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CONTENTS

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CONTENTS

SECTION B

Letters to the Editor

SECTION C

Letters to the Editor

spare no improper names

"When we published our essay on the Nomenclature of Chemistry, we were reproached for having changed the language which was spoken by our masters, which they stamped with their authority, and have handed down to us. But those who reproach us on this account, have forgotten that Bergman and Macquer urged us to make this reformation: In a letter which the learned professor of Upsal, M. Bergman, wrote, a short time before he died, to Mr. Morveau, he bids him 'spare no improper names; those who are learned, will always be learned, and those who are ignorant will thus learn sooner'."

(Lavoisier—'Elements of Chemistry in a New Systematic Order Containing All the Modern Discoveries', translated from the French by Robert Kerr, 3rd Edition, 1796.)

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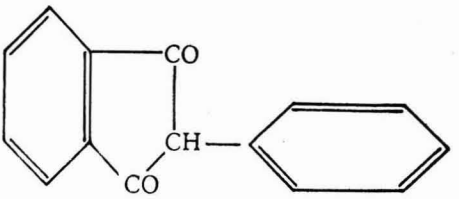

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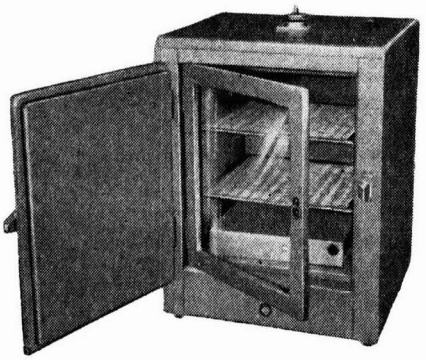

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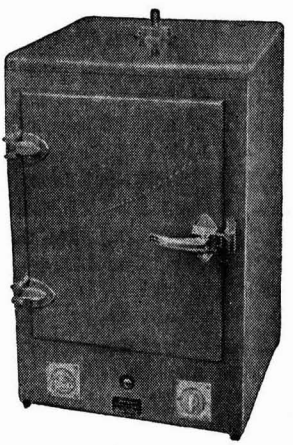

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INDEX TO ADVERTISERS

Current Topics

SOVIET MOON ROCKET

THE LANDING ON THE MOON OF THE SECOND RUSSIAN space rocket, Lunik II, is an achievement of historical significance and marks the beginning of a new epoch in man's attempt to conquer space. Lunik II reached the moon at 2 hr 32 min. 24 sec. IST on 14 September after a flight of about 34 hr. It was launched by means of a multi-stage rocket, the last stage of which was a guided rocket weighing 1511 kg. (without fuel). It carried a hermetically sealed spherical container with scientific and radio-engineering equipment weighing 390·2 kg. The last stage rocket attained a speed of about 11·2 km. (7 miles)/sec. and reached a trajectory of flight towards the moon approximating the calculated orbit. At the moment of impact, the rocket was travelling at 3·3 km. (2·05 miles)/sec. relative to the moon at an angle of 60° to the moon's surface.

The precision achieved both in the matter of time and position of landing in the face of a multitude of unknown factors and the large magnitudes of distance and speeds involved, has been truly amazing. After travelling a distance of 233,600 miles, the rocket hit the moon 2 min. 36 sec. ahead of the scheduled time and almost at the exact place where it was intended to land (in the area of the *mare tranquillitatis*, *mare serenitalis* and *mare vaporum*, about 497 miles from the centre of the visible surface of the moon). Care was taken to sterilize the rocket before launching and after landing in order to prevent possible contamination of the moon's atmosphere with microbes or fast-growing forms of plant life from the earth.

The equipment carried by the rocket included, besides three radio transmitters, instruments for providing data on the earth's magnetic field, radiation zones round the earth, composition of interplanetary gas, intensity of cosmic radiation, micro-meteors, etc. Preliminary analysis of the collected data has revealed that the moon has no magnetic field. Information has been obtained on the currents caused by particles of ionized gas caught by traps in the rocket's container; the force of currents differed along the rocket's route, a marked increase having been observed at a distance of about 10,000 km. from the moon. This is explained either on the basis of the existence of a layer of ionized gases around the moon or an area of greater concentration of corpuscles.

Another major step towards the conquest of space was the launching of an automatic interplanetary space station on 4 October. The 278·5 kg. station, mounted on the last stage of a cosmic rocket weighing 1553 kg. (without fuel), disengaged itself from the rocket after going into orbit. Two radio transmitters on the station use radar batteries operating on frequencies of 39·986 and 183·6 Mc/s. They transmit at definite intervals, for periods of 2 to 4 hr, scientific information and the results of the measurements of the parameters of the movement of the station. The operation of the equipment in the station is controlled from a co-ordination and computing centre in U.S.S.R. This space station will permit the study of the 40 per cent of the territory of the moon which has never before been seen by man, and supply new information on outer space.

DOMESTIC FUEL

THE AGGREGATE FUEL CONSUMPTION FOR HEATING and cooking purposes in Indian households amounts to the colossal figure of 83 million tons of wood equivalent. Indeed the domestic sector is a major consumer of energy accounting for nearly 40 per cent of the total energy consumption. While this is a feature of the pattern of energy consumption in all underdeveloped countries, a matter for serious concern in India relates to the sources from which the domestic sector draws its energy requirements. Reliable data on the types and quantities of fuels used in various parts of the country are not available. An attempt has been recently made to collect information from various sources and estimate the consumption both for rural and urban areas. The results of the survey, published in this issue, show that wood, charcoal, and agricultural wastes and cattle dung account for 97 per cent of the total fuel consumed and that cattle dung forms roughly half of it. The large-scale exploitation of fuel wood for burning, as such or after

conversion to charcoal, and of cattle dung, which has been going on for centuries, has had serious repercussions on soil conservation and soil fertility.

The energy demands of the domestic sector have been continuously increasing consequent on the growth of population and the need for arresting the wasteful burning of wood and cattle dung for fuel purposes by making available alternate fuels at economic prices has gained in urgency. The use of firewood and cattle dung as fuel is wasteful and only 5 per cent of the heat released by burning them is actually utilized. Firewood is becoming scarce in some parts of Rajasthan and in the plains of Uttar Pradesh, North Bihar, Madras and Andhra, and in a few states, e.g. Kerala, Orissa and Assam, the climatic conditions during a large part of the year are unfavourable for the sun-drying of cattle dung cakes.

Researches at the Regional Research Laboratory, Hyderabad, and the Central Fuel Research Institute, Jealgora, have established the commercial feasibility of producing smokeless fuel from coals at economic prices. Domestic coke is being produced at Hyderabad in a 25 tons/day pilot plant and it has found ready consumer acceptance. The plant in operation at Jealgora yields domestic coke from all types of coal, coking and non-coking. These are important developments. If commercial production of soft coke and smokeless fuel is established and sustained efforts are made to popularize their use, the consumption of firewood and cattle dung can be greatly reduced. It is gratifying to learn that serious consideration is being given to the production of domestic coke in the country in the Third Five-Year Plan.

TELEVISION SERVICE

THE INAUGURATION OF THE EXPERIMENTAL TELEvision (TV) service of the All India Radio at New Delhi on 15 September 1959 " marks a significant step in the progress of broadcasting and telecommunication in India ". The TV station, which is equipped with a 500 W. transmitter, four cameras and ancillary equipment, is housed on the fifth floor of the broadcasting house in New Delhi, and has been set up with the assistance of the Unesco and the Government of U.S.A.

Much planning and experimentation had to be done before inaugurating the service to attain suitable conditions for transmission. Problems on lighting systems and lighting arrangements had to be gone into and illumination of studio settings had to be checked; illumination level on an average subject, strength of the light source, nature and colour of the reflecting surface, heat dissipation and air-conditioning, etc., which enable the camera to produce an acceptable picture, had to be determined. Many of these intricate problems were tackled by the technical staff of the All India Radio in collaboration with the research personnel of the Optics Division of the National Physical Laboratory.

Because of its audiovisual appeal, TV has great potentialities as a tool of education and mass communication. Its effectiveness for classroom teaching has been recognized in U.K.; it has been employed as a demonstration aid in medical education in U.S.A. The electronic applications of the television principle in defence installations and in industrial management are well known. As President Dr Rajendra Prasad put it, television will go a long way in broadening the popular outlook and bringing people into line with scientific thinking. There is no doubt that the television service should be extended to other parts of the country, and this implies the training of personnel. Provision has to be made in universities and technical institutions to teach the principles of television and a centre should be set up in the All India Radio to impart necessary training on the practical aspects of television.

Food Technology for Asia & the Far East: F.A.O. Regional Seminar

V. SUBRAHMANYAN & M. SRINIVASAN

Central Food Technological Research Institute, Mysore

THIS seminar, first to be organized in this region, was held at the Central Food Technological Research Institute, Mysore, from 1 to 8 August 1959, at the invitation of the Government of India. Dr A. G. van Veen of the F.A.O. acted as the Director of the seminar and Dr V. Subrahmanyan, Director, Central Food Technological Research Institute, as the co-Director. Delegates representing the following twelve countries of the region attended the seminar: Burma, Ceylon, China (Taiwan), Hong Kong, India, Indonesia, Japan, Korea, Pakistan, Philippines, Thailand and Vietnam. The seminar afforded an opportunity and a forum for persons in the discipline of food technology in the region to exchange views and establishing contacts so helpful for progress and mutual benefit.

Country statements presented by the head of each delegation and lectures and discussions that followed focussed attention on the place of foods processed by traditional or modern methods in national diets, present status of food industries in the region, availability of raw materials for processing, effects of processing on nutritive value, packaging and transport, storage, hygiene and sanitation, food legislation and additives, importance of protein-rich foods, technical resources that exist within the region for the study of associated problems and machinery for dissemination of knowledge.

Traditional methods

A feature common to most countries in the region is the overall importance of traditional methods of food processing, the great variety of some products made by these processes and the important place they have in the diet of the people. Thus, in Korea, there are nearly 40 different kinds of *kimchies*, a pickled product consisting mainly of vegetables, spices and some cereal products. In Japan, two fermented products, *miso* and *shoyu* alone, together with *soya*, contribute about 6 g. of protein daily to the diet of the people. Parboiling of rice is mainly practised in India, Burma and Pakistan and by other people of Indian origin in the region. India has further improved upon the method which aims at reducing the processing time considerably with a corresponding reduction in the cost of production and improvement in quality. Fermentation processes for pulses and fish with or without addition of cereals are largely used in all countries in the region. In India, fermented milks and fermented mixtures of rice and a pulse are important, like the notable example of *iddli*, a fermented and steamed pudding made of rice and black gram. Smoking of fish is not widely practised in the region. Though foods processed by these traditional methods do not appear to contribute significantly to the food supplies in these areas, some of them are of nutritional importance and are suitable for being utilized on a much larger scale. However, there is need for knowledge of the basic scientific principles involved.

Protein-rich foods

In large areas of the region, different grades of protein malnutrition are observed. Some of the countries of the region reported an increase in the products of milk. Good use has been made of supplies of surplus dried skimmed milk from North America. But very often milk and milk products are not available at reasonable prices or are not available at all. For this reason, the seminar stressed the need for developing other protein-rich foods of animal or vegetable origin of high biological value and particularly those which are assimilable by infants and children.

Fish flour of an acceptable quality is produced and is in use in Thailand and Burma, to some extent in Philippines, and is in the experimental stage in Pakistan and Indonesia.

Soyabean preparations have long been used in the national diets of Japan, Taiwan, Korea, Indonesia and Hong Kong. In Indonesia, a new product called 'Saridele', which is a spray-dried vegetable milk produced from soyabean and sesame, fortified with calcium, vitamin B_{12} and vitamin A-palmitate, is in production and use for feeding school children. Soyabean milk is being produced in Philippines and Hong Kong and to a smaller extent in Thailand. In India, vegetable milk, prepared from peanuts, suitably fortified with calcium and vitamins, has been produced on a pilot plant scale for use, after fermentation,

mainly as vegetable curds. Japan is carrying on research on the preparation of a fermented soyabean product for infant feeding.

Groundnut flour of edible quality for use in low-cost protein foods, enriched flours and composite grains is being produced in India on a pilot plant scale. Other reports related to experimental production of defatted peanut flour in Indonesia, Vietnam and Taiwan, defatted soyabean flour in Korea, and defatted coconut flour in the Philippines and Ceylon.

The seminar considered that: (1) the blending of protein-rich materials from different sources to produce the optimum combination of essential amino acids was desirable; and (2) the protein-rich foods could be suitably enriched with calcium and vitamins, to make up for these deficiencies prevalent in some of the countries of the region.

Food processing

Food processing was discussed under the following titles: Raw materials, Canning and bottling, Dehydration, Refrigeration, Food irradiation and Influence of storage and processing on nutritive value. The main emphasis was on the methods of processing rather than on the processed foods themselves. Economic factors were considered in so far as they had a direct bearing on the technical discussions.

In all countries in the region, the processed foods are largely cereals, legumes, fruits, vegetables and fish and generally there is little processing of other animal products. An outstanding feature of food processing in the various countries in the region is the great importance of small factories. For example, in Japan there are nearly 30,000 food processing plants that employ less than 20 people each. This represents over 80 per cent of the food processing plants in the country. Nevertheless, in the same country, the major part of some important processed products (e.g. soya sauce) is manufactured in large factories. In some countries there is a considerable demand for imported processed products which cannot be produced locally because of the lack of raw materials. An example is that of Indonesia which imports each year some 20 million kg. of processed milk. India imports even greater quantities.

In cases where a food processing industry is linked with a considerable export trade, a high level of technical development is found. Particular examples of this are the frozen fish industry of Japan and the pineapple canning industry in Taiwan.

Canning and bottling — In Taiwan, the canning industry has expanded to reach in 1958 a total production of 2,000,000 standard cases, mainly pineapple, and in Japan, the yearly production was 26,000,000 standard cases as against 9,400,000 in pre-war years, mainly fish and shell fish. In general, the canning industry in other countries of the region has remained at a low level or has shown only a slight progress, in spite of there being excellent resources for the production of raw materials needed for the purpose. Among the factors responsible for this situation are the low purchasing power of the people, prejudice against processed foods and sometimes the poor quality of most of the raw materials, the deterioration caused by defective packaging and transport, the poor quality of auxiliary materials such as sugar and salt and inadequate control during the canning process itself, besides sub-standard containers and the cost factor (since pectin and chemicals like citric and tartaric acids and specialized equipment for processing have to be imported). Lack of adequate cold storage facilities lead to serious losses in perishables used as raw materials for processing.

Dehydration of foods — Dehydration by modern methods is little developed in the region. Sun-drying is practised to varying extents. Sun-drying of fish in Japan amounts to 300,000 tons annually, in Korea 10,000 tons and in Taiwan about 12,000 tons. In Thailand, about 7000 tons of tamarind (for export) and 8000 tons of fish are sun-dried. In Ceylon, about 20,000 tons of sun-dried fish are utilized and small quantities of jackfruit and breadfruit are sun-dried. Commercial dehydration is confined to industrial crops like tea in India, and tea and coconut in Ceylon. Recently, Taiwan has installed two modern dehydration plants for sweet potatoes with a daily capacity of 50 tons.

Refrigeration — Except where it is associated with an export industry, refrigeration is not adopted in many countries of the region. Nevertheless, it can play an important role in developing food industries of a country and India may be quoted as an example of this, where there are at present 182 cold storages with a total capacity of about 130,000 tons. Another 240 cold storages are planned for fruits and vegetables and an equal number for fish. To minimize losses, the cold storages for fruits and vegetables will be located near the main marketing centres.

In the export trade of some countries, for example, refrigerated foods passing through Hong Kong and frozen fish from Japan and in the storage of imported foods before distribution as with temperate fruits and dairy produce in Ceylon, refrigeration plays an important part in the region.

Food irradiation — Little work has been done on this aspect in the countries of this region. Recently, the Atomic Energy Department of the Government of India has started a centre for research on food irradiation. Discussions at the seminar showed an

awareness to the limitations of radiation treatment of foods, as was brought out fully at an F.A.O. meeting on the use of Ionizing Radiations for Food Preservation held at Harwell, England, in November 1958, and the need for further research to be done in the region. At present, it seems that sub-sterilizing doses rather than sterilizing doses might lead to practical applications in a reasonably near future and that such processes may have to be combined with other methods of processing.

The handling, packaging and transport of perishable foods present a serious problem throughout the region. There is an urgent need to improve containers, especially those made from indigenous materials. In most countries, cans have to be imported and the costs are high. Some countries have to import both cans and glass containers, but more usually glass containers are made locally. However, it is often the case that these glass containers are difficult to seal in automatic or semi-automatic machines and are liable to break during heat processing of the foods.

A considerable proportion of food produced is lost during processing, storage and transport and there is often a loss in nutritive value. Improved methods of handling, packaging, storage, transport and processing, with which the science of food technology is concerned, would do much to reduce these losses. There is a need to provide facilities for more rapid transport of perishable foods.

Influence of storage and processing on nutritive value — Since relatively little is known about the effects of processing and storage on the nutritive value of the foods commonly used in the region, and for the improvement of the processes, both traditional and modern, the seminar considered that: (i) data should be collected from different countries in the region on the effects of canning, dehydration and refrigeration on the nutritive values of locally available foods. The data should refer to the foods as freshly produced and after specified periods of storage under typical local conditions; and (ii) data should also be collected on the effects on nutritive value and the traditional methods of food processing, especially as operated on a small scale. These processes include sun-drying, salting and brining, pickling, smoking, starching, deep fat frying and home baking.

Food legislation

After hearing the views expressed on food legislation, food additives, hygiene and sanitation, the seminar came to the conclusion that a proper consideration could be given to these subjects only in a seminar exclusively devoted for the purpose and accordingly made a recommendation to the F.A.O. to hold a seminar in the region in the near future.

Personnel and training facilities

Research in food technology and training of personnel are receiving attention in all countries in the region which includes training abroad under fellowships granted by the United Nations organizations and under bilateral aid agreements. With the exception of Japan and India, the facilities for specialized courses in food technology are rather limited in the area. The necessity is, therefore, urgently felt for the establishment of national training centres. The seminar was also of the opinion that it would be extremely useful if a regional training centre could be set up where students from the different countries could be trained in food technology at different levels and where researches pertaining to the problems of the region could also be undertaken. Accordingly, it was recommended that the F.A.O. should explore the possibilities for setting up such a centre, keeping in view a programme for exchange of technical and research personnel between the different countries of the region, in developing this centre.

Among the various recommendations made to governments based on discussions at the seminar was the need for starting extension services to promote food processing industry and to impart instruction to people with regard to simple methods of food processing and food preservation and conservation, and prevention of wastage.

Domestic Fuel Consumption in India

JAI KISHEN*

Manuscript received 26 *February* 1959

In this paper an attempt has been made to estimate the domestic fuel consumption in rural and urban areas in India. The estimates given are based on the population figures for the year 1954-55 and have been derived from an analysis of the available and recorded data.

