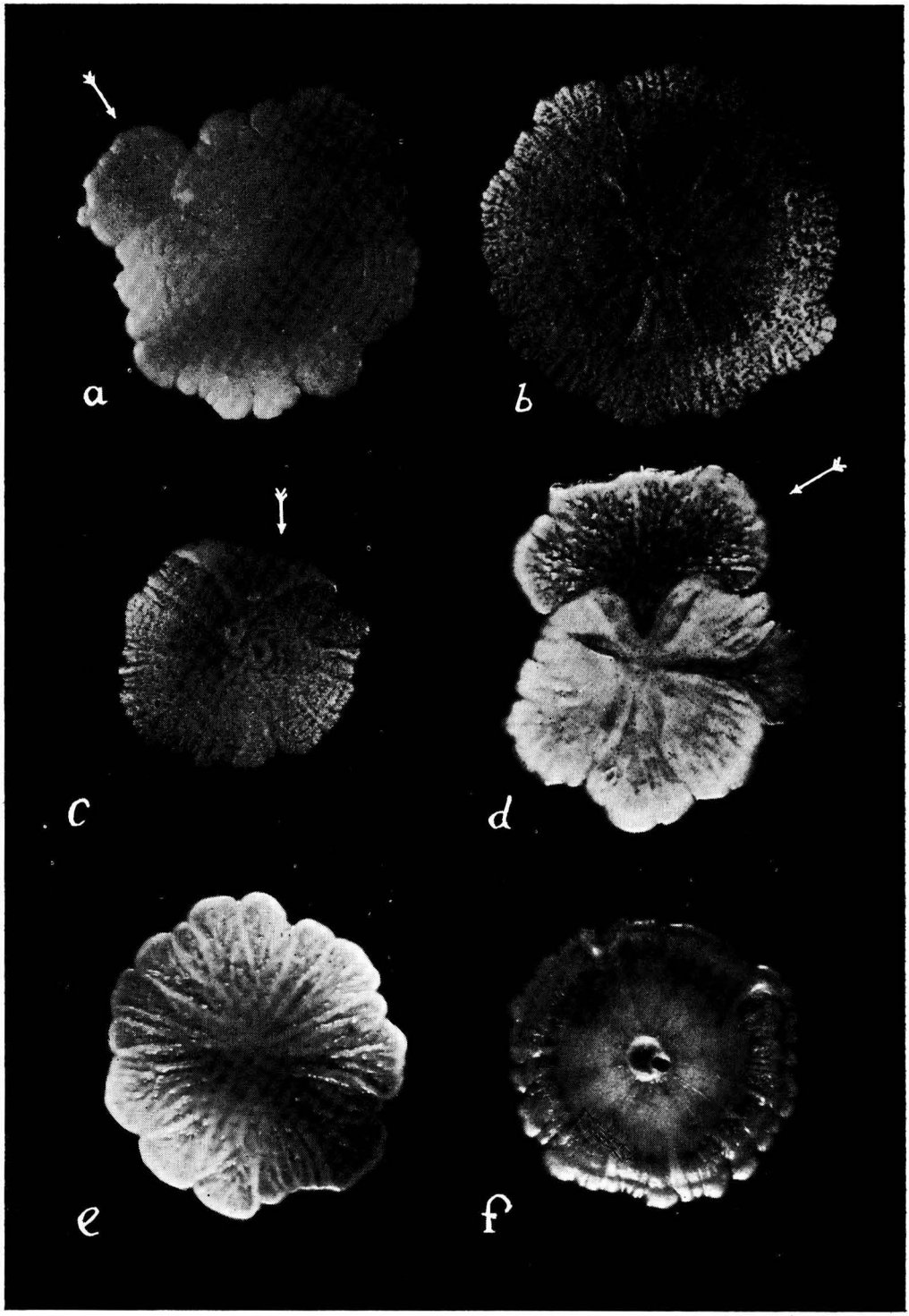
Observations

In March 1947 when the control strain, *BY1*, was exposed to a mercury arc for an hour at a distance of 90 cm., the resultant colony showed some peculiar sectors (FIG. 1a). Though these sectors had an identical type of sculpturing as the main colony, their shape indicated that the cells composing them ought to have a very high growth rate. There is a seasonal change in the characteristics of the giant colony of the control and in July 1947 the outer half of the colony had a rough sculpturing (FIG. 1b). Active cells from the above culture, kept at the same distance as before, were exposed to a mercury arc for 3 hours, and a colony was grown from the treated culture. From the appearance of the colony illustrated in Fig. 1c, ultra-violet light seems to have induced two changes. Irradiation had induced tetraploidy and produced a mutation in the cell resulting in the production of colonies having a completely rough surface. On the basis of evidence from spontaneous reverse mutations it was surmised that the *Rough I* type (FIG. 1b) should be heterozygous for the *rough* allele, having the genic constitution, *rough/smooth*. In a previous contribution[8] a reverse mutation to the entirely *smooth* condition by irradiation was demonstrated. Fig. 1c indicates a change to the completely *rough* type. It is reasonable to conclude that the following changes should have occurred.

1. *Rough I* { *Rough* → Mutation → *Smooth*; *Smooth* ——→ *Smooth* } *Smooth I* (FIG. 2, a & b)

2. *Rough I* { *Rough* ——→ *Rough*; *Smooth* → Mutation → *Rough* } *Rough II* (FIG. 1c.)

From the shape of the sector it would be evident that the tetraploid has a higher growth rate than the rest of the cells of the colony. A comparison of the sectors in Figs. 1a and 1c would indicate that the


a
b
c
d
e
f

sector in the former has a much higher growth rate than the tetraploid itself. The sculpturing in the sector in Fig. 1a was identical with that of the main colony and hence it was concluded that the increased growth rate may be gene determined.

After exposure of the active *Rough I* type of cells (FIG. 1b) of the control to a mercury arc for 4 hours, the treated culture was grown for 24 hours in wort and then plated. 9 types were selected from the plates and these have been under constant observation for the past 8 months. Among these, only the strain *BYU2* has repeatedly given rise to sectors similar to that illustrated in Fig. 1a. The sculpturing of the sectors may be identical with that of the colony (FIG. 1a) or may be different. In Fig. 1d it would be observed that the sector has a different appearance.

From observations on a continuous series of giant colonies of the above strain, it appears that the mutation producing a rapidly growing sector has no relation to the nature of sculpturing of the colony. In fact, the evidence indicates that independent mutations are occurring at two different loci. It has, however, not been possible to distinguish between the homo- and heterozygous expressions of this gene. The strain *BYU2*, like the control *BY1*, shows a seasonal variation in the characteristics of its giant colonies when grown at room temperature. In September-October 1947, when spontaneous reverse mutations were first observed in the control, the colony of *BYU2* had the appearance illustrated in Fig. 1e. That irradiation had produced a genic change would be evident from the different characteristics of the colonies illustrated in Fig. 1b, 1c and 1e. In November-December a new allele was observed (FIG. 1f) which was succeeded by the *smooth* types in January 1948 (FIG. 2a and 2b). In April-May-June 1948 when the control began to change from the *smooth* to the *rough* type, similar changes were observed in *BYU2*. While the main colony (FIG. 1d) was smooth, the sector had vein-like sculpturing.