The total domestic consumption of fuels in India is estimated at 82·24 million tons in air-dry firewood equivalent, about 78 per cent of which is consumed in the rural areas and 22 per cent in the urban areas. Of the total quantity of fuel consumed, cattle dung contributes 49·6 per cent, firewood and charcoal 38·7 per cent, plant waste 8·5 per cent, soft coke 2·7 per cent, kerosene 0·4 per cent and electricity 0·1 per cent. According to the derived estimates the total quantity of firewood consumed is about five times the recorded production. The total quantity of cattle dung (green) produced in the country is 1036 million tons and the quantity available for use is 696 million tons of which 300 million tons are dried and burnt as fuel.

FOR the implementation of any scheme of industrialization, adequate supply of energy is as important a problem as the supply of raw materials or technical manpower. In the Third Five-Year Plan, the Government of India is laying special emphasis on the development of energy resources. In this context, it is, therefore, necessary to have as precise an estimate as possible of energy consumed by industrial, domestic and other sectors.

In India, as in other industrially under-developed countries, the domestic sector is by far the biggest energy consumer and any survey regarding the supply and consumption of energy has to begin with the domestic sector, because its requirements have to be met first.

The survey regarding domestic consumption of energy in India is beset with a serious difficulty. More than four-fifths of the population is rural and the people living in the villages depend upon firewood, cattle dung and agricultural and other plant wastes for fuel. These materials are generally obtained free of cost from all possible local sources according to the needs of the user. Under these conditions it is well nigh impossible to arrive at precise estimates of the consumption of different types of fuels without the aid of a properly planned and comprehensive survey. No such overall survey, for all types of fuels, for the whole country has so far been undertaken in the country and no direct recorded data are available for certain types of fuels.

For the purpose of the present survey, scattered information dealing with domestic fuels has been collected from various sources, and after examining it in the light of the local conditions, estimates of consumption have been formed for the whole country, separately for the rural and urban areas. The estimates are derived values and are based on the population figures for the 1954-55; the energy consumption for illumination purposes has not been taken into consideration and the domestic heating and cooking requirements are the main areas covered.

Types of fuels

With the exception of hydro-electricity, utilizable energy is mostly obtained by burning certain organic materials, generally designated as fuels, which, for convenience, have been classified into the following three categories:

(a) *Primary fuels* — This class includes mineral oil, coal, lignite, etc. To these may be added hydro-electricity. They provide the bulk of the energy used in the industrially advanced countries.

(b) *Secondary fuels* — To this class belong firewood, charcoal, vegetable oils and animal fats, cattle dung, agricultural and other plant wastes, etc. These materials form the major part of the fuel consumed in industrially under-developed countries.

(c) *Atomic fuels* — At present the use of these fuels is not widespread.

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Quality of domestic fuels

The quality of a domestic fuel is determined by its calorific value and its moisture and ash contents. Fuels which burn away rapidly require constant feeding and heat wastage is high. Leaves, brush wood and most of the agricultural and other wastes suffer from this drawback. Woods which burn uniformly and are converted into charcoal before turning to ash are good fuels. Smokelessness and ability to ignite readily are also desirable qualities.

In Table 1 are listed the fuels commonly used in the Indian households, along with their calorific values and ash and moisture contents[1,2]. The approximate conversion factors for deducing air-dry wood equivalent are also given which have been fixed, taking into consideration the calorific values and heat losses in use. Firewood has been made the basis because, for a long time to come, it will perhaps continue to be the most important domestic fuel in India.

TABLE 1 — CALORIFIC VALUE AND MOISTURE AND ASH CONTENTS OF FUELS

Fuel	Moisture %	Ash %	Calorific val. *B.t.u./lb.*	Conversion factor for wood equivalent
Wood (air-dry)	9·8	1·5	8000	1·00
Charcoal	2·0	3·0	13900	2·00
Mango leaves	9·8	18·0	6100	0·50
Casuarina leaves	8·4	1·3	8000	0·60
Palmyra leaves	9·4	5·3	7600	0·60
Date palm leaves	10·5	4·4	7300	0·60
Paddy husk	11·6	19·5	6200	0·50
Coconut shell	9·3	0·2	7700	0·75
Dung (sun-dry)	9·0	18·0	5000	0·63
Coal	—	—	10700	1·60
Soft coke	5·0	25·0	10200	1·60
Kerosene	—	—	19800	3·00

Pattern of domestic fuel consumption in rural and urban areas

Domestic fuel consumption in the rural and the urban areas in India is different both in quantity and kind, and the quantity of fuel used in a rural household is less than that in an urban household. The choice of the domestic fuels in the villages is governed mainly by two considerations. The first is the traditional disinclination of a villager to buy fuel. Secondly, the transport of fuels in rural areas is difficult due to poorly developed roads and other transport facilities and the little demand at any one place. Not only the supply of primary fuels to the rural areas is ruled out but also that of firewood if it has to be brought from some distance. Thus the fuel supplies in the rural areas are highly localized and where firewood resources are meagre, they consist mostly of agricultural and other plant wastes.

In urban areas every item of domestic fuel is a commercial commodity, and firewood is still the main fuel. In most of the towns in the eastern parts of India and parts of North India, the quantity of soft coke consumed is more than that of firewood, because the former is relatively cheap. The proportion of cattle dung used is small and that of plant waste insignificant. In cities electricity and kerosene are being increasingly employed.

Domestic fuel consumption in rural areas

Due to scarcity of firewood, especially in the densely populated parts of the country, the consumption of fuel in the majority of the rural households is reduced to the barest minimum. This can be assumed to be the case for all the states but for the differences in climate and eating habits. States having a colder climate consume more fuel. Similarly the requirement of fuel by wheat eaters is more than that required by rice eaters. After making due allowance for these variations, it should be possible to estimate the total quantity of fuel burnt in rural households in each state.

Rural Punjab is economically somewhat better off than its counterpart in other states. Its climate is cold in winter and the inhabitants are principally wheat eaters. The domestic fuel consumption in this state should, therefore, be among the highest in India. In the rural areas of Amritsar district the monthly intake of fuel per household is about 4 maunds* (*c.* 328 lb.). By weight, 80 per cent of this is constituted of sun-dry cattle dung, 15 per cent air-dry firewood and 5 per cent agricultural and other plant wastes. In terms of air-dry wood equivalent it comes to about 540 lb. per head per year. This may be taken as a reasonable average for the whole state. In arriving at this figure the average household has been taken to consist of five persons[3] and the conversion factor of plant waste to firewood equivalent as 0·5.

In rural areas of Uttar Pradesh the domestic fuel consumption is slightly less than that in the Punjab and is about 500 lb. per head per year†.

Orissa State is among the poorest in India and the domestic fuel consumption per head per year in firewood equivalent is 420 lb. in this state (personal communication from the Forest Utilization Officer, Government of Orissa).

In Madras and Kerala, the density of rural population is high and the fuel supplies limited. In these states fuel consumption may be taken as 400 lb. of firewood equivalent per head per annum.

The estimated fuel consumption in the rural households for each state in India is given in Table 2.

*A survey was conducted by the author in September 1958.
†A survey was conducted by the author in October 1958.

TABLE 2 — ANNUAL DOMESTIC FUEL CONSUMPTION IN RURAL AREAS

(Fuel consumption given in terms of wood equivalent)

STATE	CONSUMPTION PER HEAD *lb.*	RURAL POPULATION *millions*	TOTAL CONSUMPTION *million tons*
Andhra	420	26·70	5·01
Assam	550	8·93	2·19
Bihar	480	37·42	8·02
Bombay	450	35·82	7·20
Kerala	400	12·18	2·18
Madhya Pradesh	480	23·74	5·09
Madras	400	23·45	4·19
Mysore	420	15·47	2·89
Orissa	420	14·54	2·73
Punjab	540	13·52	3·26
Rajasthan	500	13·47	3·07
Uttar Pradesh	500	56·50	12·61
West Bengal	420	20·72	3·89
Delhi	520	0·30	0·07
Himachal Pradesh	600	1·10	0·30
Manipur	500	0·59	0·13
Tripura	480	0·63	0·14
Jammu-Kashmir	700	3·62	1·13
All India	465	308·70	64·10

The population figures given are for 1954-55 projected from the census held in 1951, assuming a yearly increase of 1 per cent.

Firewood supplies in rural areas — In rural areas firewood is obtained from nearby fuel-wood plantations, if any, from trees growing on private lands, village commons, wastelands, boundaries of the fields, fruit gardens, etc. Villages situated near the forests draw their requirement of firewood from them.

During the past 50 years the supply of firewood has considerably deteriorated in the rural areas. Before the First World War, firewood formed a large part of the domestic fuels and good quality species were available in plenty. At present they have almost disappeared and others are also getting scarce. The scarcity of firewood in the rural areas has also been aggravated by the high cost of its transport. The result is that the areas which are densely populated or are away from the forests generally suffer from acute shortage of firewood. Whatever quantity is available, comes mainly from the local industrial species which are felled to meet some immediate demand and the felling waste is used as fuel. Fruit trees that are no longer productive and trees of stunted growth are also cut down, irrespective of their worth as fuel. Wood from palms is also burnt as fuel in South India.

States which are surplus in firewood also have pockets suffering from its shortage because the distribution of the resources is uneven and transport facilities are inadequate. For example, there is acute shortage of wood fuel in the rural areas of the coastal plains of Orissa, a state in which the production of firewood is more than the demand. Even in the plains of Assam, the most forested state in India, firewood supplies are inadequate.

In 1954, the National Sample Survey of India, New Delhi, estimated the firewood and charcoal consumption in the country both for the rural and urban households. Their estimate[4] of 93 million tons of annual firewood consumption in the rural areas is very high and is far beyond the productive capacity of the country. Very probably the estimates also include dung in addition to agricultural and other plant wastes, since in the rural areas all these are used together. The data are, therefore, not of much help in determining the consumption of firewood alone.

In the absence of any other data, one has to make the best of the piecemeal information which can be obtained from various sources. It has been stated that the supply of firewood in the rural areas is inversely related to the density of population and directly to the extent of forests or firewood plantations. The means of transport to some extent and the unequal distribution of firewood resources are also factors which affect the supply of firewood. Consequently, domestic consumption of firewood in these areas varies considerably with each state.

In the Punjab, the forests occupy only 12 per cent of the total land area, and a part of it is unreserved. There is little forest in the plains where the demand for firewood is the highest. Species like *jand* (*Prosopsis spicigera* Linn.), *kikar* (*Acacia arabica* Willd.) and *shisham* (*Dalbergia sisso* Roxb.) are getting scarce and whatever is available is now burnt. On account of pressure of agriculture on land, the progress of afforestation is extremely slow. The supply of firewood in the state has been low for a long time but after the partition of India in 1947 it has become worse. About 15 per cent by weight of fuel consumption in the rural households in Amritsar is met by firewood, which comes to about 120 lb. per head per year. This figure may be accepted for the whole state.

The supply of firewood in Uttar Pradesh is no better. In the vast Gangetic plains of the state there are hardly any forests and the density of rural population is high. Non-forest species like mango (*Mangifera indica* Linn.), *jaman* (*Syzygium cumini* Linn.), *ber* (*Zizyphus mauritiana* Linn.), *nim* (*Azadirachta indica* A. Juss) and *mohua* (*Madhuca indica* J. F. Gmel) supply firewood. In western Uttar Pradesh nearly the whole of the cattle dung produced in the dry eight months of the year is burnt. In eastern Uttar Pradesh, there is serious shortage of firewood but in the Himalayan and Terai regions the supplies are fair. About 100 lb. of firewood per head may be taken as the estimate for the rural areas in the state.

Bihar has three serious handicaps which have adversely affected the availability of firewood in the

rural areas. Firstly, Bihar is one of the most densely populated states in India. Secondly, communication and transport facilities are not well developed, and lastly, the frequent occurrence of devastating floods. North Bihar, where the population is the densest, experiences chronic firewood shortage and supplies from other parts of the state are negligible because of the absence of transport facilities. As a consequence about 75 per cent of the fuel consumed in rural houses is constituted of cattle dung. South Bihar has more forest area but it is not served adequately by railways. The domestic firewood consumption in the rural sector of Bihar may be nearly the same as in Uttar Pradesh, i.e. 110 lb. per head per year.

West Bengal's position is peculiar. The state is fairly urbanized and industrialized but the density of rural population is very high (about one person per acre). It is apparent that a part of the rural population is depending upon urban areas for the supply of domestic fuels. The rural resources at a liberal estimate may be providing about 1 cu. ft of firewood per head of rural population. This is supplemented by another cu. ft per head from the urban areas and firewood depots amounting to 15 million cu. ft in all. This quantity is what is left over after deducting the quantity consumed by urban population from a total recorded availability of firewood of 25 million cu. ft in the state which is made up of 15 million cu. ft of forest fellings, 8 million cu. ft of sawmill and wood-working waste and about 2 million cu. ft obtained from other states[5]. Thus in the rural areas domestic consumption may be about 2 cu. ft or 90 lb. of firewood per head per annum.

The firewood resources of Orissa are ample but are unevenly distributed and means of communication and transport are inadequate. In the coastal districts of Puri, Cuttack and Balasore, where the population is the densest, firewood forms only 20 per cent of the domestic fuel consumption. For the rural areas of the whole state it may be estimated at about 50 per cent of the total firewood supply or about 200 lb. per head per year.

Madhya Pradesh has a large area under forest, but not uniformly distributed. About half of the firewood produced in the state is consumed in the urban areas and a part is exported. What is left for the rural sector is small (about 60 lb. per head per year) and its distribution is uneven. Consequently, the rural population depends mainly upon local resources for firewood which may be about double of the above quantity. The total firewood consumption of the rural areas in the state may be about 160 lb. per head per annum.

In Rajasthan, because of its large area, most of which is in the arid zone, and poor means of communication, firewood consumption in the rural areas is the lowest in India and may be put at 60 lb. per head per annum.

In Mysore State 18 per cent of the total area is under forests and the density of rural population is not high. The state being away from the coal-producing centres, the urban areas use mostly firewood and charcoal with some quantities of cattle dung. About one-third of the firewood felled in the forests is used in the rural areas which amounts to about 70 lb. per head per annum. Some quantities of firewood are also obtained locally from unrecorded sources which may be on an average 1·5 cu. ft per head per year. The total annual firewood consumption in the rural households in Mysore State may be taken as 130 lb. per head per year.

In Bombay State, the western parts are urbanized like West Bengal, but this does not materially affect the overall position of the rural areas in respect of firewood supplies. The domestic consumption of firewood may be put at 120 lb. per head per year.

The density of rural population in Madras is high like Uttar Pradesh. The forests of the state have suffered a great deal from denudation but there are casuarina plantations all along the west coast. Firewood supplies in the rural areas are meagre and may be the same as in Uttar Pradesh amounting to about 90 lb. per head per year.

Firewood consumption in the rural areas of Andhra, though higher than that in Madras, may be of the same order as of Bombay or Mysore, i.e. about 120 lb. per head per year.

Assam is the most forested state in India. Out of about 80,000 sq. miles of its forests, a little less than half is in the NEFA area and about 20,000 sq. miles are in the areas which are difficult to develop. The rest, about 25,000 sq. miles, is in the plains districts. The urban population being small, its demand for firewood is not heavy, but the tea gardens need considerable quantities of firewood. On account of the unequal distribution of forests there is some shortage of firewood in the rural areas and its supply may be of the order of 300 lb. per head per year.

Kerala has sufficient area under forest but it is unevenly distributed. The demand for firewood by industry is heavy. The density of population in this state is the highest in India and both rural and urban areas suffer from firewood shortage. Palms, palm leaves and other plant wastes are burnt in very large quantities, palms alone accounting for more than 500,000 tons. Wood and palms combined may roughly contribute 180 lb. per head per year as fuel in the rural areas.

TABLE 3 — ANNUAL CONSUMPTION OF FIREWOOD IN RURAL HOUSEHOLDS

STATE	*Per capita* CONSUMPTION OF FIREWOOD *lb.*	TOTAL CONSUMPTION OF FIREWOOD *million tons*
Andhra	120	1·43
Assam	300	1·20
Bihar	110	1·84
Bombay	120	1·92
Kerala	180	0·98
Madhya Pradesh	160	1·70
Madras	90	0·94
Mysore	130	0·90
Orissa	200	1·30
Punjab	120	0·72
Rajasthan	60	0·36
Uttar Pradesh	100	2·52
West Bengal	90	0·83
Andamans	—	Small
Delhi	80	0·01
Himachal Pradesh	450	0·22
Manipur	380	0·18
Tripura	350	0·10
Jammu-Kashmir	400	0·65
All India	129	17·72

The firewood resources in the rest of the states are fair considering their population. Delhi is, however, an exception.

In the light of the above considerations the consumption of firewood for the different states has been calculated and given in Table 3. From Table 3 it can be seen that the total annual firewood consumption in the rural households in India is 17·72 million tons and the average per head is about 129 lb. The total annual recorded production of firewood in the country during 1952-55 was 6·37 million tons[6]. The rural consumption of firewood alone is thus a little less than three times its recorded production in the whole country.

Domestic consumption of charcoal — The use of charcoal in rural households is small and it is mostly used up near the centres of production where it is available cheaply. According to the National Sample Survey[4] about 234,000 tons of charcoal were consumed in the rural areas in India in 1954 (figures for Jammu-Kashmir are not included). The average consumption of charcoal per head of rural population can, therefore, be put at 1·7 lb. or 3·4 lb. of wood equivalent.

Consumption of agricultural and other plant wastes — Rice husk, stalks of cereals, bagasse, stems and roots of agricultural crops, coconut shells, shrubs, brush wood, leaves and grasses, etc., are extensively used as domestic fuels in the villages. Principally these waste materials are burnt in the households to relieve shortage of firewood and cattle dung.

The consumption of agricultural and other plant wastes as fuel depends upon various considerations. In the Punjab, agricultural waste is utilized as cattle fodder. A part is also used for making articles of utility. Consequently little is left for use as domestic fuel and what is available is approximately one-third by weight of the firewood consumed. In Rajasthan the quantity thus used may be the same and in Uttar Pradesh and North Bihar slightly more.

In Assam, Orissa and Kerala, the use of plant waste is high because larger quantities are available and the production of cattle dung is not only small but the climate for the major part of the year is too wet for its drying. In the coastal plains of Orissa, the use of plant waste as fuel is two and a half times that of firewood. In these states, on the average, the consumption of plant waste should be well over that of firewood. For the whole country, the consumption of plant waste in the rural areas is about three-fourths by weight of firewood consumed and its firewood equivalent may roughly be put at 7 million tons or about 51 lb. per head per year.

It may be mentioned here that agricultural and other plant wastes are highly heterogeneous and accurate estimate of their consumption is very difficult.

Cattle dung as domestic fuel in rural areas

Enormous quantities of cattle dung are used in rural households for domestic heating and cooking purposes. As dung is meant to be used primarily as a soil fertilizer, it may be worthwhile ascertaining its total production in the country and how much of it is used as fuel.

Annual production of cattle dung in rural areas — The production of cattle dung in the country has been variously estimated by different authorities[2,7,8]. The Compost Development Officer, Government of India, estimates the production of green dung in the country at 1200 million tons annually. The different states are divided into two groups with respect to production of dung per animal per day. The first group includes Assam, Kerala, Orissa, West Bengal, Jammu-Kashmir, Himachal Pradesh, Tripura and Manipur, where the size of the cattle is small. In the second group are included the rest of the states in which the cattle are of larger size. The estimates for the two groups are as follows:

	GROUP I	GROUP II
Adult buffalo	25 lb.	80 lb.
Adult cattle	20 ,,	40 ,,
Young stock	10 ,,	20 ,,

The estimates in the second group require some modification. The average yield of 80 lb. of dung per adult buffalo is rather high. The average should be about 55 lb. Similarly, for the cattle it should be

about 35 lb. After making allowances for these, the statewise production and consumption of green dung has been calculated for rural areas and is given in Table 4. The buffalo and cattle population for these calculations has been obtained from the *All India Livestock Census*, 1956.

The total production of green dung in the rural areas in India is estimated at 995·14 million tons — 100·53 million tons in Group I states and 894·61 million tons in Group II states.

Annual consumption of dung for domestic use as fuel in rural areas — Surveys on the production and utilization of dung have been undertaken in some parts of the country. Recently, one such survey was carried out in Chingleput district, Madras[9]. But no survey has been undertaken for the whole country. A number of estimates have been put forward which show wide differences. According to Burns[8] about 115 million tons of dry dung are burnt in India as domestic fuel annually. Putnam[10] estimates that out of 10·62 million B.t.u. of energy consumed per head in the country, about 73 per cent comes from dung which amounts to 250 million tons of dry dung. According to Bhabha, the quantity of dung used is 224 million tons. In arriving at this estimate, Bhabha[11] has assumed that firewood used in the country is only 33 per cent more than its recorded production while actually it is considerably more. This assumption accounts for the high estimate. Acharya[7] reports that two-thirds (*c.* 600 million tons) of the green dung produced in the country is used as fuel. According to the Indian Council of Agricultural Research *Memorandum on the Development of Agriculture and Animal Husbandry in India*[12], about 40 per cent of the available dung is consumed for domestic purposes while according to the *Report of the Experts Committee on Manures and Fertilizers*[13] it is 50 per cent. Saha, accepting the first estimate, concluded that 256 million tons of green dung (71 million tons dry) are consumed as fuel.

The above estimates are for both the rural and the urban sectors; separate data for the former are not available. However, with data already available for firewood, charcoal and plant waste under total domestic fuel consumption in the rural areas, the amount of dung consumed can be calculated. The total amount of energy, in terms of air-dry wood equivalent, is 64·10 million tons and to it firewood, charcoal and plant waste contribute 17·72, 0·47 and 7 million tons respectively. The remaining 38·91 million tons of wood equivalent come from 62·26 million tons of sun-dry, or 286 million tons of green dung which is 43 per cent of the 663 million tons of available green dung, assuming that one-third is lost during grazing, etc. Thus, the *per capita* consumption of dung as fuel can be assumed to be 452 lb. (sun-dry) or 282 lb. of wood equivalent.

TABLE 4 — ANNUAL PRODUCTION AND CONSUMPTION OF DUNG AS FUEL IN RURAL AREAS

State	Total green dung production *million tons*	Available green dung *million tons*	Quantity used as fuel *million tons*	Consumption %
Group I				
Assam	16·12	10·7	1·83	17
Kerala	7·76	5·2	0·93	18
Orissa	25·20	17·0	4·11	24
West Bengal	33·17	22·0	9·98	45
Jammu-Kashmir	5·76	3·8	3·75	30
Himachal Pradesh	9·26	6·0		
Manipur	2·30	1·5		
Tripura	0·96	0·6		
Group II				
Andhra	94·44	63·0	24·64	39
Bihar	95·86	64·0	37·60	59
Bombay	128·68	86·0	37·02	43
Madhya Pradesh	142·74	95·0	23·73	25
Madras	58·09	39·0	20·67	53
Mysore	59·78	40·0	13·00	32
Punjab	51·96	35·0	17·76	51
Rajasthan	78·09	52·0	18·81	36
Uttar Pradesh	181·45	120·0	71·30	59
Delhi	3·45	2·3	0·37	16
Andamans	—	—	—	—
Total	995·14	663·1	285·00	43

It may be of interest to know the factors which promote the use of dung as domestic fuel and how its use varies in different states.

The first of these factors is the scarcity of firewood which may be due to lack of firewood resources as in Rajasthan and the plains of Punjab, Uttar Pradesh, North Bihar, Madras, Andhra, etc. In areas which suffer from paucity of firewood resources and where the density of population is high, the demand on dung as domestic fuel is very heavy, as in Uttar Pradesh, Bihar, Madras and Punjab. Secondly, the quantity of dung produced should be large and the climatic conditions should facilitate its sun-drying. For this reason the consumption of dung in Rajasthan Madhya Pradesh and parts of Punjab, Mysore, Bombay and Andhra is high. In Kerala, Orissa and Assam, the production of dung is low and also its use as fuel is scant.

Based on these considerations and taking into consideration the total domestic fuel requirement and the production of firewood, charcoal and agricultural waste, the consumption of dung as fuel for each state has been worked out and is given in Table 4.

The total domestic consumption of various fuels in rural areas is summed up in Table 5. Dung forms 60·7 per cent and firewood 27·7 per cent of the total consumption of 64·10 million tons of firewood equivalent.

TABLE 5 — DOMESTIC CONSUMPTION OF FUELS IN RURAL AREAS

Fuel	Total consumption		Consumption per head		Percentage of total
	As fuel *million tons*	Wood equivalent *million tons*	As fuel *lb.*	As wood equivalent *lb.*	
Firewood	17·720	17·72	1·29	129·0	27·7
Charcoal	0·234	0·47	1·70	3·4	0·7
Agricultural and plant wastes (in wood equivalent)	7·000	7·00	50·60	50·6	10·9
Dung (sun-dry)	62·260	38·91	452·00	282·0	60·7
Total	—	64·10	—	465·0	100·0

Domestic consumption of fuel in urban areas

During the past fifty years the pattern of fuel consumption in the urban households has undergone some change. To begin with, firewood was the only domestic fuel employed; small amounts of dung were also used. The supplies of firewood were obtained from the rural areas and forest plantations near the urban centres. During the First World War, the forest plantations suffered heavily and after the war, although firewood was still the main domestic fuel in the towns, its supplies were no more local. During the Second World War, firewood supplies decreased further and the rural areas were almost exhausted of firewood species. Since then the urban population has started using soft coke and electricity and kerosene oil to some extent. Sawdust and wood-working waste are also now employed in urban households.

The consumption of different fuels for domestic purposes in urban areas is discussed below. Since plant wastes are consumed in negligible amounts, firewood, charcoal, dung and other primary fuels such as coke and kerosene are discussed.

Firewood — The National Sample Survey of India has collected information on the domestic consumption of firewood and charcoal for the urban areas. Recently, the National Council of Applied Economic Research, New Delhi, also undertook an investigation on similar lines. According to the National Sample Survey[4] the consumption of firewood is the lowest in east India amounting to 198 lb. per head per year. It is because urban areas in this zone lie mostly in West Bengal where, on account of the proximity to the coalfields, soft coke is available in plenty and cheap, and is consequently the main domestic fuel. Firewood, on the other hand, is in short supply and costly. Calcutta, which is by far the biggest single urban unit in this area, uses firewood only as a subsidiary fuel.

In the central zone, firewood consumption is the highest, i.e. 618 lb. per head per year, and but for the region constituted by the former Hyderabad State, the central zone has ample firewood resources. The Madhya Pradesh Government is paying special attention to the proper distribution of firewood over the whole state. Lastly, this zone is not sufficiently urbanized and hence the use of soft coke and other primary fuels is yet to be established.

For the country as a whole the annual domestic consumption of firewood is 372 lb. per head of urban population. The total firewood consumption is 11·45 million tons which is a little less than twice its recorded production. This is understandable because practically the whole of the recorded production of firewood is directed towards meeting the needs of the towns with additional supplies coming from unrecorded sources like the surrounding rural areas, private lands, gardens, etc., and from the sawmills and wood-working industries.

Charcoal — Only south and south-west India are consuming significant quantities of charcoal and the consumption is estimated at 27 lb. per head per year. Since these zones are far away from coal production centres, soft coke is not used to any great extent.

The total amount of charcoal used in urban households in India is 435,000 tons or 14·7 lb. per head which is nine times the amount employed in rural areas.

Dung — Dung is used in relatively small amounts as compared to rural areas and the dried dung cakes are produced locally. As a rough estimate about 40 per cent (33 million tons) of the available dung is burnt as domestic fuel in the urban sector which works out to 3 million tons (sun-dry) or 97 lb. of dry dung per head per annum. The corresponding figure as air-dry wood equivalent is 1·89 million tons or 61 lb. per head. Thus the use of dung in the urban households is about one-fifth of that in the rural households.

Soft coke — Soft coke is being increasingly used as domestic fuel in the urban areas. In the eastern parts of the country its use is the greatest. In Delhi it forms about 50 per cent of the total domestic fuel consumption. In Calcutta the percentage is higher. In 1954, the amount of soft coke used for domestic use was 1·4 million tons or 1·75 million tons[14] of coal equivalent. The wood equivalent of it is 2·24 million tons. Assuming that the whole of it was consumed in urban areas, the *per capita* consumption of coal is 45·4 lb. or as wood equivalent to 73 lb.

Electricity — In 1954, electrical energy used for heating and other purposes in the domestic sector in India

was estimated at 135·4 million kWh.[15]. Since practically the whole of it was confined to the urban areas, the consumption per head works out to 1·96 kWh. Assuming that the efficiency of electric heating is about four times that of the burning of firewood, this works out to, in terms of wood equivalent, 0·1 million tons or 3·3 lb. per head of urban population.

Kerosene oil — Although mainly used for illumination purposes, kerosene oil is also used for domestic heating and the quantity used may be about 0·1 million tons or 0·3 million tons in wood equivalent or 9·7 lb. per head per year. Its consumption is, however, increasing rapidly.

The consumption of fuel in hostels, boarding houses, messes, hotels, restaurants, etc., should be considered as part of the fuel used for domestic purposes. For want of a better estimate, the consumption by these establishments has been fixed at 10 per cent of that in the urban households. Modifying the estimates for firewood, charcoal and electricity accordingly, the domestic power and fuel consumption in the urban areas is summarized in Table 6.

In terms of wood equivalent, the total domestic fuel consumption is 18·14 million tons and *per capita* consumption is 588·3 lb. This does not include the energy used for illumination. Assuming the average strength of a household as 5·3 persons, the consumption per household is 3118 lb. of firewood equivalent or 25×10^6 B.t.u. The estimate according to the Central Fuel Research Institute[1] is 30×10^6 B.t.u.

Table 6 shows that firewood is still the principal domestic fuel in the urban areas, forming over 69 per cent of the total consumption. The consumption of dung and soft coke is nearly the same, each being about 10 and 12 per cent respectively of the total fuel consumed. Charcoal, which comes next, is 5 per cent. Thus in the urban sector the average amount of domestic fuels utilized per head is about 27 per cent more than that in the rural areas.

Total domestic fuel consumption in India — In Table 7 is recorded the total domestic fuel consumption for both rural and the urban areas.

The quantity of firewood consumed per annum in the domestic sector is 30·32 million tons which, together with 1·2 million tons consumed in other ways, makes a total of 31·52 million tons. Of this quantity about 0·7 million tons is wood-waste obtained from the various wood-based industries. The rest of 30·82 million tons are made up of firewood. Thus the total quantity of firewood consumed in the country is about five times its recorded production.

The average annual production of industrial wood in the country for 1953-55 has been estimated at 225 million cu. ft or 4·5 million tons[16]. The quantity of firewood produced in India is seven times that of industrial wood. In most countries of south-east Asia this ratio varies from 8 to 10. *Per capita* annual consumption of firewood in India works out to 180 lb. or 4·4 cu. ft. If wood for making charcoal is included, it works out to 4·9 cu. ft.

TABLE 6 — ANNUAL DOMESTIC FUEL AND POWER CONSUMPTION IN URBAN AREAS

Fuel	Fuel consumption		In wood equivalent		
	Total *million tons*	*Per capita lb.*	Total *million tons*	*Per capita lb.*	Percentage of total
Firewood (air-dry)	12·60	409·00	12·60	409·0	69·5
Charcoal	0·50	16·00	1·00	32·0	5·4
Dung (sun-dry)	3·00	97·00	1·89	61·0	10·4
Soft coke	1·40	45·40	2·24	73·0	12·4
Electricity*	48·94	2·16	0·11	3·6	0·6
Kerosene	0·10	3·20	0·30	9·7	1·7
All fuels	—	—	18·14	588·3	100·0

*Total electrical energy consumed expressed in million kWh. and *per capita* consumption in kWh.

TABLE 7 — TOTAL ANNUAL DOMESTIC FUEL CONSUMPTION IN INDIA

Fuel	Quantity consumed *million tons*	Quantity in wood equivalent *million tons*	Consumption %
Firewood (air-dry)	30·320	30·32	36·9
Charcoal	0·734	1·47	1·8
Agricultural and plant wastes (in wood equivalent)	7·000	7·00	8·4
Dung (sun-dry)	65·260	40·80	49·6
Soft coke	1·400	2·24	2·7
Kerosene	0·100	0·30	0·4
Electricity*	148·940	0·11	0·1

*Electrical energy consumed expressed in million kWh.

In addition to 734,000 tons of charcoal consumed in the domestic sector, another 150,000 tons are utilized in industry, bringing the total to about 884,000 tons. Out of this, 335,000 tons are the recorded production, the rest coming from unrecorded sources.

The total green dung produced in the country is 1036 million tons and the quantity available for use is 696 million tons. The dung consumed as fuel is about 300 million tons (green) or 65·26 million tons (sun-dry), which forms 43 per cent of the available amount.

For the whole country the quantity of fuel used for domestic purposes is 82·24 million tons in wood equivalent. Wood, charcoal, agricultural and plant wastes and dung constitute 97 per cent of the total and the primary fuels constitute only 3 per cent. Dung alone accounts for 50 per cent of the total amount of fuel consumed.

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Sir Alfred Egerton, F.R.S.: 1886-1959—Obituary

THE NEWS OF THE DEATH OF SIR ALFRED EGERTON, F.R.S., Professor of Chemical Technology, Imperial College, London, on 7 September 1959 will be received with regret by many Indian students who have had their research training under him. Sir Alfred will, however, be remembered in India for his work as the Chairman of two scientific reviewing committees — the Indian Institute of Science, Bangalore, in 1948 and the Council of Scientific & Industrial Research in 1954 — and for his contributions to the development of scientific research in India.

Born on 11 October 1886, Sir Alfred was educated at Eton and the University College, London. He was one of the last group of research students of Sir William Ramsay. He subsequently studied in Berlin under Prof. Nernst, a Nobel Laureate. In 1923, he was appointed Reader in Thermodynamics at Oxford University. From 1936 to 1952, he was Professor of Chemical Technology, Imperial College, London. He was elected a Fellow of the Royal Society in 1926 and served as its Secretary from 1938 to 1948. He was knighted in 1943. He filled many important positions in public life. He was a member of the War Cabinet Scientific Advisory Committee, Fuels and Propulsion Committee (Admiralty), Scientific Advisory Council (Ministry of Fuel) and Director, Salters' Industrial Research Institute. He first visited India in 1948 as the Chairman of the Reviewing Committee for the Indian Institute of Science, Bangalore. Later, in 1954, he was invited to accept the Chairmanship of the Reviewing Committee set up by the Council of Scientific & Industrial Research to appraise the researches, both pure and applied, conducted at the national laboratories, and sponsored research at universities and other research institutions, and suggest future lines of development.

Sir Alfred Egerton was an authority on Combustion, particularly on problems bearing on 'knock', a phenomenon which occurs in internal combustion engines. As a result of brilliant research he showed that the 'knock' was brought about by the local enhancement of the rate of reaction owing to chain reactions produced and sustained by highly energized intermediate products identified as peroxides. His approach was mainly fundamental, resulting in studies bearing on a better understanding of the phenomenon of combustion. The results of these researches are found in the *Proceedings of the Royal Society*, covering varied topics in combustion such as (1) limits of inflammability, (2) flames under low pressure, (3) flat flames, (4) combustion in engines, (5) exhaust flames from jet engines, etc. In these projects many Indian students made valuable contributions under his guidance.

An Examination of Axiomatization & Information Theory Application in Neurophysiology*

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The axiomatization tendency and the information network theory application in neurophysiology have been critically examined, and the experiments and linguistic habits the various theories involve have been briefly discussed. From this analysis, it is concluded that biological material can be handled only in a framework of empirically workable concepts.

IT is in the nature of scientific enquiry that every potential subject of scientific thought reaches sooner or later a stage in which it is treated axiomatically and thereby enters the domain of mathematics: " Science concedes to idealism that its objective reality is not given but to be constructed ", was the way in which Weyl[1] characterized this state of affairs. In biology, however, a large part of statements about the subject matter is of purely descriptive nature or of a type which Mainx[2] named ' Pauschalaussagen ' (blanket statements); these are statements referring to highly complex occurrences which can be analysed into a series of lower order, testable statements. " The respiratory quotient of Herbivorous is one ", exemplifies a blanket statement which in the course of further analysis can be broken down into observational records of lower generality and finally into ' protocol sentences ' of the type idealized by the Vienna circle. Even in very elementary descriptive statements, however, there exists already the beginning of hypothesis construction and, in fact, the structure of the language used to formulate a statement, in itself, determines to some extent, the nature of the hypothesis. It must not be overlooked that the subject-predicate construction of human languages represents in itself a hypothesis about the nature of the Universe as pointed out by Whorf[3]. But statements about observations are not only determined by the syntax of the language in which they are formulated but also by the meaning of the constituent words which, at some early stage of the development of a field of scientific enquiry, may be identical with their intuitive meaning in everyday linguistic use. More frequently, however, specific semantic rules are developed to define the way in which certain words may be connected to meaningful sentences and such semantic rules imply in most cases a very specific hypothesis as to the nature of the event which is to be represented by the particular statement about it: " the drug A produces behavioural arousal by desynchronizing the electroencephalogram " is a typical statement which may be found in the note-book of an experimenter in neuropharmacology and it has, structurally, the appearance of an observational record. However, the terms ' arousal ' and ' desynchronization ' are connectible to a meaningful sentence only if we take a specific hypothesis for granted, namely that statistically irregular activity of nerve cells of the central nervous system is in some way linked with the organism's ability to perceive, and react upon, the environment. The credit for pointing out the ' principle of connectivity ' in scientific discourse goes to Mises[4].

Goody[5] has recently given a typical example for the kind of fallacy that may arise from improper linguistic habits in neurology, which dates back to the days of Jackson: " the activity X is localized in region Z of the central nervous system ". A statement of this type is legitimate only on the basis of a specific hypothesis, namely that there exists a specific and invariable correspondence between certain functions of and certain regions in the central nervous system. Such a hypothesis, in its generality, is no longer tenable on experimental grounds, and

*The present paper is meant as a personal tribute to Prof. C. R. Sankaran, Phonetics Laboratory, Deccan College Research Institute, Poona, through whom I have learnt so much about the subject. I am also indebted to Prof. Sankaran for the final form in which the paper is presented here.