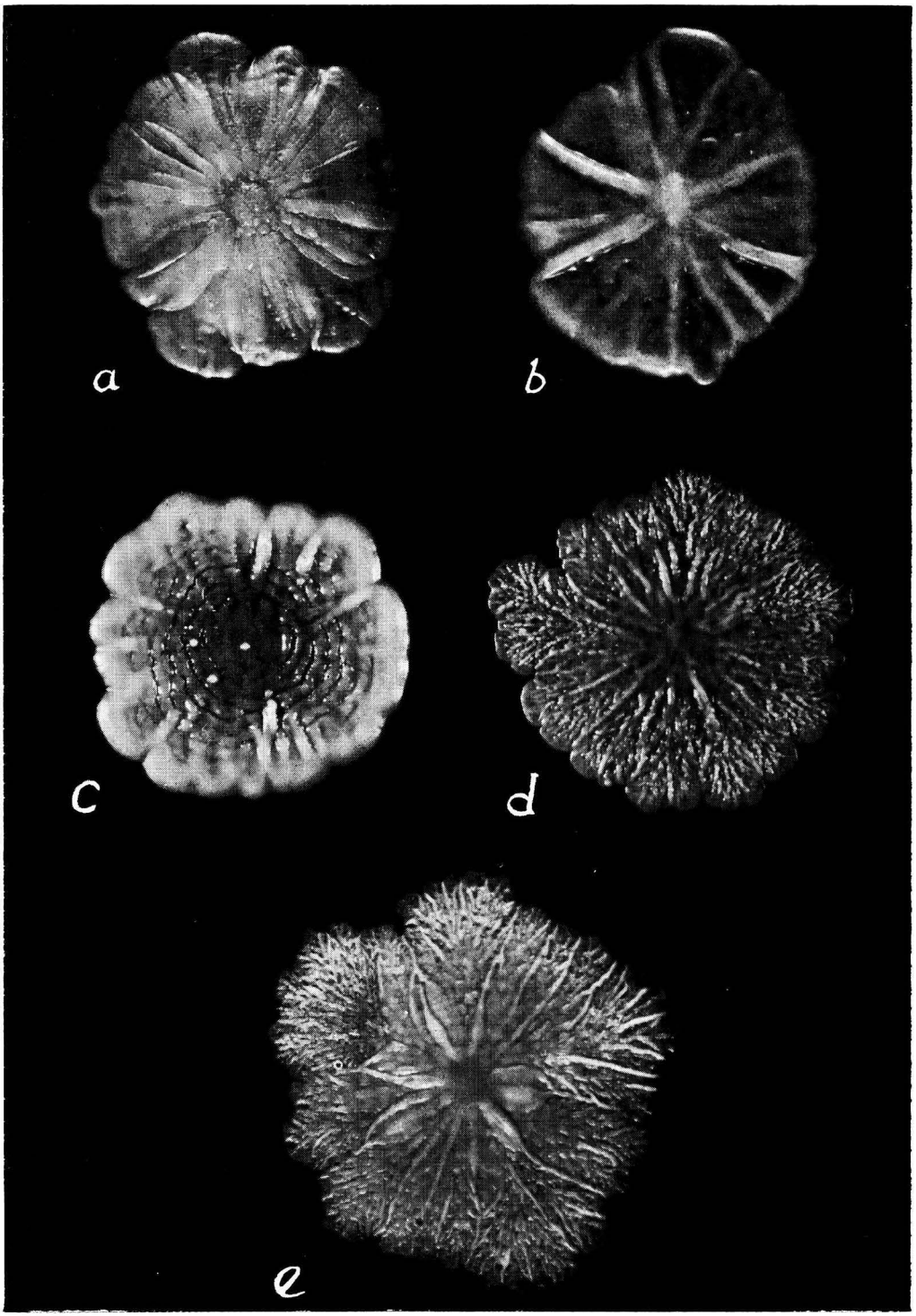
A sample from the sector was inoculated into a tube of wort, and a fresh giant colony grown from the above had the appearance illustrated in Fig. 2c. The general appearance of the colony was similar to that illustrated in Fig. 1a. This particular mutant was succeeded by a more stable one having a pronounced vein-like sculpturing (FIG. 2d). The curious fact was that the control during the same period gave rise to colonies (FIG. 2e) indistinguishable from the above on the same type of medium.

Discussion

From the observations detailed above it would be apparent that mutations are occurring at two loci independent of one another. While the mutation producing a cell possessing a high growth rate is an isolated phenomenon, the locus determining the nature of sculpturing of the colony seems to be highly mutable. Thus it is possible to get strains having identical colony appearance, but widely differing in their growth rate.

Is the growth gene mutating to a hypermorphic state? Timofeef-Ressovsky[9] seems to have demonstrated such a possibility from X-ray experiments. Mutations in the positive direction are very rare. Muller[10] states: "As for the question, why further 'positive' steps beyond the normal are not observed — from normal to 'hypermorphic' type, i.e. one showing opposite deviation from that of the ordinary mutant — the answer is that such changes doubtless do occur, too, perhaps with a frequency similar to that of the reverse mutations involving origination of the normal itself from a hypermorphic mutant, but they could seldom be observed". Since the terms "hypo-" and "hypermorphs" are used with reference to the standard wild type, any assertion that the extraordinarily high rate of growth of the mutant *BYU2S* is a mutation in the positive direction, would be justifiable only if we know what exactly is the behaviour of the standard wild type growth gene. There appears to be another complicating factor also. The dominance of any gene has been shown to depend on the genotypic background [11, 12]. The genes in domestic fowls, which are dominant over the wild type allelomorphs, become recessive when transferred to a wild genotypic milieu.

← FIG. 1 — (a) CONTROL, *BY1*, GROWN IN BARLEY-MALT-AGAR AFTER EXPOSURE FOR 1 HOUR TO A MERCURY ARC; 30-DAY GROWTH, 3·7 CM. (b) *BY1*, *Rough I* TYPE OF COLONY; 16-DAY GROWTH, 3·1 CM. (c) CONTROL, GROWN IN BARLEY-MALT-AGAR AFTER EXPOSURE FOR 3 HOURS TO A MERCURY ARC; 9-DAY GROWTH, 2·5 CM., JULY 20, 1947. (d) *BYU2* GROWN IN RAGI-MALT-AGAR; 20-DAY GROWTH, 2·6 CM., MAY 25, 1948. (e) *BYU2* GROWN IN RAGI-MALT-AGAR; 14-DAY GROWTH, 3·7 CM., OCT. 10, 1947. (f) *BYU2* GROWN IN RAGI-MALT-AGAR, 25-DAY GROWTH, 2·5 CM., DEC. 10, 1947.


a
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e

Since we do not know the original history of the control strain, *BY1* itself, it would be hazardous to identify any particular type as the standard.

The isolation of a new strain with a shorter generation time naturally raises the question whether further improvement in its performance could be effected. The obvious mode of approach is to induce tetraploidy with acenaphthene. When the tetraploid isolated after treatment of the control with acenaphthene has a shorter generation time[7] the doubling of the chromosomes in the strain, *BYU2S*, should produce a new one having a very high growth rate. The tetraploids studied in this laboratory show improvement over the control in several directions [13, 14]. The most important fact, however, is that doubling the chromosomes and hence the gene dosage is conducive to stability in the vegetative condition since mutations of any one of the genes would not usually find any phenotypic expression at all.

How far these expectations would be realized can be judged only by future experiments.

Summary

1. Growth genes appear to exist in yeasts.

2. A giant colony grown from a culture exposed to a mercury arc for an hour showed some peculiar sectors. The shape of these sectors indicated that the cells composing them ought to have a high growth rate. A comparison showed that the new type of sectors had a higher growth rate than even the tetraploid.

3. Spontaneous and periodic appearance of such sectors was observed in a strain, *BYU2*, isolated after 4 hours' ultra-violet irradiation.

4. The sculpturing of the new sectors may be identical with that of the colony or may be different.

5. The seasonal changes in the sculpturing of the giant colonies of the rapidly growing strain are illustrated.

6. It is possible to get strains having identical colony appearance but widely differing in their growth rate.

7. Doubling of the chromosomes should improve not only the stability but also the growth rate.

Acknowledgement

The authors are grateful to the *Council of Scientific & Industrial Research* for generous financial assistance.

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← FIG. 2 — (a) *BYU2* GROWN IN RAGI-MALT-AGAR, 15-DAY GROWTH, 2·4 CM., JAN. 7, 1948. (b) *BYU2* GROWN IN RAGI-MALT-AGAR, 15-DAY GROWTH, 2·6 CM., JAN. 5, 1948. (c) *BYU2S* GROWN IN RAGI-MALT-AGAR, 11-DAY GROWTH, 1·8 CM., JUNE 5, 1948. (d) *BYU2S* GROWN IN RAGI-MALT-AGAR, 12-DAY GROWTH, 3·2 CM., JULY 2, 1948. (e) CONTROL, *BY1*, ISOLATED ON DEC. 14, 1945; GROWN IN RAGI-MALT-AGAR, 14 DAY GROWTH, 3·3. CM., APRIL 29, 1948.