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statements of this type are, therefore, not permissible, although they occur frequently in neurological language.

In more recent years, it has become customary to use in neurology, as in linguistics[6], certain terms and phrases which originally were formulated, and whose semantics was defined, in information theory or in algebraic theory of electrical networks[7]. Their use is now common in neurophysiology and it seems necessary to examine whether their semantic rules are such as to justify their use in the subject matter of neurology, for which they were not specifically defined. Such an examination is all the more necessary as the previously indicated examples show to what extent linguistic habits determine the structure of statements and involve assumptions about the nature of facts; they thereby may, as in fact the linguistic habit of ' cerebral localization ' did, interfere with progress in a certain field of enquiry. Information and network theories were from the very beginning particularly attractive to neurologists, because they permitted to some extent an axiomatic approach in neurology, as will be shown subsequently.

Axiomatic systems in general must fulfil certain conditions in order to be considered valid[4]: (1) there must be consistency within the system, i.e. statements of the type (a. $\sim$a) are prohibited; (2) independent interchangeability of the axioms must be granted; and (3) correspondence to observables, obtained by co-ordinating the arbitrary symbols of the axiomatic system with certain protocol sentences about observables, must be demonstrable.

Although axiomatic systems consist only of tautologies, as repeatedly pointed out by the logical positivists, their importance consists in the fact that, provided certain formulae of the system are made to correspond to observables, any derived formula will also correspond to observables.

For the axiomatic systems under consideration, conditions (1) and (2) will be considered as valid and no further discussion appears necessary in view of the existing literature[8,9]; only the correspondence principle will be discussed here for the subject matter of neurology and an attempt will also be made to analyse explicitly whether, and to what extent, semantical rules and basic assumptions of information and formal network theories may be applied to represent observations about the way in which the central nervous system functions. More specifically, an attempt will be made to show whether communication and electrical network theory can be considered as a potentially useful theory in neurology whose linguistic apparatus may legitimately be used to map events occurring in the central nervous system. It will be useful to divide the enquiry into two parts, and consider network and information theories separately. Both represent higher level hypothesis in the sense defined by Woodger[10,11], characterizing the introduction of words and subject-matter signs different from the lower level hypothesis (i.e. generalized observational records).

Formal neural network theory

When Turing[12] in 1936 offered the complete proof for the now famous theorem according to which it is always possible to design a machine that, given any axiomatic system, can state and prove all theorems possible within that system, up to the limitation drawn by Gödel's theorem, he set the stage for the development of theoretical neurophysiology. Making a series of plausible assumptions, such as: (1) the activity of the neuron is an ' all-or-none ' process; (2) a certain fixed number of synapses must be excited within the period of latent addition in order to excite a neuron at any time, and this number is independent of previous activity and position of the neuron; (3) the only significant delay within the nervous system is synaptic delay, which is measured in quantized units; (4) the activity of any inhibitory synapse absolutely prevents excitation of the neuron at that time; and (5) the structure of the net does not change with time.

McCulloch and Pitts[13,14] outlined in 1943 a propositional calculus of neuron networks which permitted to represent, by a formal network, any event describable in a finite number of words. Their work allowed to draw some very interesting epistemic conclusions: specification of the state of a given net at any one time t is sufficient to determine fully its state at the time $t+1$; however, knowing the state of the net at time t never permits complete determination of the state at $t-1$. The existence of regenerative activity of constituent circles and the inclusion of the disjunctive relation makes statements about time past indefinite. It is, therefore, obvious that any event can be mapped on activity within a neuron net, but by no such activity are the actual afferents unambiguously determined: " The thing in itself ceases to be knowable ".

For several reasons, it soon became necessary to revise the nerve-net theory of McCulloch and Pitts, for the purpose of satisfying the correspondence requirement of axiomatic systems for the subject of neurophysiology. The universal elements of the McCulloch-Pitts networks are postulated to function errorlessly and it is obvious that one single failure of a neuron in a highly specific net renders the whole net useless. It also became apparent that some more complicated representations would need more neurons than there are nerve cells in the central nervous

system. Finally, there will always be an infinity of networks whose firing pattern will be isomorphic to a given event and this fact diminishes the predictive and representative value of the theory.

Shimbel and Rapoport[15] examined a probabilistic approach by assuming the existence of a probability distribution of different kinds of synaptic connections in the net. Considerations of faulty functions of the basic elements of a net are, in such instances, of particular interest in which the 'logical depth' of the represented event (i.e. the number of sequential operations in time) is large. Neumann[16] proposed as solution the existence, and essential properties, of 'neuron pools', for restoring the excitation level of multiple transmission lines to either of the two values of the digital system, i.e. 0 or 1, in accordance with the actual excitation level in the line. Assumptions of this kind seem sufficiently realistic since it is well established that the analogue principle is extensively represented in the functioning of nervous structures.

A set of basic assumptions, different from the systems mentioned so far, was made as the starting point of a much promising theory by Cragg and Temperley[17]; the functional structures of the cerebral cortex is considered in terms of 'co-operative phenomena' which represent the subject of statistical mechanics. Apart from digital interaction between neurons through synapses, analogue processes in the form of extracellular current flow are discussed. There would be a differentiation of the whole system in domains defined by equal values of membrane potential, and energetic considerations always favour in such a system the assumption of a domain pattern with a minimum of free energy. Levels of excitation are consequently not only dependent on the pattern of afferences, but also on the distribution of domains over the whole system and impulses impinging upon the system alter, in turn, the domain pattern of the whole system. Observations of Lilly[18] on travelling waves in the central nervous system are compatible with this model and his observations cannot be explained on the basis of ordinary digital automata theories. It, therefore, appears that the linguistic and the formal apparatus of the thermodynamics of co-operative phenomena is more adequate for the representation of events in the central nervous system than any other existing form of theoretical neurophysiology. However, this approach is still in the very early stages of development.

Obviously, any one of the hypotheses discussed suggests certain types of experiments and certain linguistic habits which one should be aware of whenever statements are translated from one conceptual framework to another. To give an example: 'impulse', in the McCulloch-Pitts hypothesis, is a localized event occurring in one faultlessly working universal organ whose interaction with its neighbours is described by the rules of Boolean algebra, extended in quantized time. In a co-operative phenomena theory, an impinging impulse alters the energy distribution of a set of domains and the semantic rules for the use of the word 'impulse' are consequently different.

Communication theory

The subject of communication theory is the amount of information and the quantitative relations describing its transmission. Assuming a finite number of events whose *a priori* probabilities of occurrence (p_i) are known, the amount of information obtained can be defined by, knowing which of these events actually occurred, as $H=-\sum_{i=1}^{n} p_i \log_2 p_i$ (in bits). This definition bears close formal resemblance to the statistical definition of the entropy of a closed system, and in fact, the definition is formally identical, considering that the 'configuration number' is the number of *a priori* equally probable states that are compatible with the macroscopic description of the state. In other words, the entropy of the sytem corresponds to the amount of (micro-state) information that is missing in the macroscopic description. The theory was developed in this form by Szilard[19]* and Shannon[20] and is of great value in all cases which information is processed, as for instance in transmission lines and computers; computers, in this sense, are looked upon as circuit elements with characteristic transfer functions for information.

Taking into account the apparent similarity between impulses conducted in peripheral nerves and signals transmitted in electronic network, it is tempting to represent events occurring in the central nervous system in terms of concepts of information theory. This has, in fact, been extensively done in recent years, and as a result, corresponding hypotheses on central nervous system functioning have been proposed. The notion of feedback (i.e. transfer of a fraction of the output signal to the input terminals in suitable phase relation) proved particularly useful for designing models with goal seeking behaviour[21]. In all these cases the central nervous system was considered to be a 'black box' and only input-output relations were discussed.

*For a satisfactory phenomenological formulation of the entropy law *see* Popper, K. R., *Brit. J. Phil. Soc.*, **8** (30) (1957), 153-5, in which he has demonstrated the unsatisfactory nature of Szilard's discussion on Maxwell's Demon. Popper's concluding comments are illuminating.

Certain basic considerations about the applicability of information theory to neurophysiology are, however, essential before any such theory may be considered as legitimate in its extension to the central nervous system. Assuming, for the moment, that sense data in the form of measurable quantities in space and time were transformed in the central nervous system as sensations (i.e. qualities, not measurable in space and time), an attitude of neurological idealism would be adopted, with which the application of information theory to neurological data are no longer compatible. In this case, we would have to say that the central nervous system generates topological invariants out of metrical invariants. Some support for this idea can be obtained from the work of Piaget who showed that in the course of development of the child's concept of the Universe, topological aspects controlling behaviour arise long before the notion of metrics. In order to apply information theory to neurology, we must adopt a 'neurological realism' of the kind that any sensation exists in the central nervous system as patterns of neuronal activity in space and time. The application of information theory to neurology, therefore, already implies in itself a basic decision about a high level hypothesis according to which we assume the central nervous system to work.

Having made the decision that the information theory may be applied to neurological data, the following problem arises: a 'black box' considered as an organ in which information transfer takes place, can at best transmit an amount of information equal to the one received at the input terminals; as a rule there will be degradation and waste of information taking place. The central nervous system on the other hand is undoubtedly able to perform activity (i,e. produce output) in the absence of an input signal and it resembles, therefore, in some functions at least, more an information generator than an information machine (i.e. a computer). An example for activity independent of input to the central nervous system was first discovered by Adrian[22] when he demonstrated electric activity in the completely isolated olfactory bulb of fishes, the 'emission of behaviour' as used for operant conditioning[23] and numerous instances of innate behaviour patterns activated by releasers[24] are also not compatible with the 'black box' notion of the central nervous system.

In some respects, it will undoubtedly be permissible to apply formal apparatus and semantic rules of information theory to certain functions of the nervous system, e.g. in the description of simple input-output relation across synapses of any kind, as long as they can be looked upon as 'black boxes'. Reichenbach[25] even came to the conclusion that the notion of direction of time was based on memory function, acting like a registering instrument that stores information; time's arrow points in the direction of increase of information content. It is evident that, within certain domains of events, information theory provides useful linguistic rules and concepts; however, for the fundamental reason that the central nervous system, in its entirety, cannot be considered a 'black box', information theory cannot be applied to phenomena of more complex occurrences in the central nervous system.

Dealing exclusively with quantities of information, definable as a logarithmic measure of the statistical unexpectedness of a message, Shannon's theory leaves completely open the question involved in the qualitative characterization of messages, i.e. their meaning to the recipient. A profoundly 'biological' approach to this problem was suggested by Mackay[26]: meaning in his concept is closely tied up with the behavioural consequences a message produces in the recipient. The meaning of a message depends, therefore, also on the recipient's past knowledge. Measurement of meaning may conveniently be based on the selective function of a message on the ensemble of possible 'conditional probability matrices' which describe the set of behaviour patterns of an organism. We may thereby extend the 'classical' information theory of Shannon to the domain of meaning, by showing that 'meaning' can be given a quantitative place within an enlarged framework of information theory: 'meaning' can be quantitatively defined and experimentally determined as logarithmic measure of the size of change caused by the selective operation of a message on the ensemble of possible outcomes (in biological terms: conditional probability matrix of organismic behaviour). In geometrical interpretation, the meaning of a message can be pictured as a vector in the 'information space' where each point stands for a particular state of the represented organism[26]. The similarity of Mackay's basic idea to the concept of the 'semantic reaction' of Korzybski is apparent: information, looked upon from the point of view of the recipient's past knowledge, turns into semantics.

The utility of this concept may be illustrated by a set of recently communicated observations. In accordance with its general definition, we may take the electrical response of various areas in the central nervous system as one of the measurable indices of 'meaning' of a real-life stimulus situation; such records were taken by Hernandez-Peon[27] and Hernandez-Peon *et al.*[28] in animals with permanently implanted electrodes and it became obvious from this work, to what extent temporal succession of identical

and simultaneously competing stimulus patterns alter the electrical response, i.e. direction and absolute size of the vector representing the 'meaning' of physical stimulus patterns in the 'information space' of the observed organism.

Taking together the evidence presented with respect to the legitimacy of theoretical neurophysiology and information theory in neurology, it becomes evident that both approaches can at best be looked upon as models, suggesting certain linguistic and semantic rules of a specific vocabulary, to be used, however, only with great caution. In the classical and original form, their axiomatic structures do not correspond to the neurological reality*. This state of affairs is remedied to some extent in the modifications and extensions as given in the Cragg-Temperley hypothesis or in Mackay's concept of meaning. In these modified forms, the theories are, however, not yet sufficiently formalized as to provide a generalized abstract representation of neurological events.

Once more, the view of Burnett is confirmed, viz. "The handling of biological material will always be the business of sciences using their own working concepts"[29].

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*For a similar limitation to axiomatic treatment with respect to linguistic structures, reference may be made to the work of Meyer-Eppler[6]. For, in the history of languages there is a good deal of mixing and blending. Language phenomena do not work on schematic lines, as we see that "the great linguistic stocks of the world must have evolved by a process of constant mixing, blending and splitting" (Uhlenbeck[30]). In other words, both the fields of neurology and linguistics cannot be "exhibited as a set of logical deductions from postulates of impotence, as has already happened to thermodynamics". In order that our meaning may be made clear, here we refer to the following words of Whittaker[31]: "We may therefore conjecturally look forward to a time in the future when a treatise in any branch of physics could, if so desired, be written in the same style, as Euclid's *Elements of Geometry*, beginning with some *a priori* principles, namely postulates of impotence, and then deriving everything else from them by syllogistic reasoning".

Chemical Composition of Tobacco Leaves & Its Influence on the Grade Obtained on Flue-curing

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The influence of the various chemical constituents in green tobacco leaves on the grade of tobacco obtained on flue-curing has been investigated. By assigning marks to the various grades of cured tobacco on the basis of colour and extent of blemish, a multiple regression equation connecting the various chemical constituents with the quality of cured tobacco has been worked out. It has been found that on the basis of the chemical composition of green leaves, the favourable influence of moisture and starch on the quality of cured tobacco is respectively 3 and 1½ times the unfavourable influence of nitrogen. Leaves with a fairly good amount of moisture (80-85 per cent) and starch (*c.* 13 per cent) tend to produce good grades of tobacco on curing. In the cured leaves sugars are positively correlated with good grades of tobacco while nitrogen is negatively correlated.

IT is common experience that tobacco leaves grown under similar conditions and harvested at the same time and apparently at the same stage of maturity, and cured on the same stick, fall into different grades. Minute differences in temperature and humidity conditions to which the leaves are subjected during curing may be one of the factors responsible for this. The differences in the chemical composition of the leaves may be another factor.

The positive influence of carbohydrates and the negative influence of nitrogenous constituents on the quality of flue-cured tobacco have been recognized by several workers. Schmuck[1] showed that quality in Russian cigarette tobacco varied directly with the percentage of sugars and inversely with the proteins, and the ratio of these two constituents is known as 'Schmuck number'. Kovalenko[2] substituted the proteins in this ratio by the percentage of total nitrogen excluding nicotine nitrogen. According to Ward[3] and Darkis *et al.*[4], quality in flue-cured tobacco is directly related to percentage content of sugars in the cured leaf. Blick[5] found a fairly good agreement between quality and the ratio of total sugars to total nitrogen in New Zealand leaves. Phillips *et al.*[6] showed that grades of flue-cured tobacco which differ in physical properties also differ decidedly in chemical composition. Elliot *et al.*[7] worked out statistical correlations between the chemical composition and arbitrarily assigned prices of grades of flue-cured tobacco and found that the ratio of total sugars to total nitrogen gave the best correlation with quality.

The influence of the chemical composition of green leaves on the quality of cured leaf, as determined by grades of tobacco obtained on curing, has been extensively investigated by Sastry[8-11] and it has been shown that the initial carbohydrate content of the green leaf — which was mostly starch — largely accounted for the production of better grades[8,9,11]. It has also been observed that leaves cultured on water for different periods produced better grades than those allowed to wilt for the same periods[10] or cured immediately after harvest[12]. These studies have given an indication that starch and moisture in the green leaf are in some way connected with the grade of tobacco obtained on curing the leaf. The influence of nitrogen in the green leaf, however, has not been brought to light in the above studies. Macdowell[13], however, has stated that high protein content in the green leaves was detrimental to quality.

The above investigations, however, were carried out with groups of leaves and variations in the individual leaves would have been masked by such studies.

The present investigations have, therefore, been conducted with the object of obtaining more precise information on the magnitude of importance of the

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various chemical constituents, viz. moisture, starch, and nitrogen in the green leaf and sugars and nitrogen in the cured leaf, on the grades obtained on curing. This information was sought to be obtained by working out statistical correlations between the chemical constituents in each individual leaf and the grade obtained on curing the same.

Materials and methods

For the purpose of this study leaves of five plants of the variety Chatham (*N. tabacum* L.) were used. They were harvested in 8 successive primings when they were at the right stage of maturity. Each of these leaves was quickly divided into two halves by cutting it along the centre of its midrib and the green weights of these two halves were determined. One of the half-leaves was preserved in the green stage by steaming and quickly drying in a current of air at 60°C., while the other was cured under controlled conditions in the laboratory. For curing the following procedure was adopted. The half-leaves were allowed to yellow at 90°F. and 88-90 per cent relative humidity. When most of the half-leaves became completely yellow—in most of the curings this took *c.* 30 hr — they were transferred to a specially designed chamber for the 'fixing' and 'drying' operations. This chamber was equipped with electric heaters and water sprays and by adjusting and drawing air over them, air of any required temperature and humidity could be drawn through the chamber, thereby avoiding any sponging or scalding during fixing. The dry and wet bulb temperatures during these operations in a typical curing are given in Table 1.

The 'fixing' was completed in *c.* 8 hr and the entire curing took 20-22 hr. After the curing was over the leaves were brought to condition by opening the doors of the chamber and exposing them to the humid atmospheric air. They were then bulked for 10 days and their grades noted. For determining the grades the specifications given in the Agmark grading and marking rules[14] were followed, except that mixture of grades 1 and 2 of Agmark was designated as Y_1 and mixture of grades 3 and 4 of Agmark was designated as Y_2.

TABLE 1 — CURING CONDITIONS

Curing schedule *hr*	Dry bulb temp. °F.	Wet bulb temp. °F.
0-1	93	85
1-2	100	90
2-3	105	93
3-4	108	95
4-5	110	95
5-6	118	96
6-7	120	96
7-8	125	100
8-9	130	100
9-10	147	97
10-22	150	97

Leaves of plant No. 1 were destroyed by weevils and could not be analysed. The green halves were individually analysed for moisture, starch and total nitrogen and the cured halves for total sugars and total nitrogen. The methods of analysis employed were the same as those described in a previous paper[8].

Results and discussion

By curing *c.* 15 half-leaves at a time, and fixing and drying them in conditioned air, the curing conditions were kept as near ideal as possible. However, the grade of tobacco obtained by a particular leaf is the result of not only its inherent physical and chemical make-up but also the deviations from the ideal curing conditions. The fit between the chemical composition and grade obtained is not always exact. The only way to assess the influence of chemical composition on the quality of cured leaf is by working out statistical correlations between the various chemical constituents in the leaves and the grades of tobacco. For this purpose the grades of tobacco obtained have to be equated with marks assigned to them on a rational basis. The basis used in this study is the specifications given in the grading and marking rules[14]. According to these rules, grades 1 and 2 — mixture of which is the same as Y_1 in this study — possess bright lemon yellow or orange appearance with sponginess, scalding or blemish extending from 0 to 5 per cent of the leaf area. Hence this grade can carry a maximum of 100 marks and a minimum of 95 marks and is given 97·50 marks, the average of the two figures.

Grades 3 and 4 — mixture of which is the same as Y_2 used in this study — possess yellow to orange colour (a little less bright than grades 1 and 2) with blemish extending to 25 per cent of the leaf area. Therefore, the maximum marks these leaves can carry are 95 and the minimum 75 per cent of 95 or 71·20. This grade is, therefore, given 83·10 marks, the average of 95 and 71·20.

Grade L.G. is of a lower colour category than Y_2 and consists of light green coloured leaf with blemish not exceeding 10 per cent of the leaf area. This can, therefore, carry a maximum of 71·20 marks, which is the minimum of Y_2, and a minimum of 90 per cent of 71·20 or 64·10, and is given an average mark of 67·65.

Grade L.M.G. is of a still lower colour category and consists of leaves of light medium green colour with blemish not exceeding 25 per cent of the leaf area. This can carry a maximum of 64·10 marks — the minimum of L.G. grade — and a minimum of

TABLE 2 — CHEMICAL COMPOSITION OF GREEN AND CURED HALF-LEAVES

Grade designation	Marks assigned	Plant and leaf No.	Moisture (on fresh basis) %	Starch %	Total N %	Total sugars %	Total N %
D.G.	24·05	2-21	77·56	16·90	1·38	6·61	1·66
		2-23	75·91	10·33	1·45	7·77	1·78
		Av.	76·74	13·62	1·42	7·19	1·72
L.M.G.	56·10	2-8	87·58	1·42	1·07	5·39	1·93
		2-10	85·78	1·34	1·28	6·57	2·16
		2-11	85·58	3·77	1·43	7·70	1·99
		2-12	85·48	7·76	1·53	7·09	1·65
		2-14	84·65	7·34	1·79	7·34	1·82
		2-20	75·96	19·88	1·43	13·99	1·66
		3-9	86·26	4·23	1·53	6·16	1·30
		3-28	76·81	17·73	1·29	9·93	1·68
		4-8	86·19	4·15	1·51	5·09	1·40
		4-28	77·46	18·46	1·02	—	—
		4-29	77·24	12·24	1·38	11·00	1·59
		5-27	77·26	10·47	1·21	11·36	1·43
		Av.	82·19	9·07	1·37	8·33	1·69
L.B.Y.1	62·30	2-19	79·19	12·54	1·29	8·17	2·11
		2-26	74·79	12·72	1·22	13·13	1·72
		2-25	73·75	16·88	1·35	12·66	2·06
		3-32	78·22	5·38	1·34	7·46	2·01
		3-30	78·20	12·25	1·37	7·54	1·82
		3-31	75·81	12·45	1·17	13·18	2·01
		3-29	75·20	9·37	1·19	12·64	1·60
		5-21	79·75	21·81	1·00	8·33	0·91
		5-23	76·51	22·93	1·35	13·05	1·27
		5-29	76·48	17·52	1·27	7·49	1·46
		5-28	76·00	10·89	1·21	7·90	1·16
		5-30	75·28	12·31	1·49	8·69	1·47
		Av.	76·60	13·92	1·27	10·02	1·63
L.G.	67·65	2-9	87·00	0·98	1·26	6·62	1·80
		2-16	84·53	5·45	1·64	10·67	1·83
		2-15	82·64	7·18	1·68	9·87	1·95
		2-18	79·50	15·54	1·70	7·41	1·96
		3-8	85·76	3·12	1·51	4·59	1·30
		4-9	86·47	5·81	1·59	—	—
		4-23	78·47	27·86	1·13	8·50	1·37
		4-26	77·16	12·46	1·13	9·55	1·46
		4-27	76·59	21·93	1·19	15·36	1·25
		4-24	76·43	20·65	1·27	14·32	1·33
		5-8	89·12	7·31	1·38	4·30	1·61
		5-12	84·30	17·74	1·55	9·80	1·41
		5-24	77·99	17·79	1·26	13·03	1·31
		5-26	77·24	8·90	1·34	13·23	1·26
		5-25	77·17	17·66	1·23	9·60	1·33
		Av.	81·36	12·69	1·39	9·78	1·51
Y_2	83·10	2-13	85·72	5·72	1·43	6·31	2·17
		2-22	76·26	14·40	1·41	14·46	1·50
		3-14	87·58	5·49	1·29	11·10	1·31
		3-12	85·17	7·56	1·39	8·17	1·21
		3-10	84·97	8·40	1·30	8·75	1·06
		3-19	84·01	13·50	1·19	12·05	1·23
		3-16	83·55	13·68	1·32	10·75	1·40
		3-13	82·93	15·37	1·33	13·56	1·38
		3-20	82·62	5·46	1·27	10·82	1·54
		3-18	81·67	12·43	1·27	11·38	1·18
		3-22	80·68	9·09	1·19	13·14	1·17
		3-26	72·52	18·75	1·18	—	—
		4-12	86·92	11·33	1·50	19·33	1·28
		4-15	85·62	21·91	1·25	10·16	1·41
		4-19	82·98	20·04	1·30	12·52	1·38
		4-18	82·55	22·02	1·33	—	—
		4-22	80·89	16·76	1·10	13·57	1·25
		4-21	80·10	20·02	1·22	5·74	1·57
		4-25	76·54	25·14	1·30	5·80	1·42

TABLE 2 — CHEMICAL COMPOSITION OF GREEN AND CURED HALF-LEAVES — *contd*

Grade designation	Marks assigned	Plant and leaf No.	Moisture (on fresh basis) %	Starch %	Total N %	Total sugars %	Total N %
Y_2	83·10	5-11	87·33	11·02	1·55	8·79	2·06
		5-9	87·04	7·16	1·43	5·75	1·52
		5-10	86·99	7·39	1·47	7·16	2·04
		5-14	84·33	19·60	1·35	13·58	1·49
		5-16	83·91	12·62	1·42	13·62	1·34
		5-15	82·02	17·15	1·33	12·15	1·29
		5-18	80·18	18·39	1·26	17·34	1·37
		5-20	79·55	10·81	1·19	8·89	1·11
		5-22	77·94	16·08	1·17	11·51	1·25
		Av.	82·59	13·83	1·31	11·02	1·42
Y_1	97·50	2-17	83·15	4·60	1·47	6·45	1·79
		3-11	87·17	4·84	1·42	8·58	1·28
		3-17	84·64	9·44	1·32	8·36	1·46
		3-25	81·30	9·65	1·18	16·25	1·29
		3-21	81·17	12·03	1·18	10·39	1·29
		3-27	79·25	9·86	1·23	10·94	1·56
		3-24	78·14	16·71	1·16	8·53	1·25
		4-10	88·30	5·53	1·48	8·05	1·41
		4-14	87·59	6·71	1·34	12·91	1·46
		4-17	85·42	14·62	1·37	7·09	1·43
		4-13	84·78	15·24	1·50	9·35	1·39
		4-11	84·72	16·14	1·48	10·03	1·29
		4-16	83·96	18·89	1·26	14·72	1·30
		4-20	80·16	18·65	1·17	7·31	1·33
		5-13	86·61	12·43	1·40	12·81	1·31
		5-17	82·55	20·87	1·51	14·12	1·53
		5-19	82·02	18·03	1·20	13·72	1·34
		Av.	83·58	12·60	1·33	10·56	1·39

75 per cent of 64·10 or 48·10 and is given an average mark of 56·10.

Grade D.G. consists of dark green coloured leaves not falling into the above two categories. This grade carries a maximum of 48·10 and a minimum of 0·0 marks and is given an average of 24·05 marks.

Grade L.B.Y.1 is again of lower basic colour than Y_2 and consists of leaves of light brownish yellow colour with blemish not exceeding 25 per cent of the leaf area. This grade carries a maximum of 71·20 marks (the minimum of Y_2) and a minimum of 75 per cent of 71·20 or 53·40 and is assigned an average of 62·30 marks.

Grade L.B.Y.2 is of the same colour category as L.B.Y.1 but with blemish not exceeding 50 per cent of the leaf area. This can carry a maximum of 53·40 — which is the minimum of L.B.Y.1 — and a minimum of 50 per cent of 71·20 which is the minimum of Y_2 grade leaves or 35·60 and is given an average of 44·50 marks.

Grade B consists of brown coloured leaf and is of a lower category than L.B.Y.2 with blemish not exceeding 40 per cent of the leaf area. This can, therefore, carry a maximum mark of 35·60 and a minimum of 40 per cent of 35·60 or 21·40, and is given an average of 28·50 marks.

The chemical composition of green halves, cured halves, grades obtained on curing and the marks assigned to each grade on the above basis are presented in Table 2.

The present investigations have been designed to get precise correlations between the chemical composition of green leaves and the grade obtained on curing them. To achieve this, half-leaves have been cured. It is possible that the results obtained with half-leaves may not be completely applicable to whole leaves. However, the studies of Askew[15], who found that removal of midribs did not interfere with respiration leading to carbon dioxide evolution, protein hydrolysis and production of sugars, make it probable that these findings hold good even for normal curings using whole leaves.

It was of interest to find out how the various chemical constituents are distributed in the leaves yielding the same grade. This was obtained by working out the internal correlations between the chemical constituents in the leaves falling into the same grade. The data are presented in Table 3.

There is always a negative correlation between moisture and starch in all the green leaves except in the case of those falling into L.B.Y.1 grade. As the grade improves, the negative correlation decreases.

TABLE 3 — CORRELATIONS BETWEEN CHEMICAL CONSTITUENTS OF LEAVES OF DIFFERENT GRADES

GRADE DESIGNATION	MARKS ASSIGNED	SIMPLE CORRELATION COEFFICIENTS BETWEEN			
		Moisture and starch in the green leaf	Moisture and nitrogen in the green leaf	Starch and nitrogen in the green leaf	Sugars and nitrogen in the cured leaf
L.M.G.	56·10	−0·9169*	+0·3148	−0·2060	−0·1668
L.B.Y.1	62·30	+0·0850	−0·2872	−0·2263	+0·1768
L.G.	67·65	−0·7396*	+0·4973†	−0·4703	−0·3684
Y_2	83·10	−0·5131*	+0·5697*	−0·3308	−0·3911†
Y_1	97·50	−0·3697	+0·6741*	−0·1652	−0·3182
All grades	—	−0·5170*	+0·4022*	−0·3358*	−0·3121

*Significant at 1% level.
†Significant at 5% level.

In the case of moisture and nitrogen there is positive correlation which increases as the grade of the cured leaves improves. Again the leaves under L.B.Y.1 are an exception. The trends in the correlations between starch and nitrogen in the green leaf and sugars and nitrogen in the cured leaf are not definite.

The reason for the exceptional behaviour of leaves in L.B.Y.1 grade is not clear. It is interesting to note that the green leaves giving this grade are strikingly low in moisture and high in starch. Also out of the 12 leaves which fall into this category, 9 belong to the topmost portion of the plant. These results show that green leaves with a fair amount of moisture (80-85 per cent) and starch (*c.* 13 per cent) and a balanced composition yield good grade cured leaves.

In order to get a measure of the importance of the various chemical constituents on the quality of the leaves, multiple regression analysis of the various constituents in the green leaf on the quality of the cured leaf (as judged by the marks) has been worked out and the following equation was obtained.

$$Y = 97{\cdot}20 + 2{\cdot}36x_1 + 0{\cdot}96x_2 - 24{\cdot}20x_3$$

where Y = the quality on the basis of marks; x_1 = moisture; x_2 = starch and x_3 = total nitrogen per cent in the green leaf. The multiple regression coefficient was 0·52 and was highly significant. This shows that variations in these constituents accounted for the grades obtained in 52 per cent of the leaves.

Statistical correlations between the chemical constituents in the green leaf and the quality of the cured leaf were worked out. The data presented in Table 4 show that all the partial regression coefficients are significant. The influence of moisture and starch in the green leaf on the quality of cured leaf is positive while that of nitrogen in the green leaf is negative.

In order to take into account the range and mean percentage of the constituents they are expressed in terms of their standard deviations and the standard coefficients are obtained (last column, Table 4). On the basis of the standard coefficients it is obvious that the positive influence of moisture and starch are approximately 3 and 1½ times the negative influence of nitrogen.

When the multiple regression equation between the grades and chemical constituents in the cured leaf is worked out, the following equation is obtained:

$$Y = 92{\cdot}02 + 0{\cdot}88x_1 - 17{\cdot}23x_2$$

where Y = quality on the basis of marks; x_1 = total sugars and x_2 = total nitrogen per cent.

The multiple regression coefficient is 0·30 and is highly significant.

Statistical correlations between the chemical constituents in the cured leaves and the grades are shown in Table 5. The partial regression coefficient due to sugars is not significant while that due to nitrogen is highly significant. While sugars are positively correlated with grades, the correlation of nitrogen with grades is negative. These trends confirm the trends shown by starch and nitrogen in the green leaves.

On the basis of the standard coefficients the negative influence of nitrogen on quality appears to be more than the positive influence of sugars. This is just the reverse of what has been found on the basis of the composition of the green halves where the positive influence of starch is more than the negative influence of nitrogen. This is due to the poor correlation between starch in the green half and sugars in the cured half. The correlation coefficient between these two constituents is only 0·387 as compared to 0·815 obtained in another study[16] using Harrison's special leaves. Examination of the data in Table 3 shows that in a number of cases the sugars obtained in the cured half are not accounted for by the hydrolysis of starch in the green half. Probably other

TABLE 4 — CORRELATIONS BETWEEN CHEMICAL CONSTITUENTS IN GREEN LEAF AND GRADE OF CURED LEAF

Constituent	Coefficient of simple correlation	Multiple regression*		
		Partial regression coefficient	S.E.	Standard coefficient
Moisture	+0·3383†	+2·3554†	0·437	+0·6169
Starch	+0·1191	+0·9564†	0·295	+0·3615
Total N	−0·1013	−24·1048‡	11·002	−0·2281

*Coefficient of multiple correlation 0·5243.
†Significant at 1% level.
‡Significant at 5% level.

TABLE 5 — CORRELATIONS BETWEEN CHEMICAL CONSTITUENTS AND GRADE OF CURED LEAF

Constituent	Coefficient of simple correlation	Multiple regression*		
		Partial regression coefficient	S.E.	Standard coefficient
Total sugars	+0·2660†	+0·8808	0·5579	0·1721
Total N	−0·3548‡	−17·2347‡	6·2400	−0·3011

*Coefficient of multiple correlation 0·3007.
†Significant at 5% level.
‡Significant at 1% level.

polysaccharides like dextrins and glucosides contribute to the production of sugars in this variety.

These results corroborate the previous findings of Sastry[8-12] and bring out the fact that starch and moisture in the green leaf are favourable for the production of better quality of cured leaf. Moisture appears to be nearly twice as important as starch in regard to the quality of cured leaf produced. The role of carbohydrates and moisture, in bringing about better yellowing of the leaf and for obtaining a better quality cured leaf, has been discussed in detail in a previous study[11], on the basis of which the following hypothesis has been formulated to explain the various observed facts. Chlorophyll is held by chemical forces on proteinaceous matter, degradation of proteins being accompanied by an equivalent destruction of chlorophyll. This unmasks the yellow colour of the leaf which is due to carotenoids and flavones. According to modern views, concomitant synthesis and breakdown of nitrogen compounds is a characteristic of all life processes. According to Sastry[11], this appears to be a characteristic of the yellowing process of the leaves also, and the disappearance of proteins and chlorophyll observed in the leaves is only due to the difference in the rates of proteolysis and resynthesis. The role of carbohydrates appears to be in facilitating the reactions of resynthesis of proteins from their breakdown products, thus causing a more uniform degradation of proteins and chlorophyll in all the cells of the leaf (because of their mobile character) and hence more uniform yellowing. The role of moisture appears to be in contributing to the mobility of the carbohydrates.

These studies have brought out the unfavourable influence of nitrogenous constituents in the green leaf on the grades of leaf obtained on curing. Their exact role is not clear at present. However, on the basis of the above hypothesis, it may be postulated that their role lies in hastening the reactions of proteolysis in some cells of the leaf (where they may be more concentrated), thus causing uneven yellowing of the leaves.

The significance of these studies lies in their practical application. On the basis of these results, it can be stated that preserving moisture in the green leaf after harvest is of paramount importance. This can be achieved by covering the leaves with wet gunnies and protecting them against the sun. In a recent study Sastry and Bhat[12] have shown that the quality of the top leaves could be improved by culturing them in water before curing.

As the leaf matures the starch content attains a maximum and then decreases during senescence. This is accompanied by depletion of nitrogenous constituents also. The diurnal variations in carbohydrates also can be taken advantage of. It is thus possible to harvest the leaves when they contain the optimum concentrations of these constituents and thus improve the quality of the cured leaf.

The negative influence of nitrogen on the quality of cured leaf suggests that flue-cured tobacco should be grown with as little nitrogen as possible. However, nitrogen fertilization cannot be reduced beyond a certain limit as this element is essential for the growth of the plant.

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Lead Plating from the Pyrophosphate Bath

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The pyrophosphate bath has been studied in detail for the plating of lead. The optimum conditions for working the potassium salt bath are: composition of electrolyte (g./litre): lead nitrate, 33·2; total pyrophosphate, 78·0; and glue, 1·0; *p*H, 8·9; bath temperature, 60°C.; and limiting c.d., 3.5 amp./sq. dm.; agitation of the electrolyte facilitates plating. The deposits are finer grained than those from acid baths. The throwing powers of the plating solution, measured with a modified Haring-Blum cell, are 60-88 per cent as per Field formula from the weights of deposits and 6-20 per cent using the Gardam equation involving cathode potentials and resistivity.

LEAD is commonly electrodeposited from acid baths such as fluoborate, sulphamate and fluosilicate baths. There is no reference in the literature to the use of the complex pyrophosphate bath for the electroplating of this metal. The preliminary work carried out on this subject has already been briefly reported from this laboratory[1,2].

This paper reports the results of experiments on the determination of optimum conditions for the plating of lead from the pyrophosphate bath.

Experimental procedure

The plating bath was prepared by the addition of alkali pyrophosphate to lead nitrate; the solubility of the dry precipitate of lead pyrophosphate in alkali pyrophosphate was low. The pyrophosphate content of the solutions was always in excess of that required for complex formation. Physico-chemical measurements have shown[3] that the molar ratio of pyrophosphate to lead in the complex is 1 as well as 2, the metal ion concentration and the instability constant being of the order of 10^{-11} g. ion/litre and 10^{-11} respectively for the latter ratio.