Experiments in Mineral Khaki—Part III

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THE present study relates to the effect of pre-treatment and after-treatment of the processed material, on the final shade and fastness properties of mineral khaki. In the pre-treatment, the material originally scoured was subjected to the action of wetting-out and swelling agents and also of detergents. The after-treatments consisted of subjecting the material to pressure boil in a small kier and scouring for definite periods with such agents as sodium silicate, which form complex silicates of chromium and iron. The treated fabrics were expected to show superior fastness properties.

In view of the difference in shade and feel and the varying fastness properties of dyed samples it was of interest to subject them to a microscopic study. The study would throw light on the nature of deposition of the pigment on individual fibres, and provide data on the penetration of the pigment particles inside the body of the fibre. Observations were made with a high power microscope and photomicrographs* were taken. A study of the samples under polarized light was also carried out with a view to obtaining information as regards absorption by fibres of heavy metals from solutions of their salts (FIG. 1).

Experimental

A study was made of dyed samples developed in a caustic soda bath containing variouss welling agents. The swelling agents employed were sodium zincate, Triton B and cuprammonium hydroxide.

1. Sodium Zincate[1] — That the swelling action of caustic soda on cotton could be increased by a solution of zinc oxide in alkali was observed by Mercer as long back as 1851, and was later utilized by Davidson[2].

The scoured drill was impregnated with a solution containing 10 per cent reduced dichromate and 2 per cent ferrous sulphate and the dried fabric was then developed in 25 per cent cold caustic soda, the developing bath containing 2, 5, 10 and 15 per cent sodium zincate on volume basis. The developed fabric was then dried, steamed and washed as usual. The samples obtained were then studied.

From Table I it would be noted that the samples had practically no lustre, had rough metallic feel and were neither uniform nor clear. As regards handle, they were similar to those obtained without the use of swelling agents. Though the 2 per cent sample was greener than the one without the swelling agent in the developing bath, with increase of sodium zincate the tone changed to the brownish side.

From a study of fastness properties it will be noted that the samples had the same fastness to light, washing, rubbing and perspiration as before, but the 10 per cent and 15 per cent sodium zincate samples showed a slight deterioration towards perspiration.

2. Cuprammonium Hydroxide — The effect of cuprammonium hydroxide on cellulose was discovered by Mercer and Schweitzer[3] who observed that swelling generally preceded

*The utility of photomicrographs for assessing the penetration of dyes into the body of textile fibres has been referred to by Preston, *Modern Textile Microscopy*, pp. 88 and 212.

TABLE I — SODIUM ZINCATE AS SWELLING AGENT

Concn. of sodium zincate %	Shade	Lustre & brightness	Feel and handle	Appearance	Tintometer readings			Fastness			
					Red	Yellow	Blue	Washing	Perspiration	Light	Rubbing
2	Greenish khaki	Very little	Metallic rough, fuller	Not clear and uniform	1·4	3·1	2·4	5	3	8	5
5	Loss of green	,,	,,	,,	1·5	3·2	2·4	5	3	8	5
10	,,	,,	,,	,,	1·5	3·2	2·4	5	2	8	5
15	,,	,,	,,	,,	1·6	3·2	2·4	5	2	8	5

solution. The relationship between the swelling of cotton and the concentration of cuprammonium hydroxide as measured by its copper number was demonstrated by Brownsatt, Farrow and Neale[4]. A solution containing less than 0·25 per cent copper had no appreciable swelling effect.

Cuprammonium hydroxide was prepared according to Clibbens and Geake[5]. Different amounts of the solution were added to the 25 per cent cold caustic soda developing bath on volume basis. The samples obtained were then studied.

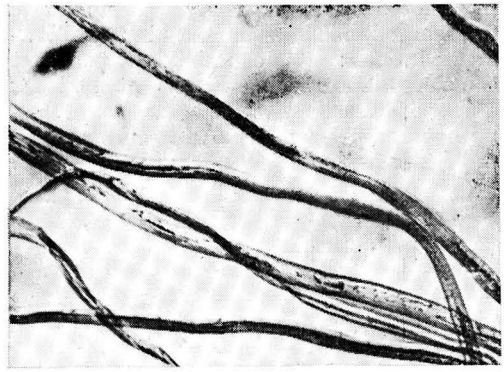
From a perusal of Table II it would be noticed that with increase in copper content, the greenish tone became predominant. All the 3 samples showed distinct lustre and had marked clarity and uniformity of shade. The fabric had a slight metallic rough feel and exhibited a fullness of feel, irrespective of the copper content in the developing bath. The samples had the same general fastness to washing, light and rubbing as before, but the perspiration fastness of all the 3 samples showed considerable deterioration.

3. Triton B[6] — This is one of the recently synthesized quaternary ammonium compounds and is capable of swelling cellulose to such an extent as to give a clear viscous solution. Triton B is trimethyl benzoylammonium hydroxide and is generally available as 30 per cent solution below which it does not dissolve cotton cellulose at room temperature.

The impregnated material was developed in baths containing varying amounts of Triton B (2, 5 and 10 per cent on volume basis of the developing bath).

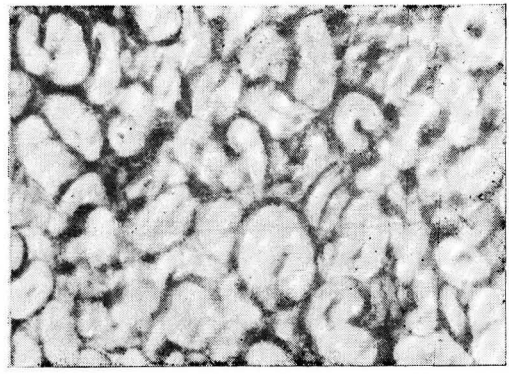
From a study of Table III it will be noticed that all the 3 samples were deeper in shade than the one without Triton B, and that with increase of Triton B the tone slightly went over to the brownish side.

White undyed × 220.



Khaki dyed × 220.

White undyed × 400.



Khaki dyed × 400.

FIG. 1

The lustre, feel and handle and clarity of the fabric were unaffected by the increase, except that the fabric became full with increasing quantity of Triton B. The dyeings were characterized by lack of uniformity. The general fastness of all the 3 samples to washing, perspiration, light and rubbing was the same, irrespective of the Triton B content (TABLE III). The washing fastness slightly improved, while the rubbing fastness decreased when compared to the sample with no swelling agents in the developing bath. The light and perspiration fastness remained unaffected (the former being excellent, the latter very poor).

Effect of Pre-treatment on Dyeing—Throughout the series of experiments described earlier, the grey drill was given only a scouring treatment in the rope form. To study the effect of pre-treatment, the boiled drill was given the following additional pre-treatments prior to dyeing :

The pre-treatments were given on a small jigger of 3-gallon capacity and the fabric was worked in it in open width in the following solutions : (1) containing 2 per cent caustic soda on volume basis at boil for 1 hr. It was then washed free from alkali by hot and cold water, and later with 0·25 per cent acetic acid (30 per cent) to remove any trace of alkali, washed and then dried ; (2) containing 2 per cent caustic soda and 5 per cent sodium zincate on volume at boil for 1 hr. It was then treated as in (1) ; (3) containing 2 per cent caustic soda and 1 per cent Isapol Brilliant Oil (*I.C.I.*) (sulphonated ricinoleic acid containing optimum quantities of pine oil) on volume at boil for 1 hr. It was then treated as in (1) ; (4) containing 2 per cent caustic soda and 1 per cent Aerosol OT which is a powerful wetting agent (*Carbide & Carbon Chemicals Corporation*) on volume at boil for 1 hr. It was then treated as in (1) ; (5) containing 2 per cent caustic soda and 1 per cent Triton B on volume for 15 min. at room temperature. It was then treated as in (1) ; (6) the fabric was treated exactly as above, but treatment was carried out at boil, instead of at the room temperature.

All the differently pre-treated fabrics were then stitched together and processed in the manner described earlier.

From a study of Table IV it would be noted that a pre-treatment in open width considerably influenced the final shade produced. There was a marked increase in the total depth of shade in each case, and on the whole there was a tendency towards a khaki shade. This was in accord-

TABLE II — CUPRAMMONIUM HYDROXIDE AS SWELLING AGENT

Concn.		Shade	Lustre & brightness	Feel & handle	Appearance	Shade			Fastness			
Cupram. %	Cu %					Red	Yellow	Blue	Washing	Perspiration	Light	Rubbing
2	0·03	Green khaki	Very lustrous	Fuller and slightly metallic rough	Very clear and uniform	1·3	3·1	2·2	4	2	8	5
5	0·075	Greener	,,	,,	,,	1·3	3·3	2·2	4	2	8	5
15	0·225	,,	,,	,,	,,	1·3	3·5	2·4	4	2	8	5

TABLE III — TRITON B AS SWELLING AGENT

Concn. of Triton B %	Shade	Lustre & brightness	Feel & handle	Appearance	Shade			Fastness			
					Red	Yellow	Blue	Washing	Perspiration	Light	Rubbing
2	Khaki	Considerable lustre	Full, highly metallic	Very clear and not uniform	1·5	3·2	2·6	5	3	8	4-5
5	,,	,,	Fuller	,,	1·7	3·3	2·6	5	3	8	4-5
10	,,	,,	,,	,,	1·7	3·3	2·6	5	3	8	4-5

TABLE IV — DIFFERENT PRE-TREATED DYEINGS

No.	Shade	Lustre & brightness	Feel & handle	Appearance	Shade			Fastness			
					Red	Yellow	Blue	Washing	Perspiration	Light	Rubbing
1	Khaki	Considerable lustre	Soft, fuller	Clear	1·9	3·8	2·4	5	3	8	5
2	,,	,,	Metallic, fuller	,,	1·9	3·8	2·4	2	2-3	8	5
3	Deep khaki	,,	Rough, fuller	,,	2·0	4·2	2·4	5	3-4	8	5
4	Khaki	,,	Metallic, fuller	Clear, uniform	1·8	3·6	2·2	5	3	8	5
5	Light khaki	,,	Rough, fuller	,,	1·5	3·4	2·1	5	3	8	5
6	Deep khaki	,,	Soft, fuller	,,	1·8	3·5	2·1	5	3	8	5

ance with the tintometer readings. All the samples showed considerably increased lustre and clarity of shade. The uniformity in general was good but was more pronounced with treatment 4. The pre-treatments 1 and 6 gave a fabric having a comparatively softer feel, while the others gave a metallic rough feel. All the samples were quite full to handle. The dyeings also were of good all-round fastness (TABLE IV).

Effects of After-treatment — The mineral khaki samples were submitted to the following after-treatments: (1) the dyed samples were subjected to a simple water-boil in a kier described by Dhingra, Uppal and Venkataraman[7] under a pressure of 30 lb./sq. in. for 3 hr. For this purpose the experimental kier was loaded with 5 lb. bleached yarn and dyed samples were sandwitched in between the yarn, a material-liquor ratio of 1 : 4 being maintained; (2) after-treated with 0·8 per cent boiling soap solution for 1 hr. in the open; (3) worked in a 0·5 per cent solution, at boil, of Aerosol OT for 1 hr.; (4) after-treated with a 0·5 per cent solution of Turkey red oil (50 per cent fat content) at boil for 1 hr.; (5) a silicate after-treatment with 1·0 per cent sodium silicate solution at boil for 15 min. was given; (6) after-treatment with 1·0 per cent trisodium phosphate at boil for 1 hr.; (7) processed at boil in a solution containing 0·5 per cent soap and 0·5 per cent soda ash for 1 hr.

The treatments 2 and 7 were carried out in the open. The after-treated samples were washed with cold water, dried, ironed and then examined.

It will be noted from Table V that treatments 2 and 7 resulted in a loss of green. Treatment 3 gave a more greenish shade. The rest showed no change of tone. The

TABLE V — AFTER-TREATED SAMPLES

No.	Shade	Lustre & brightness	Appearance	Feel & handle	Shade			Fastness			
					Red	Yellow	Blue	Washing	Perspiration	Light	Rubbing
	Original greenish brown	Much lustre	Clear	Fuller, metallic rough	1·4	3·1	2·3	4·5	3	8	5
1	Loss of green, brownish	Increase in lustre	Very clear	Much fuller, metallic rough	1·4	2·9	1·9	5	4·5	8	5
2	,,	No change	Clear, no change	Less, fuller soft	1·4	2·9	2·0	5	3·4	8	5
3	,,	,,	,,	More full, metallic rough	1·4	2·9	2·2	5	4	8	5
4	,,	Increase in lustre	Very clear	Less full, soft	1·4	2·8	2·0	5	4	8	5
5	Much greener	Decrease in lustre	Loss of clarity	Full, more metallic rough feel	1·3	3·2	2·7	5	4	8	5
6	No change	,,	Clear, no change	More full, metallic rough	1·4	3·1	2·2	5	3·4	8	5
7	Loss of green	No change	,,	No change	1·4	2·9	2·0	5	3	8	5

TABLE VI

Sample	Treatment	Observations	Dia.	Fastness			
			μ	Washing	Perspiration	Light	Rubbing
1	White, undyed	Many convolutions, no swelling	21·2	...	...	...	...
2	Fabric impregnated with 10% reduced dichromate, 2% $FeSO_4$. H_2O and dried	No swelling; pale green colouration due to salts; brown deposits on surface	22·2	...	...	...	...
3	Above fabric developed in cold 25% caustic soda, dried and washed	Fibres highly swollen with rounding up; pale yellowish shade; clots of surface deposits on some fibres	27·5	4	2-3	8	4-5
4	Impregnated fabric as in (2) developed and steamed	Mature fibres more swollen than in (1); distinct mercerized action; pale yellow uniform shade with surface deposits	24·5	5	3	8	5
5	Same as above, but with 10% sodium zincate in developing bath	More swollen; shade lighter than (4); good uniformity; sheath-like deposits lying beside fibre; large number of surface deposits	26·7	5	2	8	5
6	Same as above, but with 5% cuprammonium in developing bath	Well swollen; large number of surface deposits; good uniformity; mature fibres darker than immature	25·6	5	2	8	5
7	Same as above but with 10% Triton B in developing bath	Good swelling; uniformity not good; mature fibres darker than immature; few surface deposits	24·8	5	3	8	4-5
8	Same as (3) but developing at boil, airing and washing	Shade lighter than others; no surface deposits; less swelling	23·4	4	2	8	5

lustre appeared to increase by treatments 2 and 4, while treatments 5 and 9 caused a decrease in lustre. The rest of the samples showed no change. Similarly, treatments 2 and 4 resulted in clear shades, while treatment 5 resulted in loss of clarity. Treatments 2 and 4 gave a softer handle while the rest of the samples had a more or less metallic rough feel.

It would be noted that the rubbing fastness and light fastness of all the samples were excellent and in every case the washing fastness improved. The perspiration fastness of the original sample, which was 3, was considerably improved by all treatments except the 7, the improvement being more pronounced in the cases of treatments 1, 3, 4 and 5, leading to the conclusion that where improved fastness to washing and perspiration are desired, these treatments could be employed with advantage.

Microscopic Examination of Dyed Materials

The microscopic examination was carried out in 3 stages, viz. (a) whole fibre from several sections of yarns of warp and weft were examined for external and internal deposition of salts and penetration of the pigment, resulting in the variation of shades, both under (i) transmitted light, and (ii) polarized light ; (b) whole fibres were measured for comparative changes in diameter as a result of the swelling action of the reagents employed in various treatments ; (c) sections of yarns were cut to see how deep and how uniformly the pigment had penetrated the yarn and fibre structure.

For the examination of the whole fibres as in (a) and (b), fibres were untwisted from equal numbers of pieces of warp and weft yarns ; they were mixed and mounted in tufts of parallelized fibres on glass slides in glycerine. The preparations were covered with a cover-glass and examined under a magnification of 100 dia. for (a) and 500 dia. for (b) ; a microprojector was used for measuring the diameter. 100 readings were taken with each sample and the average of each noted.