It was considered necessary to raise the *p*H of the plating solutions containing sodium pyrophosphate to 10·8 (from 9·8) in order to prevent the tendency of the solution to precipitate on keeping. With the potassium salt bath, however, no difficulty was experienced at *p*H 8·9. In both cases the molar ratio of pyrophosphate to lead in the solution was kept at 4·5 or 5·0; otherwise there was turbidity on electrolysis.

Fresh solutions (200 ml.) were taken for each experiment. The anode was a hollow cylinder ($\frac{1}{8}$ in. thickness, $\frac{7}{16}$ in. height and $7\frac{3}{8}$ in. circumference) of chemically pure lead. A cylindrical platinum hollow cathode ($1\frac{1}{2}$ in. length, $\frac{3}{8}$ in. diam.) was placed inside the anode and rotated. The interelectrode distance was 0·5 in. and the cathode area was 2·25 sq. in. The anode area was four times that of the cathode, thereby reducing the anode current density and facilitating anode corrosion. Plating time for an

experiment was 10-45 min. Still, plating was not satisfactory. The experimental details concerning the cleaning of electrodes, plating equipment, current efficiencies, temperature, agitation, *p*H, resistivityand electrode potentials were the same as described earlier[4]. The *p*H was adjusted by the addition of hydrochloric acid and sodium or potassium hydroxide. Plating conditions were carefully controlled to obtain electrode potential values (hydrogen scale) accurate to $\pm 0{\cdot}005$ V.

The throwing power of the plating solution was measured under optimum conditions with a modification of the Haring-Blum throwing power box[5]. The object was to obtain a relative idea of the throwing power of different plating solutions. A cylindrical glass cell, 15 cm. long and 4·5 cm. diam., was used, with two copper cathodes and a perforated lead anode in between. The distance between the cathodes was 12 cm. The cathodes were weighed before and after electrolysis, and cathode potentials and resistivity of the solution determined. The throwing power was calculated from the Field formula[6] and also from the equation of Gardam[7]. There was no variation of the cathode efficiency with current density.

Photomicrographs of a thick coating (0·001 in.) of the surface of lead deposit were taken with a Leitz projection microscope. X-ray powder pattern of the deposit was obtained from Siemens, Baujahr 1950 model X-ray unit with 57·3 mm. diam. camera. Iron Kα-radiations with manganese filter at 35 kV.

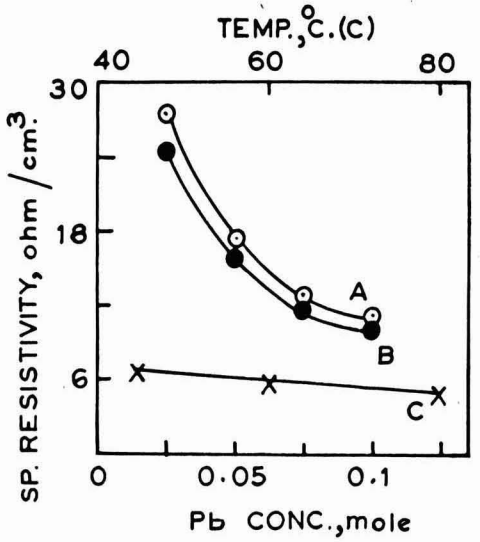

FIG. 1 — EFFECT OF LEAD CONCENTRATION, RATIO AND TEMPERATURE ON SPECIFIC RESISTIVITY [(A) Ratio of pyrophosphate to metal, 4·5; temp., 60°C.; Na salt; (B) ratio of pyrophosphate to metal, 5·0; temp., 60°C.; Na salt; (C) Pb, 0·1M; ratio of pyrophosphate to metal, 4·5; K salt]

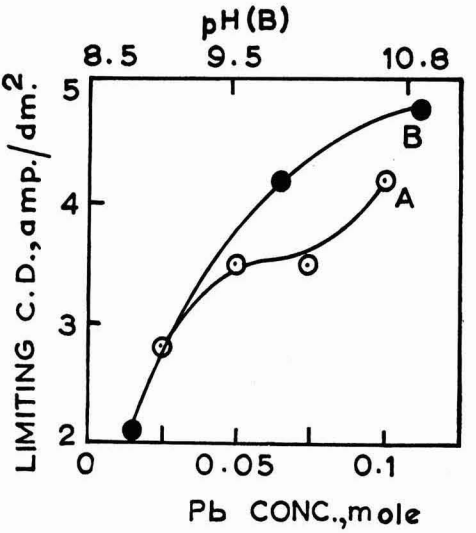

FIG. 2 — EFFECT OF LEAD CONCENTRATION AND *p*H ON LIMITING CURRENT DENSITY [(A) Ratio of pyrophosphate to metal, 4·5 (or 5); temp., 60°C.; (B) Pb, 0·1M; ratio of pyrophosphate to metal, 4·5; temp., 60°C.]

and 15 ma. were employed. Hardness measurements were made on the surface of the deposit with Leitz 1151 Durimet Midget hardness tester.

Results

Electrodeposition was carried out under the following conditions: lead concentration, 0·01, 0·025, 0·05, 0·075, 0·1 and 0·125M (K salt); ratio of pyrophosphate (P_2O_7) to metal, 4, 4·5 and 5; *p*H, 8·8 (8·9 K salt), 9·8 and 10·8; and temperature, 40°, 45°, 50°, 60°, 70° and 80°C. The results are presented in Figs. 1-9 and Tables 1-3. Electrode efficiencies have not been included as the values are very close to 100 per cent under all conditions. All the results have not been covered to avoid overlapping and the data recorded are for good quality deposits only. The decomposition potential for the plating solution was 2·4 V. and the bath voltage 0·1-1·0 V.

Specific resistivity — Increase in metal content, ratio of pyrophosphate to metal or bath temperature lowered the specific resistivity of the plating solutions; *p*H had little effect. The resistivity of the plating solutions with potassium salt was much less than that with sodium salt (Fig. 1 and Table 3).

Limiting current density — The limiting current density (cathode and anode) was increased by an increase in the lead content or the *p*H of the solution (Fig. 2), and to a small extent by an increase in the ratio (not shown). At *p*H 9·8 it decreased when the temperature was raised above 60°C., by stopping agitation, and by most of the addition agents. At

*p*H 10·8 or with the potassium salt bath, increase in temperature had no effect on the limiting current density. It was possible to work the bath up to a cathode current density of 4·2 amp./sq. dm. and anode current density one-fourth the value. There was some sludge formation at the anode after electrolysis, but this did not affect the efficiency.

Potentials — The cathode potential decreased with increase in lead content of the solution or temperature, and decrease in the ratio of pyrophosphate to metal. Variation in *p*H had little effect, and some of the addition agents like glue, gelatin and β-naphthol increased the potential (0·1-0·2 V.). The values were increased by the substitution of potassium salt for the sodium salt. The potential changes were, however, not very marked. There was no change in the form of the potential curve when the limiting current density was reached (Figs. 3 and 4).

The effect of the variables on anode potential was not consistent, and the changes in potential values were very small. When the limiting current density for the anode was reached, the potential suddenly jumped to more positive values (broken portion of curve) and the anode efficiency decreased. Finally the potential approached oxygen evolution values and there was total passivity (Figs. 5 and 6).

Corrosion of lead anode was favoured by an increase in lead content, ratio of pyrophosphate to metal, *p*H of the solution and temperature (40-60°C.), and use of the potassium salt. Above 60°C., the anode became passive at very low current densities when the *p*H was 9·8. Glue was the only addition agent which was beneficial in this respect.

Throwing power — In Tables 1 and 2 are given the results on throwing power measurements for the pyrophosphate, fluoborate[8] and sulphamate[8] baths under optimum conditions. The throwing power of the pyrophosphate bath decreased with increase in the current density or decrease in the linear ratio. The reciprocal of the slope of the plot of the metal ratio against linear ratio (termed throwing index[9]) gives a direct measure of the throwing power. Fig. 8 gives this plot for the three baths, and the index values are given in Table 2.

Control and maintenance of bath — The bath was quite stable under the conditions of operation. In a typical case with a solution containing 0·1M lead and a pyrophosphate to metal ratio of 4·5, the cathode and anode efficiencies were 98 and 99 per cent respectively. The changes before and after electrolysis for 1 hr at 2·8 amp./sq. dm. and 60°C. were: lead, 20·3, 21·0; total pyrophosphate (P_2O_7), 78·0, 76·6 g./litre; *p*H, 9·80, 9·75; sp. resistivity, 11·11, 10·06 ohm/cm.³. A freshly prepared solution could be used for several runs with consistent and satisfactory results. Ageing

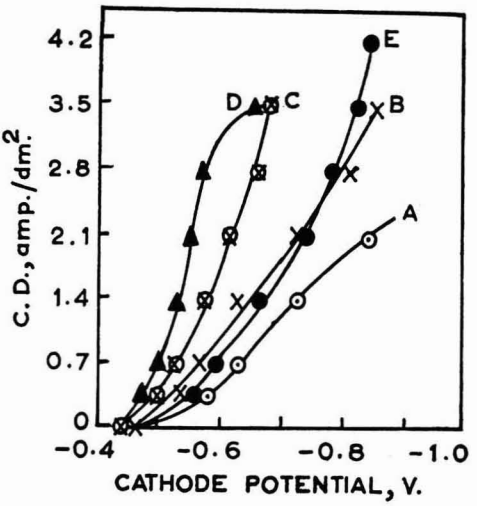

FIG. 3 — EFFECT OF LEAD CONCENTRATION AND GLUE ON CATHODE POTENTIAL [Na salt; temp., 60°C.; ratio of pyrophosphate to metal, 4·5; (A) Pb, 0·025M; (B) Pb, 0·05M; (C) Pb, 0·075M; (D) Pb, 0·1M; (E) Pb, 0·1M+glue, 2 g./litre]

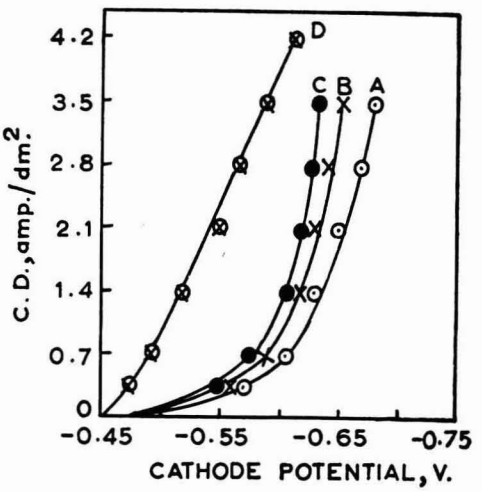

FIG. 4 — EFFECT OF TEMPERATURE ON CATHODE POTENTIAL [Pb, 0·1M; ratio of pyrophosphate to metal, 4·5; (A) K salt; temp., 45°C.; (B) K salt; temp., 60°C.; (C) K salt; temp., 80°C.; (D) Na salt; *p*H, 10·8; temp., 60°C.]

TABLE 1 — THROWING POWER (GARDAM) OF DIFFERENT BATHS

BATH	SP. RESISTIVITY (ρ) *ohm/cm.*³	SLOPE OF CATHODE POTENTIAL-C.D. LINE (*b*)	THROWING NUMBER ($N_1=b/\rho$)	THROWING POWER %
Pyrophosphate	10·31	3·419	0·3316	8
Fluoborate	8·11	2·980	0·3676	8
Sulphamate	2·37	0·723	0·3049	7

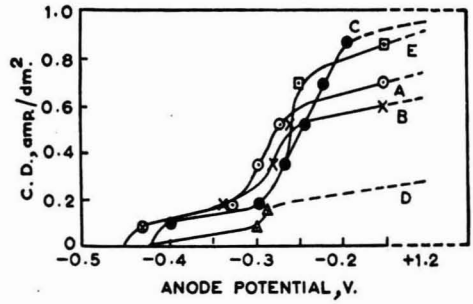

FIG. 5 — EFFECT OF LEAD CONCENTRATION AND RATIO ON ANODE POTENTIAL [Temp., 60°C.; (A) Pb, 0·05M; ratio of pyrophosphate to metal, 4·5; (B) Pb, 0·075M; ratio of pyrophosphate to metal, 4·5; (C) Pb, 0·1M; ratio of pyrophosphate to metal, 4·5; (D) Pb, 0·1M; ratio of pyrophosphate to metal, 4; (E) Pb, 0·1M; ratio of pyrophosphate to metal, 5]

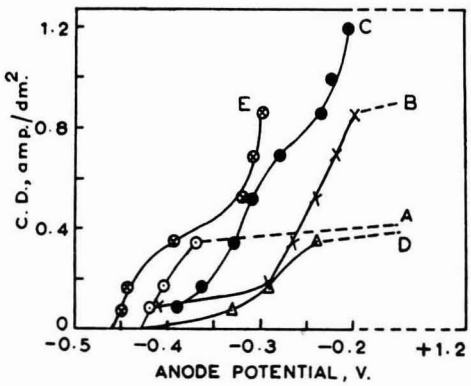

FIG. 6 — EFFECT OF TEMPERATURE AND *p*H ON ANODE POTENTIAL [Pb, 0·1M; ratio of pyrophosphate to metal, 4·5; (A) Na salt; *p*H 8·8; temp., 60°C.; (B) Na salt; *p*H, 9·8; temp., 60°C.; (C) Na salt; *p*H 10·8; temp., 60°C.; (D) Na salt; *p*H, 9·8; temp., 70°C.; (E) K salt; *p*H, 8·9; temp., 60°C.]

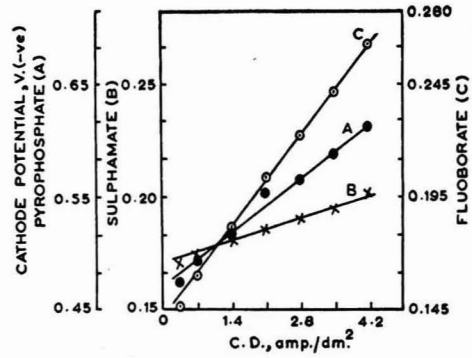

FIG. 7 — CATHODE POTENTIAL-LOG CURRENT DENSITY LINES [(A) Pyrophosphate; Na salt; (B) sulphamate; (C) fluoborate. Experimental conditions as described in Table 3]

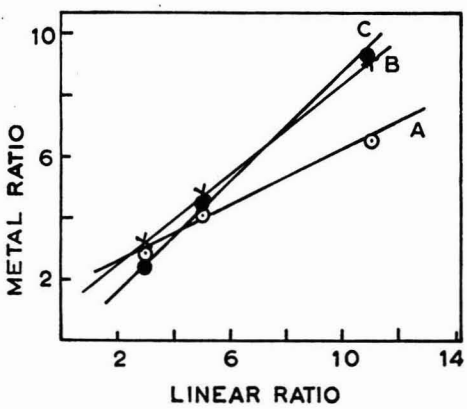

FIG. 8 — THROWING INDEX [L and M values at 2·8 amp./sq. dm. are from Table 2. (A) Pyrophosphate; Na salt; (B) sulphamate; (C) fluoborate]

TABLE 2 — THROWING POWER (FIELD) OF DIFFERENT BATHS

(Distance of the nearer Cathode from the anode in the throwing power cell is 2 cm.[7])

BATH	C.D. amp./ sq. dm.	LINEAR RATIO (*L*)	METAL RATIO (*M*)	THROWING POWER %	THROWING INDEX
Pyrophosphate	0·7	5	3·15	30	2·2
	1·4	5	4·10	13	
	2·8	5	4·08	13	
	4·2	5	3·76	18	
	2·8	11	6·57	46	
	2·8	3	2·87	3	
Fluoborate	0·7	5	4·74	3	1·2
	1·4	5	4·70	4	
	2·8	5	4·67	4	
	4·2	5	4·11	13	
	2·8	11	9·21	10	
	2·8	3	2·53	13	
Sulphamate	0·7	5	5·20	−27	1·4
	1·4	5	4·50	7	
	2·8	5	4·76	3	
	4·2	5	4·56	6	
	2·8	11	9·14	10	
	2·8	3	2·19	19	

of the electrolyte up to six months had no effect on the performance of the bath.

Nature of deposit — The bath gave adherent, light to dark grey deposits of lead on platinum (steel or copper) cathodes over a wide range of plating conditions. The following addition agents were tried: resorcinol, ammonium citrate, β-naphthol, gelatin, glycerol, rochelle salt and glue. Only glue made the deposits finer grained, and others were not beneficial. Photomicrographs of lead deposited from the pyrophosphate and acid baths under optimum conditions are shown in Fig. 9. The effect of glue can be seen from Fig. 9 (A and B). Fig. 9 (B, C and D) shows that the deposits from pyrophosphate bath are finer grained than those from the acid baths. X-ray studies showed that the deposit has a f.c.c. structure with $a = 4{\cdot}959$ A.

Testing of deposits — Satisfactory coatings of any desired thickness from 0·0005 in. and above could be

TABLE 3 — COMPARISON OF PYROPHOSPHATE AND ACID BATHS

Particulars	Pyrophosphate		Fluoborate	Sulphamate
	Sodium salt	Potassium salt		
Composition, g./litre	Lead nitrate 33·2 Lead 20·3 Total P_2O_7 78	Lead nitrate 33·2 Lead 20·3 Total P_2O_7 78 Glue 1	Lead carbonate 150 Lead 120 Hydrofluoric acid 240 Boric acid 106 Glue 0·2	Lead carbonate to give 80 g./litre of lead Sulphamic acid to give a *p*H of 1·7
*p*H	10·8	8·9	1·2	1·7
Temp., °C.	60	60	29	25
Sp. resistivity, ohm/cm.[3]	10·31	5·55	8·11	2·37
Bath voltage, V.	0·1-1·7	0·2-1·7	0·1-0·8	0·1-1·3
Agitation, ft/min.	200	200	nil	nil
Cathode c.d. (max.), amp./sq. dm.	4·2	3·5	4·0	5·6
Anode c.d. (max.), amp./ sq. dm.	1·1	0·9	>1·0	>1·4
Cathode efficiency, %	95-100	95-100	100	100
Anode efficiency, %	95-100	95-100	100	100
Cathode polarization, V., 0·35-4·2 amp./sq. dm.	0·08-0·21	0·10-0·21	0·04-0·15	0·02-0·05
Throwing power, %,				
Field, 2·8 amp./sq. dm.	13	74	4	3
Gardam	8	6	8	7
Hardness (Vickers)	15	16	12	10

obtained. Bending and breaking tests indicated good adherence of the electroplate. The deposits were free from pores as shown by the ferroxyl test (on steel).

Comparison between pyrophosphate and acid baths — In Table 3 are given the plating characteristics, under optimum conditions, for pyrophosphate, fluoborate and sulphamate baths for lead plating. The data recorded for the last two baths have been obtained experimentally for typical compositions[8].

The pyrophosphate bath is comparable to the acid baths in most respects. The advantages of the pyrophosphate bath over the others are: low lead content, greater throwing power and ability to give deposits free from treeing without the use of addition agents.

Discussion

The results of this study show that the pyrophosphate bath is satisfactory for the plating of lead. In previous work on alkaline baths based on plumbite[10-12], a high lead content was used and the limiting cathode current density, which ranged from 1·5 to 3·0 amp./sq. dm., was not very high. All of them employed addition agents. The pyrophosphate bath developed is simpler in composition and can be worked up to 4·2 amp./sq. dm. even at 40°C. The use of the potassium salt has decided advantages over that of the sodium salt.

Addition agents are mainly used in acid lead plating baths in order to suppress treeing and obtain finer grained deposits. They are not brighteners, since there is little necessity for bright lead plating. The addition agents mentioned earlier are all beneficial in acid lead plating baths, but in the pyrophosphate bath only glue effected some improvement, and prevented film formation and yellow colouration on the anode. Most of them decreased the limiting current density considerably.

The cathode polarization was high, ranging from 0·1 to 0·5 V., and of the same order as that for the deposition of other metals from this bath[13]. It was greater than that in acid baths. The relationship between cathode potential and current density was linear under optimum conditions for the pyrophosphate (sodium salt), fluoborate and sulphamate baths (Fig 7), whereas the linear relationship was between cathode potential and log current density for the potassium salt bath (not shown). The last one gives finer grained deposits than the others. This is in accordance with the views of Gardam[14] that the logarithmic relationship is an indication of the frequent formation of new nuclei. The logarithmic relationshipt ogether with fine grained deposits has also been obtained during the plating of tin, zinc, copper and nickel from the pyrophosphate bath[13].

The bath possesses good throwing power. In view of the greater slope of the potential-current density lines, the throwing power of the pyrophosphate bath is greater than that of the acid baths. The throwing index is also higher. The throwing power of the potassium pyrophosphate bath is greater than that of the sodium salt bath due to its lower resistivity.

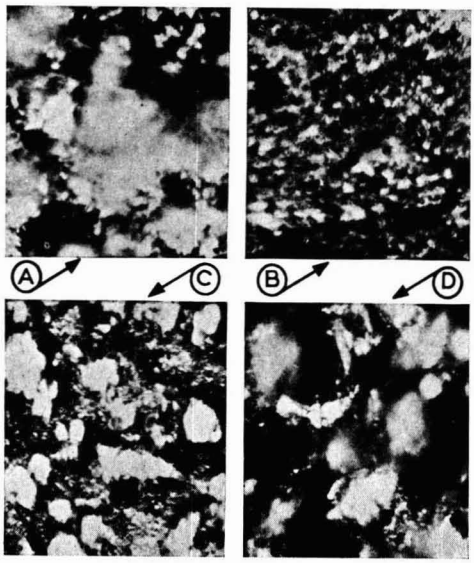

FIG. 9 — PHOTOMICROGRAPHS OF LEAD DEPOSITS × 700 [Cathode copper; c.d., 2·8 amp./sq. dm.; other experimental conditions are the same as those described in Table 3. (A) Pyrophosphate bath; Na salt; (B) pyrophosphate bath; K salt; (C) fluoborate bath; (D) sulphamate bath]

Under optimum conditions (Table 3) and in the current density range 0·7-2·8 amp./sq. dm., the throwing power of the potassium salt bath is 60-88 per cent (Field), and 6-20 per cent (Gardam). The throwing index is 13·3.

The anode potentials of lead in pyrophosphate solutions indicate the phenomenon of passivity (Figs. 5 and 6). As long as the anode is dissolving normally the potential is in the range −0·15 to −0·40 V., which is the active value. In the partially passive state the potentials are of the order of +0·2 V. This region is very narrow, and a small rise in the current density causes a sudden jump in the potential to +1·2 V. and above. Complete passivity now sets in and the anode efficiency is practically zero per cent. The anode is first partially covered with a thin film, and in the last stages of complete passivity, there appears an adherent, non-washable coating. In accordance with the anodic behaviour of lead in sodium hydroxide solutions[15], anode potential together with the bath voltage values can be used to follow the course of corrosion and passivity in pyrophosphate solutions. When the experimental conditions are properly controlled, the efficiency of the anode is very close to 100 per cent in the working current density range. The anode polarization is of the order of 0·05-0·30 V.

The electrodeposition of alloys of lead with tin from this bath has been reported elsewhere[2].

Acknowledgement

My thanks are due to Dr T. L. Rama Char for suggestions and guidance, and to Prof. K. R. Krishnaswami for his keen interest in the work.

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REVIEWS

COATED ABRASIVES: MODERN TOOL OF INDUSTRY by Coated Abrasives Manufacturers' Institute (McGraw-Hill Book Co. Inc., New York), First Edition, 1958. Pp. v + 426. Price $ 8.50

The book represents the combined effort of a team of top technical personnel working in the field and the subject matter has been so detailed and arranged that it will prove useful and interesting as comprehensive guide to operators, supervisors and production engineers, particularly those engaged in the finishing trades. It can also serve as a text-book as well as a reference book to the technical students and will be of special interest to those manufacturers, big and small, who want to cut down their finishing costs by adopting the concepts discussed in the book.

It has been rightly said that coated abrasives are as old as civilization in their use and are as modern as tomorrow as they can do most odd abrading jobs more effectively and cheaply than the usual grinding appliances. The simple looking 'sand paper', the most common and the earliest of the 'coated abrasives', has now been developed into a myriad of products, the use of which has penetrated almost every field of industry; has helped in automation in finishing operations; and has provided the key to more efficient and economic methods of polishing as well as of stock removal. The ease with which coated abrasives can be made to match the various profiles and forms, lends them special importance as tools of economy. The exhaustive applications described in the book with thought provoking discussions of the operating factors will enable any manufacturer to effect a planned changeover from the conservative to modern methods and obtain increased efficiency.

The first two chapters describe the abrasives and various other raw materials used and tests prescribed for maintaining the quality of the finished product. The next three chapters contain the various applications and the machines used for a wide range of operations. Of particular interest are the sketches of basic designs for such applications and the adaptation of the process for automatic polishing. One exclusive chapter is devoted to the details of the contact wheels, pressure pads and plattens giving useful data for their selection and use.

Subsequent chapters enumerate the various trades where the coated abrasives are employed with due consideration of the economics involved. Whether it be wood working, metal polishing, enamelling, shoe repair, glass and plastic polishing, automobile repair, egg polishing, contour polishing, etc., coated abrasives provide a suitable answer. The discussion of the economic considerations in the use of the various forms of the coated abrasives provides interesting material for a production engineer.

The book is distinctive in many ways and provides comprehensive coverage of the many recent advances as well as the principles underlying the conventional usage of the various materials, processes, such as contour polishing, and the use of cutting oils and coolants. It can be recommended as a useful addition to technical libraries, and as a reference book for use in the workshop.

OM PRAKASH

ELECTROANALYTICAL CHEMISTRY by James J. Lingane (Interscience Publishers Inc., New York), Revised & Enlarged Second Edition, 1958. Pp. xiv + 669. Price $ 14.50

Since the first edition of this book appeared in 1953, considerable additions have been made to our knowledge of electroanalytical chemistry. It is appropriate, therefore, that a second edition of this useful book has been published. In this edition, the subject of amperometry and amperometric titration, which is becoming increasingly popular, has been allotted a full chapter. The treatment of coulometric titration has also been expanded into two chapters in keeping with the extensive researches that have been done in the subject in recent years. The electroanalytical technique of chronopotentiometry has been treated comprehensively in a new chapter. A chapter on polarography and one on electrical measurements have been added, which has rendered the book more comprehensive and useful.

The high standard of presentation, characteristic of the publishers, is maintained. As exceptions, one may point out that on page 28, line 9, the reference to the figure is not correctly given. On page 569, line 16, " +2 " should be replaced by " +3 ". On page 71, more potent reasons for adopting *p*H scale could have been stated. On page 82, the discussion with regard to conditions to be satisfied for an electrode being suitable for *p*H determination is not very happy. On page 192, the later work of N. V. Achar [*Proc. Indian Acad. Sci.*, **16** (1942), 332], which appears to have some advantages, could have been referred to. On pages 495 and 607, under coulometric titration of acids, the reference to reduction of water to OH^- does not appear to be correct.

Water is ionized into H^+ and OH^- and H^+ is reduced to H_2. OH^- is just a dissociation product and not one of reduction.

The objective and impartial presentation of the subject is striking as the author has made a detached assessment of all contributions including his own as for instance on pages 280, 470, 480 and 596.

The term ' titrate ' to represent the liquid in the titration flask is a convenient innovation.

A description of Polarization Titration of Franck (1954) for finding out the end-point was desirable as also the pulse-coulometric titration of M. A. V. Devanathan (1956). A section on determination of thickness of electroplates by the method of electrolytic stripping would have been welcome. An author index would have added to the utility of the book.

The book is undoubtedly a very useful addition to the libraries of all colleges and research institutions dealing with electrochemistry.

K. S. G. Doss

NUMBER-AVERAGE MOLECULAR WEIGHTS — FUNDAMENTALS AND DETERMINATION by Robert U. Bonnar, Martin Dimbat & Fred H. Stross (Interscience Publishers Inc., New York), 1958. Pp. x + 310. Price $ 7.50

The book deals with the theory and experimental details of the various methods of determining the number-average molecular weight, $\bar{M}$. The methods in particular are the well-known ones depending on the experimental determination of freezing point depression, boiling point elevation, osmotic pressure, lowering of vapour pressure, vapour density and functional group analysis. A separate section is devoted to each of the methods, wherein have been discussed the underlying theory, the types of apparatus employed and the experimental procedures with relative merits of each, the precautions, the treatment of experimental data to obtain the best estimate and also the interpretation of the experimental results. It is reassuring to come across such a wealth of ingenuity directed towards constructional details and treatment of data even in recent years in the development of some of these almost ' classical ' apparatus into speedier and less laborious instruments without significant loss of accuracy.

Such a book which serves as a via media between laboratory manuals and original research publications on a subject which is of great practical importance in any chemical laboratory, was long overdue. The treatment is comprehensive, balanced and adequate, specially with regard to the first three methods. Particular attention has been paid to the requirement of industrial laboratories where routine determination on a large number of samples are made by operational staff.

The present book would be of immense help to any one interested in the determination of molecular weight and would eventually find a place in the book-shelf of every laboratory having to do anything with experimental determination of molecular weight.

S. R. Palit

THE INDIAN EPHEMERIS AND NAUTICAL ALMANAC FOR THE YEAR 1960 (Manager of Publications, Government of India, New Delhi), 1959. Pp. xxviii + 444. Price Rs 13.00 or 20*s*. 6*d*.

This is the third volume in the series published by the Government of India and has come out commendably early to serve the purpose these volumes are intended for. While some of the criticisms of the earlier volumes are still valid, the new volume has features of greater use to the local almanac makers, though there are still several who refuse to use the data. In the current volume under review, nine new tables have been added, making the almanac more useful for local practices. If the ephemeris continues to come out as early as the current one, in future, there will be no justification for the State Governments adopting a different calendar for fixing the holidays in a year. The reviewer did not come across any serious misprints and the production compares well with the British and American analogues.

S. V. Anantakrishnan

STRUCTURAL DESIGN FOR DYNAMIC LOADS by Charles H. Norris, Robert J. Hansen, Myle J. Holley, Jr, *et al.* (McGraw-Hill Book Co. Inc., New York), 1959. Pp. xviii + 453. Price $ 12.50

A number of factors such as the failure of the Tacoma Narrows Bridge, the occurrence of major earthquakes, developments in the field of atomic weapons, high speed aircraft and guided missiles have stimulated research in the field of structural dynamics in the U.S.A. in recent years. To give the civil engineer a grounding in the principles and applications of structural dynamics, a short-term summer course was organized at the Massachusetts Institute of Technology in 1956. The book under review is an amplification of the lectures delivered at this course.

The first of the four parts into which the book is divided deals with the behaviour of structural materials like concrete and steel under dynamic loads. In the second part, the response of structural systems to dynamic loading is presented. Part 3 discusses the tools of analysis. Methods of numerical integration are explained followed by a short introduction to the use of analogue and digital computers. The introduction of high speed computers is perhaps the

most significant development in the field of structural dynamics in recent years. Analysis of complex structural systems under dynamic loads has now become possible. Parts 1, 2 and 3 serve as an introduction to Part 4 wherein the principles and techniques described in the previous parts are applied to the design of structures for blasts, earthquakes and vibrations under moving loads. Of particular interest to us in India are the chapters devoted to earthquake-resistant design, as an Indian Code of Practice on the subject is on the anvil. Written by a Japanese expert, these chapters emphasize the recent trend in the United States of treating the action of earthquakes on structures as a dynamic problem. Empirical co-efficients are gradually giving place to the approach based on the earthquake spectrum. This is reflected in the provisions of the Joint Committee Code for lateral forces to which the author makes reference. The provisions of the Japanese Code are also discussed. Of special interest is the illustrative example given by the author wherein the different methods of analysis are compared.

The book represents the labours of six different authors and this accounts for a certain lack of continuity in the treatment. Part 2 does not refer to the Lagrange's equations of motion which form the foundations of dynamics. In fact, many of the relations in Part 2 can be derived from these fundamental equations. The value of the chapter on digital computers would have been enhanced if a typical 'programme' for a dynamic problem had been given. In the section devoted to earthquake-resistant design, tall slender structures like refinery vessels and elevated water tanks do not receive adequate treatment. Another significant omission is the effect of earthquakes on water-retaining structures like dams. The authors modestly state that the work is to be regarded neither as a reference nor a text-book. It would, however, serve as an excellent introduction to all those who are working in the field of structural dynamics.

G. S. RAMASWAMY

THE PHYSICAL METALLURGY OF MAGNESIUM AND ITS ALLOYS — International Series of Monographs on Metal Physics & Physical Metallurgy, Vol. 5 — by G. V. Raynor (Pergamon Press Ltd, London), 1959. Pp. ix + 531. Price 75*s*. net

This is an excellent treatise from an internationally renowned physical metallurgist, Prof. G. V. Raynor, and it is said to be partly based on his lectures to final year undergraduates at the University of Birmingham.

In the early chapters, the book deals with the fundamental nature of magnesium, its electronic constitution and the effects of alloying. Next the theories regarding the solid solubility limits, liquidus curves, formation of intermetallic compounds, and variations in lattice spacings are discussed; also the general interrelations between the intermediate phases are discussed in some detail. This is then followed by an outline of the essential deformation characteristics of the single crystals and polycrystalline aggregates. The latter half of the book is mainly devoted to the discussion of the various alloy systems formed with magnesium, especially those of commercial significance.

The book contains 220 illustrations and 50 tables but only 6 photomicrographs. Metallographic details are rather conspicuous by their absence and quite a few topics are more 'metal physics' than 'physical metallurgy'. Nevertheless, the book is an excellent survey of the technological aspects of magnesium metallurgy and is commended to the serious physical metallurgist.

A. A. KRISHNAN

LEHRBUCH DER ORGANISCHEN CHEMIE (A Text-book of Organic Chemistry) by Hans Beyer (S. Hirzel Verlag, Leipzig C1, SchuhmachergäBchen 1-3), 1959. Pp. xvi + 690. Price DM 22.50

This book, written by an East German Professor, has been quite popular. It was first published in 1953 and has already passed through seven editions. As is claimed in the preface, it is quite a modern book and contains a full treatment of recent developments in theory and practice. Not only are the theoretical principles introduced early but they are applied in the interpretation of different reactions all through the book. Practically all the well-known major items in the field of organic chemistry have been included though in many cases the accounts are brief in view of the size of the book. For example, quite satisfactory treatment is given of pterins and enzymes. This book covers very satisfactorily the requirements of the Honours course of Indian universities. Since it is written in German it may not be suitable for the majority of Indian students. But we are informed that an English translation is expected to be ready by 1960. If the translation is rendered properly so that the English is simple, one would expect that it would be a highly satisfactory book for the study of organic chemistry and should be warmly recommended. One suggestion could be made in this connection. In order to help students to study further on their own, references could be given to review articles and books on major topics particularly in English, e.g. acetylenic compounds by Johnson and tropolones by Nozoe.

T.R.S.

MATHEMATICS DICTIONARY, edited by Glenn James & Robert C. James (D. Van Nostrand Co. Inc., New York), Multilingual Second Revised Edition, 1959. Pp. vi + 546. Price 112*s*. 6*d*.

This is an enlargement and revision of the *Mathematics Dictionary* (1949) and underlines the importance of the study of mathematical sciences in all types of scientific and technological disciplines. There has been so much advance in every field of scientific activity that narrow specialization has come into vogue. Thus arises the need for a dictionary which the specialist can readily make use of.

The present edition incorporates a number of corrections. Its special feature is the multilingual index in French, German, Russian and Spanish which will prove to be of great help to all workers.

A wide range of mathematics, both pure and applied, is covered. It includes elementary terms in arithmetic, calculus, differential equations, geometry, topology, set and measure theories, integral equations, matrices and determinants, linear and dynamic programming, computation, statistics, theory of potential, analytical mechanics.

It will be too much to expect that a single book can cover all the mathematical terms. It is no wonder, therefore, that applied mathematics has not received the same attention as that given to pure mathematics. Important omissions include Van der Pol equation, Cornu's spiral, tautochrone, Lan-Emden equation, viscosity, centre of flexure, and non-Newtonian mechanics.

The book can be profitably used by engineers and all those working in any branch of applied science.

B. R. SETH

BORON FLUORIDE AND ITS COMPOUNDS AS CATALYSTS IN ORGANIC CHEMISTRY by A. V. Topchiev, S. V. Zavgorodnii & Ya M. Paushkin. Translated into English by J. T. Greaves (Pergamon Press Ltd, London), 1959. Pp. 326. Price 80*s*.

Boron fluoride (more usually known as boron trifluoride) is a versatile catalyst, used both in the laboratory and in technical practice, for condensations and polymerizations. A simple illustration of its catalytic activity is the preparation of acetylacetone from acetone and acetic anhydride. Other common laboratory uses are in alkylations (of aromatic hydrocarbons, phenols, acetoacetic ester, etc.) and in the preparation of phenolic ketones by the Nencki reaction. As a strong Lewis acid or electron acceptor it readily forms co-ordination compounds with molecules containing electron-donor atoms such as oxygen, nitrogen and sulphur; and boron fluoride etherate, for instance, is a convenient form in which the catalyst can be used for esterification and other reactions. In the petroleum processing and other industries boron fluoride is a valuable catalyst or initiator for cationic polymerization, alkylation and isomerization. Notwithstanding its greater cost it has advantages over aluminium chloride and sulphuric acid. Although there are innumerable papers and patents on the uses of boron fluoride, only one book (Booth and Martin, *Boron Trifluoride and Its Derivatives*, 1949) preceded the present volume, which gives a clear and comprehensive account of this important subject in the relatively short space of 326 pages. Academician Topchiev of the Institute of Petroleum, U.S.S.R. Academy of Sciences, has made notable contributions to the chemistry and utilization of boron fluoride, among them being the molecular compounds of boron fluoride and phosphoric acid. Topchiev and his collaborators, therefore, write with authority.