Considerable difficulty was experienced in obtaining and studying the cross-sections of the fibres. Since cotton fibres have a diameter of 20μ to 30μ in one direction and only 2μ to 5μ in the other direction, stable cross-sections cannot be obtained unless they are less than the measurement of the smaller diameter. Difficulties of cutting cross-sections thinner than 2μ are well known.

Cross-sections obtained by the cork method were packed together so closely that observations under high power are not practicable with transmitted light. Those obtained by the plate method were found to be unsatisfactory, as they were not sharp and thin. Hence the following technique was employed.

A hand microtome[8] recommended by the *Department of Agriculture, Bureau of Animal Husbandry*, U.S.A., and which is in use in the Technological Laboratories of the *Indian Central Cotton Committee*, Bombay, was employed. It consists of a bare brass plate with a hole which is packed up with parallel tufts of yarns whose cross-sections are to be cut. It is provided with a swivel arm through which a threaded rod is so journaled that it is able to push the tufts of fibres packed in the hole to a desired distance (about 15μ). Before the sections are cut, a drop of cellulose acetate solution (5 gm./1) in acetone is applied on the surface of the yarn pieces showing up through the hole. A safety razor blade is used to cut the section after the thin film of cellulose acetate dried the surface of the yarn pieces. It is necessary to dry the cellulose acetate solution in a desiccator containing phosphorus pentoxide before use.

The cellulose acetate serves as a cementing substance for holding the cut cross-section upright and no attempt was made to dissolve it away. But a mounting fluid with the same refractive index as cellulose acetate was used to keep it out of view while the sections were being examined. Castor oil ($\Delta=1{\cdot}48$) was used for the purpose.

The photomicrographs taken are shown in Fig. 1.

The following observations were made :

(i) Under transmitted light, the diffusion of pigment inside the body of the fibre was fairly uniform, as shown by the uniformity in the colouration of the fibre and not on the surface only. Also, a distinct swelling of the fibre associated with the removal of convolutions was noticed, resulting in the fibres' assuming the appearance of straight smooth cylinders. These mercerized effects were common in all the khaki-dyed samples, varying more or less according to the treatment given.

It was also observed that the depth of shade and its uniformity varied depending on the sample, so also its fullness. A striking feature of practically all the samples was the peculiar brownish deposits, which

varied in number according to the processing employed. Such deposits were observed even in the fabric impregnated with iron and chromium salts, but not developed, and it may be assumed that these deposits remain even after developing and washing.

Further details of the observations are given in Table VI.

(ii) Untreated cotton fibres showed, under polarized light, a play of brilliant and characteristic colours in mature and half-mature fibres. When the polarizer was rotated through a 45° angle, the immature fibres were extinguished. The play of colours in mature fibres covered practically the whole range of the spectrum, beginning with purple and going to red in fully mature fibres. These colours appeared as short bands across the fibres. In half-mature fibres the play of colours was restricted to blue, yellow and reddish orange, which sometimes appeared as purplish also. Thus, only the middle part of the spectrum was covered. The immature fibres remained distinctly colourless.

The khaki-dyed samples also showed the same colour play in fully mature fibres, but the bands were much broader and the yellow and green colours were noticeably grimy. In half-mature fibres the play of colours was from blue to red to yellow to blue again.

Using the quarter wave-length selenite plate, it was found that the colours in mature fibres of the khaki-dyed samples varied from green to yellow and green to blue with a purplish background, while half-mature fibres showed only yellow to blue bands. The immature fibres looked colourless.

The undyed fibres under similar conditions showed bands of green, yellow and purple colours in a regular pattern while the half-mature fibres showed yellow and blue bands along the walls of the fibres. As before the colours in the khaki-dyed samples lacked brightness.

These observations reveal that fully mature fibres show a maximum deposition of metallic salts, the half-mature fibres less and the immature fibres the least. The presence of these metallic salts leads to the change in shade from the brilliant colours in the undyed samples to rather dirty shades in the dyed samples.

(iii) The measurement of fibre diameter in each sample was attempted using a microprojector and a magnification of 500. (TABLE VI). The figures indicate the extent of swelling caused by the treatments. It would be noticed from Table VI that the undyed fibres, which had a diameter of 21·2μ, increased in diameter to 22·2μ on impregnation with iron and chromium salts. After-development treatments gave rise to considerable swelling. The swelling was least (dia. 23·4μ) with hot development and highest (dia. 27·5μ) with cold development without steaming. On steaming the swelling decreased (dia. 24·5μ).

The introduction of swelling agents in the cold developing bath caused considerable swelling. The zincate sample showed maximum swelling (26·7μ) followed by cuprammonium hydroxide (25·6μ) and Triton B (24·8μ).

(iv) The cross-sections of yarns showed practically uniform colouration, or equal diffusion of the pigment inside the body of the fibres. The rounding up of sections was prominently seen with a distinct swelling, which was due to the mercerizing action of the treatments. These observations are clearly brought out by the photomicrographs of the cross-sections of dyed and undyed samples.

Summary (Part II & III)

1. Composition of Impregnating Bath—The chromium oxide contents of the samples were proportional to the molecular weight of the salt of chromium employed except in the case of sulphate acetate samples. The chromium acetate samples with the highest molecular weight gives the maximum chromium oxide content, followed by sulphate and acetate nitrate samples. The depths are also found to be proportional to the oxide contents. As to the iron oxide content, it was found that for the same amount of ferrous sulphate introduced, the iron oxide deposited was practically the same within experimental limits.

From the alkali-extractable chromium it would be seen that the more complex the chromium compound initially employed for padding, the greater was the alkali-extract able chromium, indicating that it would be preferable to employ simple chromium salts.

The attempt to get chromium as chromium sulphate in the impregnating bath by reduction of dichromate showed that sugar, employed as a reducing agent, has inhibiting action on the oxide deposition and consequently gives lighter shades.

With increase of chromium the perspiration fastness showed a deterioration indicating the sensitivity of the chromium oxide to acids whereas the increase in iron content caused deterioration in the rubbing fastness of the samples.

The acidity of the impregnation bath had much to do with the final shade produced. If the acidity was high (lower than *p*H 3), the fabric showed tendering after dyeing, and on approaching neutrality (*p*H higher than 4), the shade gradually showed a change towards the brownish side. The lustre, appearance or uniformity gradually decreased. The perspiration and rubbing fastness deteriorated. It would be desirable to carry out the dyeings at *p*H 3-4 in order to obtain a dyeing of general all-round fastness.

2. Optimum Concentration of Alkali in the Developing Bath — Under the experimental conditions described, the maximum deposition of the metallic constituents was obtained by the use of 25 per cent caustic soda. In view of the wide variations produced in large-scale operations, a steady maintenance of alkali strength between 20 to 25 per cent would result in the least variation of the ultimate shade.

The introduction of cuprammonium and sodium zincate in the developing bath, though giving samples with good fastness to light, washing and rubbing, resulted in dyeings of inferior fastness to perspiration. The Triton B sample remained unaffected. In all the cases the samples developed fuller handle.

3. Effect of Pre-treatment & After-treatment — Pre-treatment under suitable conditions is a prerequisite for the production of level shades. Incorporation of wetting out agents of the type of Aerosol OT gives a definite advantage as judged by the increase in depth and levelness of shade produced.

4. Mechanism & Manner of Deposition — Chromium and iron salts which were both employed as sulphates exhibited a lack of substantive affinity for the cotton fabric, as shown by the very low quantities of the oxides fixed by alkali development of the fabric, padded through an impregnation bath, with high initial concentrations.

As the mineral pigment formation is a simple mechanical deposition in the body of a fibre which lacks substantive affinity for these oxides, the levelness and penetration would largely depend on mechanical factors such as the quality of the padding mangle, regulated pressure, uniform dyeing, and so on.

The microscopic study of khaki samples provide interesting data as regards penetration of pigments into the core of the fibre. The degree of maturity of individual fibres affects penetration.

The fastness of mineral khaki to light, washing and rubbing is due to the formation within the fibre of insoluble inorganic complexes of iron and chromium. The perspiration fastness is apparently unsatisfactory. It may be mentioned that the perspiration fastness test is carried out under severe conditions rarely met with in actual practice. Mineral khaki being a metallic pigment is easily affected by the acidity of perspiration. After-treatments impart increased resistance to perspiration.

Acknowledgement

Thanks are due to Mr. A. N. Gulati of the Technological Laboratories of the *Indian Central Cotton Committee* for assistance in the microscopic study of samples, and to Professor K. Venkataraman, Director, *Department of Chemical Technology*, for many valuable suggestions.

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Wear in Producer-Gas Converted Petrol Vehicle Engines

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ONE possible reason for greater wear with producer gas as applied to converted petrol vehicles is that owing to reduced power output, lower gear ratios are more frequently used, which means that the engine makes more revolutions for a given mileage of the vehicle. This increase will be negligible when making long continuous runs on level road for which type of duty these producer-gas converted petrol vehicles are best suited. Another reason is the abrasive action of dust carried along in producer gas. This will be a serious cause of wear in case the filters are not properly designed, serviced and maintained. The exact amount of wear caused in such a vehicle fitted with a well-designed and suitably serviced gas filtration system is not precisely known. The Indian specifications[1], which are modelled on the Australian specifications[2], fix the limit of dust concentration in the filtered gas supplied to the engine as 5 mg. per cubic metre. This figure was adopted in the belief that it will probably keep down the abrasive wear within reasonable limits without requiring too elaborate a system of filters. Very little published data is, however, available to confirm or disprove this belief.

Bowden and Kennedy[3], working in Australia, used Chevrolet, Ford V8 and Bedford trucks, operating on producer gas, using charcoal as fuel and lubricated with *S.A.E.* 30 oil for experimental road trials. Separate wear figures for petrol and producer gas were determined when using these types of vehicles. The measured wear observed in Ford V8 truck has been found to be comparable to that in Chevrolet and Bedford trucks. Spier and Giffen[4], in U.K., have carried out extensive bench tests on the performance of a converted petrol engine with different producer-gas fuels and on the effect of varying compression ratios, etc. The change in viscosity, acid value and percentage ash content of the lubricant were determined by analysing the samples of oil drawn from the sump. The wear of cylinder bore and top piston ring was also determined.

Another reason for increased wear might be the deterioration of lubricating oil or the lubricating system. This aspect can only be investigated by a combined study of oil behaviour and wear. Unlike petrol, such studies with producer gas have been very few. Other causes for wear might possibly be the corrosive effects of certain impurities in producer gas, inadequate protection from atmospheric dust at the air inlet to the gas carburetter, etc. It will require elaborate studies to isolate the effects of each of these factors and suggest remedies. Meanwhile any wear data relating to actual running conditions on Indian roads will go some way towards clearing the existing uncertainty. This is all the more important in view of the general belief that producer gas causes excessive wear. With this end in view, it was felt desirable that certain data collected during routine road tests be utilized to determine the wear caused in the petrol vehicle engine when converted to operate on producer gas under Indian road conditions.

Experimental

A lease-lend 160″ wheelbase 3-ton 1943 model Chevrolet truck fitted with a modified " Simpson " gas plant, as described in our earlier paper[5], was being used for various departmental trials on producer gas reliability and performance. The vehicle was found to pass when tested in accordance with the

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procedure for road and bench tests as laid down by the *Conference of Producer Gas Technical & Testing Officers*, India[1]. Before starting the test, the engine fitted to the truck was dismantled, thoroughly cleaned and overhauled. Measurements of cylinder bores, big-end bearing diameters and weights of top piston rings were recorded.

The engine was reassembled and the requisite quantity of lubricating oil *S.A.E.* 30, of the correct specifications recommended for use in the engine by the manufacturer, was supplied to the crankcase. The crankcase oil was changed and analysed after approximately every 2,000 miles of run. The samples of oil drawn from the sump were analysed in accordance with the *Standard Methods of Testing Petroleum & Its Products* as adopted by the *Institute of Petroleum Technologists*, London[6]. A simple method was adopted for the analysis of the sludge deposited in the crankcase. After determining the weight of sludge insoluble in petrol and petroleum ether (60°-80°C.), the residue was ignited to determine the total weight of mineral matter present in the sludge. The weight of mineral matter insoluble in aqua regia and the iron content of the oil as well as the sludge were determined by the usual methods. The results of crankcase oil analyses are summarized in Table I, in which analysis of fresh oil has also been included.

Periodic checks of the filtration system by means of bench tests ensured that filters were working properly and that the dust concentration in the filtered gas was never more than 5 mg. per cubic metre. Rectified spirit and a little petrol were also used as fuels during a part of these trials.

After the truck had completed 9,000 miles of run mostly on producer gas, its engine was dismantled. After recording the condition of various parts, they were thoroughly

TABLE I — CRANKCASE OIL ANALYSES OF CHEVROLET 1943 MODEL EXPERIMENTAL TRUCK ENGINE

	Unused S.A.E. 30 lubricating oil	Used oil after 4 successive periods			
		After 1,000 mile run on producer gas	After 2,100 mile run on producer gas	After 2,000 mile run partly on gas and partly on spirit	After 2,000 mile run on producer gas rectified spirit mixture
1. Appearance	Clear and transparent	Dark brown oil wtih slight sludge	Dark thick oil with lot of sludge	Dark brown thick with black sludge	Dark thick oil with lot of sludge
Oil Analysis					
2. Sp. gr. at 60°F.	0·885	0·889	0·894	0·897	0·890
3. Acid value	0·03	0·50	0·46	0·50	0·290
4. Viscosity in centi-strokes :					
(i) at 100°F.	125·2	136·4	146·8	162·2	145·0
(ii) at 140°F.	42·9	46·2	47·8	54·8	50·5
(iii) at 210°F.	12·3	12·6	13·2	14·5	13·5
Viscosity index	95·0	89·0	89·0	95·0	95·0
5. Ash content, %	0·008	0·54	0·34	0·96	0·613
6. Fe_2O_3, parts per million	6	1,000	51,600	197,000	110,000
Sludge Analysis					
7. Wt. of sludge, gm.	.....	29·876	67·700	22·170	48·980
8. Wt. of mineral matter, gm.	.....	20·465	42·680	15·951	26·790
9. Wt. of material insoluble in aqua regia, gm.	.....	12·865*	35·110*	3·270*	14·207*
10. Wt. of Fe_2O_3, gm.	.....	4·166	2·86	9·700	4·620

* Mostly fine dust sand.

TABLE II — WEAR OF PARTS OF EXPERIMENTAL TRUCK CHEVROLET ENGINE PER 1,000 MILE MEASURED AFTER 9,000 MILES RUN MOSTLY ON PRODUCER-GAS FUEL

								Australian figures*	
Cylinder No.	1	2	3	4	5	6	Averages	Gas	Petrol
1. Wear of cylinder bore in inches :									
(a) Along shaft	0·00032	0·00030	0·00032	0·00028	0·00030	0·00033	0·00031	0·00029	0·00017
(b) Across shaft	0·00028	0·00018	0·00013	0·00021	0·00021	0·00022	0·00021		
2. Loss in weight of top piston ring, gm.	0·281	0·279	0·297	0·131	0·260	0·321	0·261	0·807	0·164
3. Increase in big-end bearing diameter, in inches	0·00072	0·00063	0·00056	0·00064	0·00069	0·00059	0·00064	...	...

* These values are for Ford V8.

cleaned and weighings and measurements repeated for determining the wear which, after reduction to 1,000 miles run basis, are given in Table II. The corresponding gas and petrol figures of the Australian workers[3] when using Ford V8 truck have been also included for comparison.

Discussion

Taking into consideration the specific gravity, viscosity, acid value and iron content of the four samples of oil analysed (*vide* TABLE I), in every case the viscosity of the used oil has slightly increased as might be expected in the absence of crankcase dilution, but the viscosity index has decreased only in two out of four cases. The acid value, ash content and the iron content have increased in every case. It is significant, however, to note that iron has increased to a greater extent during the periods in which spirit was partly used as fuel.

There is, however, no evidence of the break-down of the lubricating oil such as to cause failure of the lubricating system. Results of the present investigations generally support the observations of Spiers and Giffen[4].

As regards the sludge analysis, it is clearly brought out that more than 50 per cent of the sludge in every case consisted of fine sand and dust and very small amounts of iron. The fine sand is likely to have come partly from the producer gas and partly from the atmosphere through the air cleaners. It may be stated that air for the gas-air mixture was supplied through the normal oil bath cleaner serving the petrol carburetter air intake. The crankcase was protected by a separate oil bath cleaner. The total weight of sludge in the sump in each case was apparently unrelated to the mileage covered. As already stated, uniform care was bestowed in the filtration and the maintenance of the gas plant, the variation in the weight of sludge deposit has to be attributed to some extraneous agency unconnected with producer-gas operation. It is most likely that due to reasons discussed in an earlier publication[7], the oil bath cleaners were not able to control effectively the entry of dust under varying atmospheric dust concentrations. The presence of fine sand dust in the sludge signified wear by abrasion.

As to the measured cylinder wear figures, ordinarily one should expect the measured wear of the cylinder bore to be greater in the direction of the piston thrust than parallel to the crankshaft. But the results of cylinder bore wear summarized in Table II show that the reverse is the case, a paradox for which no satisfactory explanation yet seems to have been offered[8]. It is most probable that the end play of the crankshaft and of bearings at the two ends of the connecting rod are responsible to some extent in wearing away the sides of the cylinders more than the thrust faces. The average cylinder bore wear observed in the present study is only 0·00026″ per 1,000 miles and is of the same order as in petrol engines and is comparable to the figures reported by Australian workers. A high rate of cylinder wear was observed by Spiers and Giffen[4] but the wear was considerably reduced when careful attention was paid to gas filtration and the engine was fitted with chrome iron, centrifugally cast " dry " cylinder liners. The wear in the big ends is reasonable and in any case this could be easily adjusted by varying the shims. The corresponding wear figures have not been reported by Australian workers.

The loss in weight of the top piston ring observed in the present study is more or less uniform in all the cylinders and is not so excessive as observed by the Australian workers with producer gas. Their figures for gas are nearly five times their petrol figures. This difference in the loss in weight of the top piston ring observed by the two teams of workers can be explained when we take into consideration the gas filtration system employed by them. The Australian workers used a cyclone filter followed by two large sisal felt filters in parallel, whereas in the present case the filtration system consisted of two catridge type of filters containing coir fibres and cotton waste followed by a third cotton cloth bag filter[5]. In an earlier investigation[9], drill cloth has been shown to be superior to the pressed wool felt when tested for the final stage of producer-gas filtration. Moreover experience gained by the authors while using cyclone filters showed that it was very difficult to remove the last traces of fine dust carried along with producer gas, when using charcoal as fuel, by the use of these filters alone. In order to eliminate this fine dust and to bring the dust content of the gas to within 5 mg. per cubic metre, an additional cotton waste filter of the cartridge type was found to be absolutely necessary. From what has been stated above, it seems most probable that the last

traces of fine dust in the gas after leaving the cyclone filters were not removed by the use of sisal felt filters in the final stage of the gas filtration system. During a discussion in the Producer Gas Standing Research Committee Meeting held in 1947, H. D. Choudhury, Producer Gas Technical Adviser to the Government of Bengal, disclosed that he too had been faced with the difficulty of removing the last traces of fine dust while working with cyclone filters alone.

Deposits on piston crowns and cylinder heads were soft and easily removable. The exhaust valve seats were generally pitted and needed recutting before regrinding. The inlet valve seats were less corroded.

According to Ballard, Nixen and Moore[10], dust is an important contributor to abnormal wear. Whenever abnormal wear occurred, the analyses of the deposits on pistons and in the ring grooves showed these to contain 5 to 25 per cent of silica. Spiers[11] has found the cylinder head deposits containing nearly 60 per cent of silica when operating the engine on gas. The high rate of cylinder wear observed by him is attributed to the dust content of the gas. According to Spiers[11], the rate of wear can be reduced materially by improving the gas filtration considerably. During the present investigation nearly more than 50 per cent of the sludge deposited in the crankcase contained fine sand dust. The photomicrographs taken by the Australian workers[3] show that abrasion and fine scouring was greater with gas. This is mostly responsible for the excessive wear of the top piston ring observed by the Australian workers. However, the dust present in the air supplied to the engine is also partially responsible for the observed wear.

The results of the present tests show that if the gas plant is maintained to satisfy the Indian specifications there is no danger of excessive wear. The presence of large amounts of fine sand in the sludge shows that it will pay to give more attention to air cleaning with a view to keep out atmospheric dust from the engine.

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Effect of Salts on Soil Permeability & Rectification of Alkali-ridden Soils

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SINCE 1939, at the suggestion of the *Indian Council of Agricultural Research*, we have been investigating the physics of sub-soil irrigation and allied problems in our laboratories at Poona. While studying the capillary ascent of water through various soils and its evaporation from the top surfaces of the soil columns, it was noticed that in alkali soils and the *bari* soil of the Punjab there was no trace of wetness or any significant evaporation even months after the commencement of the experiment. On repeating the experiment in glass tubes, it was clear that the water did not ascend through these soils due to the impermeable nature of the soil in the presence of the salt.

On investigating the matter further with the black soil of the Deccan using solutions of various concentrations of lithium and sodium carbonates, oxalic acid and lithium and sodium oxalates and a number of similar substances, the present writer, in collaboration with Mr. A. K. Mallik, observed that the impermeability is associated with the capacity of the colloidal coating of the soil particle to undergo swelling under the influence of these substances. The swelling phenomenon was studied both with individual particles as well as layers of the soil. Again, when the soil swells on wetting and then contracts on drying, it exhibits the well-known phenomenon of crack formation. The variations in these phenomena with the concentration of the salt in solution has been investigated in detail. It is found that the swelling and impermeability go on increasing up to an optimum value of the concentration beyond which chemical solution of the organic fraction of the soil colloids sets in with a consequent restoration of the permeability. These effects are best observed with sodium carbonate where a wide range of concentration is possible owing to the high solubility of this salt in water. Many of the interesting results obtained by us have been recently discussed by Ramdas and Mallik in a series of papers[1-7].

It was found that in the case of sodium carbonate solutions the black soil of the Deccan showed a maximum impermeability at a concentration of about 2 per cent, indicating this as the most efficient concentration to be maintained in the moisture within the sides of a canal if seepage is to be prevented.

Apart from the above practical aspect *there is the much larger problem of restoring the permeability of the many millions of acres of alkali-ridden lands of the Punjab, parts of the United Provinces, the Central Provinces and the Deccan which get water-logged during the rainy season or after irrigation.* If these tracts can be rendered permeable to water and their salt content leached out, it will be possible to restore their fertility and thus make plant growth feasible.

In our recent investigations the above aspect has received a special emphasis. Recently Ramdas and Mallik[8] reported that a layer of Poona soil previously treated with sodium carbonate and rendered quite impermeable becomes quite permeable to a solution of sodium chloride.

At the suggestion of the present writer, Mr. P. K. Katti working in our laboratory took up a further detailed examination of this subject. In a recent paper[9] he has shown that the beneficial effect of sodium chloride is lost when water is passed through the soil again. It is noticed that though the soil particles shrink in the presence of sodium chloride, opening out the pore space, they still retain the sodium carbonate with which they have been treated previously. On leaching out the sodium chloride with water the sodium carbonate asserts itself again rendering the soil impervious once

again. Thus the restoration of permeability by sodium chloride is only temporary.

In his latest experiments Mr. Katti observes that if instead of sodium chloride a solution of calcium chloride is placed above a soil layer previously rendered impermeable to water by treatment with sodium carbonate, the soil becomes permeable to the calcium chloride solution which passes readily through the soil layer. What is most interesting is that if *thereafter a layer of water is placed above the soil, the water also percolates through readily.* The "alkali" soil once treated with calcium chloride *remains permeable to water in any quantity.* Our experiments show also that the soil so leached out can support vegetation like a normal soil free from sodium carbonate.

The above results have been verified in the case of the *bari* soil of the Punjab and further experiments with "alkali" soils from other parts of the country are also being undertaken.

The above results are also obtained if barium chloride or strontium chloride is used instead of calcium chloride. The experiments of Mr. Katti are at present in the laboratory stage, *but it will be obvious that the above results are of great practical importance in reclaiming the "alkali" tracts of our country.*

A fuller account of these latest investigations is being given by Mr. Katti in a detailed paper appearing in the *Proceedings of the Indian Academy of Sciences.*

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Letters to the Editor

PAPAVERINE FROM INDIAN OPIUM

THE ONLY RECORD TRACEABLE ON THE subject of occurrence of papaverine in Indian opium is the work of Van Itallic and Kerbosch[1] which mentions that "Bengal" opium is totally lacking in this alkaloid, which is present in amounts varying between 0·5 to 1·0 per cent in opium from other sources[2,3].

In response to an enquiry for papaverine from Indian druggists, the present work was undertaken in order to ascertain whether the finding of the earlier workers holds true for opium grown in every part of India. It was found that small quantities of papaverine can be isolated from Indian opium, at least out of the supplies under the control of the Banaras Agency of the Government of India.

Experimental

The mother liquor left after the separation of the "Gregory salt" obtained during the recovery of morphine and codeine from opium by the Gregory process was used for the purpose. The following scheme was eventually adopted.

The mother liquor left after the separation of Gregory salts during the manufacture of alkaloids from opium is made alkaline with solid caustic soda to about 2 per cent concentration. The alkaline liquid is then extracted 10 times with $\frac{1}{20}$th its volume of benzene each time.

From the benzene extract, strained through a cloth filter, the solvent is distilled off. The dark-brown mass left is treated with 1 : 1 hydrochloric acid till distinctly acidic, diluted with an equal volume of water,

warmed, treated with about 30 gm. activated charcoal for each gallon of liquid and then filtered.

The cooled filtrate is treated with ammonia until precipitation is complete. The precipitated alkaloids are filtered off, dissolved in 1 : 1 hydrochloric acid, treated with charcoal as before and filtered. The acid solution of the alkaloids is, if necessary, repeatedly subjected to the previous cycle of operations until no further improvement in the colour can be effected.

The clarified liquor is treated with 10 per cent caustic soda solution until strongly alkaline and the precipitated alkaloids allowed to settle. The liquid is filtered off and the precipitate washed free from alkali. It is then treated with 1 : 1 acetic acid, warmed and filtered.

The acid solution is treated with ammonia until just alkaline (*p*H 7·5 to 8) and then buffered with solid sodium acetate[4]. The mixture is allowed to stand for 24 hours in the cold and the precipitated alkaloids filtered off and washed.

The precipitated alkaloids, consisting of narcotine and papaverine (mixed with a little cryptopine), are converted into the acid oxalate by treatment with $\frac{1}{3}$ per cent oxalic acid and adding alcohol to the solution. The papaverine oxalate which is insoluble in alcohol separates. It is filtered off and converted into the base by treatment with 10 per cent caustic soda solution.

The precipitated base is filtered and repeatedly crystallized from alcohol (90 per cent) until the m.p. remains unaltered at 146°-147°C.

Papaverine recovered by following the method described above answered to the following tests :

1. The base showed a m.p. of 146·5°-147·0°C. ; authentic sample of the base obtained from U.K. had m.p. 146°-146·5°C. ; mixed m.p. 146°-147°C.

2. A 2 per cent solution of the substance in chloroform showed no optical rotation.

3. 0·2 gm. of the substance converted to the hydrochloride gave a m.p. 220°C. The derivative from the authentic sample had a m.p. of 219°C. ; mixed m.p. 219°-220°C.

4. 0·2 gm. of the substance converted into picrate gave a m.p. 186°C. ; the m.p. of picrate from the authentic sample was 185°C. ; mixed m.p. 185°-186°C.

5. 10 mg. of the hydrochloride (3) dissolved in distilled water (100 cc.) and 3 drops of dil. hydrochloric acid and 5 drops of a solution of pot. ferricyanide added. There was immediate precipitation of lemon-yellow papaverine ferricyanide.

6. A solution of the hydrochloride gave with sodium acetate a crystalline precipitate of papaverine bases, m.p. 146°C.

7. 0·1 gm. of the substance was converted into acid oxalate with $\frac{1}{3}$ per cent oxalic acid. The oxalate was sparingly soluble in water ; almost insoluble in alcohol ; m.p. 200°C. corresponding to that of papaverine acid oxalate.

8. The substance dissolves in conc. sulphuric acid (cold) giving a light pink colour. This light pink colour may be due to the presence of small amounts of cryptopine (which was not separated). The light pink solution turned deep red at 110°C. and violet at a higher temperature. On cooling and adding water, the colour disappeared.

Further work is in progress in order to determine the content and yield of papaverine from opium received from different sources, as also of the comparative value of different methods described in literature for the recovery of the alkaloid.

Our thanks are due to the Government of India, Ministry of Finance, Revenue Division, for permission to publish this note.

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Ghazipur C. PARTHASARATHY
October 4, 1948

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ON THE USE OF LIME SLUDGE AS A STABILIZER IN EARTH CONSTRUCTION

IN CONSIDERING THE POSSIBILITIES OF USING earth as a building material in India it may be pointed out that it would not be economical and practicable to use costly ingredients such as cement and bitumen for soil stabilization. Of the two methods of earth construction, viz. rammed earth walls and adobe block walls, the former is definitely cheaper and quicker (being completed within a week from start), but involves skilled labour and some stabilizing agent such as cement,

since simple rammed walls, although quite strong, are susceptible to weathering by rain. The other method is simpler and better suited for Indian conditions where labour is comparatively cheap and a dry period of 3 to 4 months is available in which the blocks can be dried. Blocks of $9'' \times 6'' \times 4\frac{1}{2}''$ size are quite convenient to make in ordinary moulds. However, this type of construction also needs some sort of waterproof plaster. In this connection, work has been initiated at the *Building Research Unit*, Roorkee, and a number of indigenous substances such as gums, resins, straw, sodium silicate, lime, molasses and lime sludge have been tried. Cement was also included for the sake of comparison. It has been found that lime sludge can be successfully used for this purpose.

Lime sludge is a by-product of the sugar industry where quicklime is used for neutralizing the acidity. It is estimated that nearly 4,000-5,000 tons of this substance are thrown out as waste every year from a single factory. Preliminary experiments done on local clayey soil containing about 20 per cent sand, 43 per cent silt and 37 per cent clay indicated that 3-4 per cent of sludge is sufficient to stabilize the soil. It was also seen that whereas the ordinary rammed soil discs disintegrate when kept in contact with water, those stabilized by 3 per cent sludge stand immersion for weeks. It was found that like cement-soil-mixtures, which are cured in humid atmosphere, the sludge-stabilized blocks also gain in strength under humid conditions. In order to see if the sludge can be used for stabilizing highly calcareous soils such as black cotton soils, similar trials were conducted on 2 samples, one from Poona (42 per cent sand, 31 per cent silt and 28 per cent clay) and the other from Sholapur (40 per cent sand, 31 per cent silt and 29 per cent clay), and the results obtained confirmed these findings.

It had been a practice in olden days in this country to mix *gur* solution with lime for waterproofing plaster. Based on this traditional practice, experiments were carried out on the use of lime-molasses mixtures as stabilizers. It was found that the mixture imparts water-repellent characteristics to the soil, but it was not as good as lime sludge. Mud plaster containing 4-5 per cent lime sludge have been tried on test pillars with promising results. Further work in this direction is in progress.

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September 20, 1948

Printed by H. JACQUEMOTTE, S.J., at the Catholic Press, Ranchi.
Issued by the Council of Scientific & Industrial Research, India. Editor : B. N. SASTRI, M.Sc.