The twelve chapters of the book cover the preparation of boron fluoride, the physical and chemical properties of boron fluoride and its derivatives, co-ordination compounds, compounds with hydrogen, alkylations, polymerizations, addition of oxygen and sulphur-containing compounds to ethylenic compounds, dienes and acetylene derivatives, isomerizations, cyclizations, nitration and sulphonation, condensations and miscellaneous reactions. In addition to hundreds of references in each chapter, there is a long supplementary list of references to work which became more recently available to the Russian authors. The work of Butlerov, Nesmeyanov and other Russians naturally receives special attention, but no work of any significance outside Russia has been neglected. A serious defect is the absence of a subject index.

K.V.

MACHINE DESIGN by R. C. Patel & A. D. Pandya (Acharya Book Depot, Baroda), Second Edition, 1958. Pp. xiv + 424. Price Rs 12.50

The first edition of this book published in January 1958 was smaller in size and content than the present edition, and contained many printing errors and omissions. In the second edition many of these have been rectified, and its publication six months after the first edition is an indication of its popularity. The book incorporates some advanced problems on bending moment, eccentric loading and steam engine, and machine parts like pulleys, gears, etc. It is primarily meant for students preparing for the degree or diploma examinations and contains selected, solved and unsolved problems. Fundamental

principles of machine design are not dealt with, so also the derivation of various formulae and basic equations. This has been done because the authors feel that the students are expected to be well acquainted with the subject of applied mechanics by the time they take to the study of machine design. This is a handicap both for the student and the teacher, and it may be useful if some space is devoted to the fundamentals of applied mechanics in the next edition.

Whatever may be the drawbacks and defects of the book, the authors deserve to be congratulated in their praiseworthy attempt to bring out a book on such a vast and varied subject as machine design.

S.P.L.

THE THEORY AND DESIGN OF MAGNETIC AMPLIFIERS — Automation & Control Engineering Series — by E. H. Frost-Smith (Chapman & Hall Ltd, London), 1959. Pp. xix + 487. Price 75*s*. net

The volume, the first of a series on automation and control engineering, is intended for engineers designing or using magnetic amplifiers as well as for university students. The author builds comprehensively all aspects of the subject from basic principles to details of design. His discussions reveal real appreciation of practical problems.

A lucid account of the basic operation of transductors is followed by an exhaustive analysis of the steady state and transient operation of the idealized transductor both under self-excitation and auto-excitation. The frequency response characteristics of transductors are discussed in detail. This is followed by a clear account of high speed transductors and magnetic amplifiers as well as balanced amplifier circuits. Amplification at low levels and magnetic modulation are also covered. The basic principles developed are then applied to the practical design of magnetic amplifiers. The author's rich experience as a control engineer has enabled him to outline several practical applications of magnetic amplifiers.

The contents of the book, strictly within the confines of its title, can hardly be criticized. But considering amplifying devices in general, it is unfortunate that the book gives little help to the reader to rate the position of magnetic amplifiers in the range of such devices. A comparative study of the different types of amplifying devices and an elucidation of the conditions under which magnetic amplifiers would be more suitable than other amplifying devices for specific problems would have been valuable both from the point of the university student as well as the control engineer.

The book, scholarly in presentation and masterly in practical details, is perhaps the most complete work on the subject so far available.

C. BALAKRISHNAN

MODELMAKING FOR INDUSTRIAL DESIGN by Ralph R. Knoblaugh (McGraw-Hill Book Co. Inc., New York), 1958. Pp. xi + 276. Price $ 9.75

Modelmaking today has come to occupy an important place in science and industry, and a modelmaking department has become a vital unit of most industrial establishments. In all branches of engineering, particularly architecture and town planning, study of modelmaking is given particular attention. Books on this subject are few, and a practical treatise like this should be welcomed by all those engaged in the art of modelmaking.

In this essentially practical manual, the treatment is confined to such models as are commonly made in the workshop of an average industrial designer. Modelmaking in plaster of Paris has received more detailed treatment, as information on this subject is rather meagre; some of the plaster-working processes have been described for the first time in English. In addition, modelmaking in wood, plastics and metal, with simple hand tools and small power tools, is described.

Four kinds of models employed during the development of an industrial product are dealt with. They are: (1) study models; (2) presentation models; (3) mock-ups; and (4) prototypes. The processes involved in the making of these models are described and each step is explained with the help of excellent drawings and photographs of actual works in progress. Valuable hints are provided for the selection of materials and processes to be employed for a particular job. Practical tips are given on processing, assembling, and painting of the various components of the model and its finishing. How to judge whether a model is good or bad is discussed.

Both the hobbyman and the professional model maker will find this well-produced and illustrated book instructive, and of help in improving their model making techniques and expressing industrial design ideas more readily in three dimensions.

M. A. REGE & T. S. RAGHURAM

PLASTIC ANALYSIS OF STRUCTURES — McGraw-Hill Series in Engineering Sciences — by P. G. Hodge, Jr (McGraw-Hill Book Co. Inc., New York, Toronto, London), 1959. Pp. xiv + 364. Price $ 10.50

This book is primarily a text-book presenting systematically the available techniques used in plastic analysis of structures. The structures dealt with are

beams, frames, plates, shells and plates with cut-outs. Their load carrying capacity is determined by means of the two well-established basic theorems relating to the upper-bound and lower-bound values which can be calculated from considerations of kinematics and statics respectively of the given structure. In complex structures, in addition, the assumption that the material yields by Tresca's or Mise's yield condition is also made.

In two parts the book deals with (1) simple structures like beams and frames which fail principally in bending and (2) structures under combined stresses, i.e. beams under combined stresses, plates, shells, plates with cut-outs, etc. Worked out problems are included to illustrate the application of the principles to the various types of structures.

The theorems relating to plastic analysis are given and proof for each of the theorems is given at the end of the respective chapters. Problems for solution and selected bibliography for further reading are also included.

The treatment of the book is mathematical and it will appeal more to theoretical investigators and research workers interested in plastic design. The theories dealt with are applicable to structures of ductile materials (because of the assumed law of failure). On the other hand, there are a number of structures of other materials (like reinforced concrete) which have limited capacity for deformation. They do show limited plastic yielding and plastic redistribution. These cannot be analysed by the methods of analysis presented in this book and they have to be modified to suit the particular material. Also, the subject treated is limited in scope as problems in plastic buckling, creep, flaw, etc., associated with plastic failure, are left out; this is unavoidable in a text-book of limited size.

The book will serve not only as a good text-book for undergraduate and postgraduate study on plastic design of structures, but also as a good introduction to those who want to make a special study of plastic analysis of structures. The author deserves credit in presenting most of the existing basic information on the subject, which was otherwise available only from published papers, in a handy volume.

P. C. VARGHESE

NUCLEAR REACTOR PHYSICS by Raymond L. Murray (Macmillan & Co. Ltd, London), 1959. Pp. xi + 317. Price 30s. net

In the past few years, rapid progress has been made in the field of reactor physics and several books have been written on the subject. The book under review, based on a series of undergraduate and graduate courses given by the author, is intended to serve as an introduction to the physical concepts and calculation methods employed in reactor design.

This book starts with an introduction to the general concepts of a nuclear chain reactor and different design problems. Next, the problems of space-energy distribution of neutron flux in a moderator and multiplying medium are discussed. More rigorous derivations, employing the transport theory, are also described. Reactor constants and methods for calculating the critical conditions of a reactor are dealt with in a direct manner. The transient behaviour, temperature effects and the control of a reactor as source of heat are described in considerable detail. Special problems of slowing down of neutrons in hydrogenous materials and spherical harmonics method are also described.

The treatment of different problems is straightforward and clear-cut. This is further aided by several detailed examples and numerical illustrations of practical applications. Several problems are given at the end of each chapter together with references.

This book is specially useful to design engineers and physics students interested in reactor technology.

V. P. DUGGAL

NOMOGRAPHY by L. Ivan Epstein (Interscience Publishers Inc., New York, London), 1958. Pp. x + 134. Price $ 4.50

Rapidity in calculation, saving of time in ' trial and error ' computations and quick results even by those not familiar with the slide-rule and logarithms have made the technique of ' nomography ' almost indispensable in research, design and plant control. Many of the excellent text-books available on the subject discuss the methods of construction of nomographs which represent various types of formulae usually encountered in scientific and technological fields. While practical and automatic construction of the charts is all that is required in actual practice, the scientist and the engineer should also understand the theoretical basis. Written to serve this purpose, the present volume combines a " discussion of methods of construction with a thorough presentation of the underlying theory ". The first chapter on determinants forms the basis of the next one where the construction of nomograms representing a few simple equations, using deductive and semi-deductive methods, is clearly explained. Further chapters deal with applications of ' projective transformations ', ' matrix multiplication ' and ' non-projective transformations in nomography '. Separate chapters have been devoted to ' empirical nomography ' and treatment of equations involving more than three variables. ' Kellogg's methods ' of ascertaining whether a given equation can be nomographed are discussed in

sufficient detail. Problems have been set mainly to make the reader work out simpler proofs required for the theoretical discussion and there are also a few practice problems. The book is complete in itself, containing concise treatment of the required topics in mathematics sufficient to acquire the necessary knowledge for following the subject matter. The book should prove equally useful to the student, research worker and plant executive.

B. NARAYANA DAS

PUBLICATIONS RECEIVED

QUANTITATIVE METHODS IN HUMAN PHARMACOLOGY AND THERAPEUTICS — Proceedings of a Symposium (held in London on 24 and 25 March 1958) sponsored by the Biological Council's Co-ordinating Committee for Symposia on Drug Action Series, Vol. 3, edited by D. R. Laurence (Pergamon Press Ltd, London), 1959. Pp. xvii + 253. Price 45*s*. net

THE SCIENCE OF BIOLOGY by Paul B. Weisz (McGraw-Hill Book Co. Inc., New York), 1959. Pp. xvi + 796. Price $ 7.95

ADVERTISING LAYOUT AND ART DIRECTION — McGraw-Hill Series in Marketing and Advertising — written and designed by Stephen Baker (McGraw-Hill Book Co. Inc., New York), 1959. Pp. x + 326. Price $ 13.50

SOIL MECHANICS FOR RAILWAY ENGINEERS by U. G. K. Rao (Railway Testing & Research Centre, Lucknow), 1958. Pp. xiv + 206. Price Rs 7.50

THE WEALTH OF INDIA: RAW MATERIALS — Vol. V (H-K) (Council of Scientific & Industrial Research, New Delhi), 1959. Pp. xxviii + 332 + xii. Price Rs 30.00

FLUIDIZATION — McGraw-Hill Series in Chemical Engineering — by Max Leva (McGraw-Hill Book Co. Inc., New York), 1959. Pp. xiii + 327. Price $ 11.50

THE CHEMISTRY AND TECHNOLOGY OF CEREALS AS FOOD AND FEED, edited by Samuel A. Matz (AVI Publishing Co. Inc., Westport, Connecticut), 1959. Pp. xv + 732

TRANSACTIONS OF THE AMERICAN SOCIETY FOR METALS: Vol. LI, edited by Ray T. Bayless (American Society for Metals, Cleveland, Ohio), 1959. Pp. xx + 1136

COMPREHENSIVE ANALYTICAL CHEMISTRY: Vol. IA — CLASSICAL ANALYSIS, edited by Cecil L. Wilson & David W. Wilson (Elsevier Publishing Co., London; *Distributors*: D. Van Nostrand Co. Ltd, London), 1959. Pp. xix + 577. Price 105*s*.

RADIATION PROTECTION — Recommendations of the International Commission on Radiological Protection (Pergamon Press Ltd, London), 1959. Pp. v + 18. Price 3*s*. 6*d*.

SOVIET REVIEWS OF NUCLEAR SCIENCE (on the 40th Anniversary of the October Revolution)— International Series of Monographs on Nuclear Energy (Vol. 3, No. 11 of *Atomnaya Energiya*, Nov. 1957)—edited by R. A. Charpie & J. V. Dunworth (Pergamon Press Ltd, London), 1959. Pp. 108. Price 30*s*. net

A PRACTICAL MANUAL ON THE MONTE CARLO METHOD FOR RANDOM WALK PROBLEMS by E. D. Cashwell & C. J. Everett (Pergamon Press Ltd, London), 1959. Pp. ix + 153. Price 40*s*. net

NATURAL RESOURCES — University of California Engineering Extension Series — edited by Martin R. Huberty & Warren L. Flock (McGraw-Hill Book Co. Inc., New York), 1959. Pp. xviii + 556. Price $ 11.00

CLOSE BINARY SYSTEMS — The International Astrophysics Series — Vol. V, by Zdeněk Kopal (Chapman & Hall Ltd, London; *Distributors in India*: Asia Publishing House, Bombay), 1959. Pp. xiv + 558. Price 105*s*. net

MODERN TRENDS IN DOCUMENTATION — Proceedings of a Symposium held at the University of Southern California, April 1958 — edited by Martha Boaz (Pergamon Press Ltd, London), 1959. Pp. viii + 103. Price 35*s*. net

NOTES & NEWS

Plasma engine

THE FEASIBILITY OF A PLASMA engine, which could harness the power of a brief shock wave generated by an electric current discharged through air in a cylinder, has been demonstrated in a laboratory model. This achievement holds good prospects for the use of such engines, with further improvements, in future space ships.

By using curved electrodes in the cylinder and by attaching a nozzle to its bottom end, the shock wave has been directed to produce useful thrust; the shock wave produced could blow away a little disc into the air with a force of 4000 lb. It has been calculated that a 27,300 lb. space vehicle including a 5000 lb. instrumented pay-load could make a one-way trip to Mars in just over 8 months. The engine would give rapid bursts of low-level power over a long period and could develop 9000 lb. of thrust per pulse. But operating at a pulse rate of 500 pulses/sec., each pulse lasting only 0·39 sec., an average thrust of 1·8 lb. would be developed. Though small, this thrust is adequate as the engine is specifically designed to work outside the earth's gravity.

The potentialities of the plasma engine can be gauged by comparing an interesting statistic of this type of engine with those of other conventional ones. This statistic is the ' specific impulse ', which is the rocket engineer's equivalent of ' miles-per-gallon ', and is 1700 sec. for the plasma engine. This means that 1 lb. of thrust is delivered for each pound of fuel over an operating period of 1700 sec. The specific impulse of the V-2 rocket was 200 sec. and chemical rockets with specific impulses of 400 sec. are theoretically possible. The design of plasma engines with specific impulses of 5000 sec. is now considered practicable [*Sci. Newslett. Wash.*, **76** (1959), 21].

New method for studying shock waves in metals

AN ACCURATE AND EASY METHOD OF measuring and recording transient elastic waves created in metals by impacts and explosions is reported. The new method gives research engineers a means of studying the patterns of shock waves and their speed of transmission in solid materials in order to establish design criteria to minimize the effects of explosive shock on finished (military) equipment.

In operation, an explosion set off at one end of a metal bar to which a strain gauge has been attached, sends a shock wave down the bar at an extremely high speed. The strain gauge picks up a reading from the shock wave and transmits a signal to a set of amplifiers, which in turn, display a reading on the calibrated face of an oscilloscope in the form of a pip of light. A polaroid camera with shutter opened is prefocussed on the face of the oscilloscope and records the pip in the form of a line as it passes. The curve of the pip of light indicates the speed of propagation of the shock wave, maximum strain, shape and changes of the wave, and duration of strains. The oscilloscope is set for a 4-μsec. sweep to reproduce a detailed display of the signal picked up by the strain gauge [*J. Franklin Inst.*, **267** (1959), 548].

Amplification of magnetic resonance signals

A METHOD FOR INCREASING THE strength of nuclear, magnetic resonance (NMR) signals by factors up to 100 or even more is described. The values of the quality factor (Q) of a circuit attained in practice have rarely exceeded 250 (a common value being 100) due to losses in the circuit arising from a number of causes like skin effect, dielectric losses in the coil form and the presence of a metallic shield round the coil. In this method the quality factor of a coil containing the sample is increased by the use of an active network to supply energy to the tuned circuit to compensate the losses, by introducing a shunt negative resistance in parallel with coil.

Using this principle, experiments on proton resonance in a sample of water, treated with ferric nitrate solution, have been conducted with the amplitude bridge of Thomas and Hunton. A Q-multiplier, which employs a single tube acting as a cathode follower in the feedback path and consequently has a high inherent stability, has been used. A slight modification made in the Q-multiplier involved the application of feedback to the junction between two fixed capacitors connected in series across the main tuning condenser instead of splitting the latter. A variable resistance served to maintain a given voltage across the coil for different effective values of Q. The attainable Q-multiplication was limited because the shunt resistance of the tuned circuit was smaller than the minimum shunt negative resistance that could be generated by this simple Q-multiplier. However, it is ideal for work in low field NMR spectroscopy. The circuit should be fed from a constant current source even at high values of the Q-multiplication factor for maximum benefit. At frequencies of the order of a few Mc/s. it is desirable to use an amplifier with a stabilized gain of *c.* 10. At 7·35 Mc/s. a maximum increase in signal strength by a factor of about five has been observed. Incidentally, the circuit offers two advantages: firstly, the amplifier noise at the output will be slightly less due to the lower amplification now required, and secondly, there may be a slight improvement for an oscillographic display due to the increased selectivity of the circuit [*Proc. Indian Acad. Sci.*, **50A** (1959), 63].

Recovery of uranium

A NON-AQUEOUS METHOD FOR THE recovery of uranium from zirconium tin alloy (Zircaloy) in nuclear fuel elements is being tested at the Brookhaven National Laboratory of the Atomic Energy Commission, U.S.A. The process has two advantages over the currently used aqueous hydrogen fluoride technique: it uses less and smaller equipment and produces smaller volumes of radioactive wastes.

In actual practice, spent Zircaloy fuel elements are first dissolved in a mixture of 15 mole per cent nitrogen dioxide and 85 mole per cent hydrogen fluoride. The nitro-

gen dioxide is used to dissolve Zr-Sn and to prevent uranium from forming a stable complex salt.

The solution containing Zircaloy is then filtered to remove fission products and most of the zirconium in the form of a mixture of $(H_2NO_3)_2ZrF_6$ and $(NO_2)_2ZrF_6$. The solvent is then filtered, thus leaving soluble uranium and the soluble zirconium salts. Bromine trifluoride is added to the solution, when uranium is converted to uranium hexafluoride. Repeated evaporation separates uranium hexafluoride and the bromine trifluoride from the remaining zirconium and non-volatile fission product fluorides. Finally, uranium hexafluoride is separated from bromine trifluoride and the volatile fission products by fractional distillation [*Chem. Engng News*, **37** (20) (1959), 56].

A new paper chromatography and electrophoresis technique

A SIMPLE APPARATUS EMPLOYING centrifugal force has been developed for use in the separation techniques of paper chromatography and electrophoresis; the technique can be used for one or two-dimensional separations on circular paper sheets rotating in a horizontal plane.

The developed chromatograms closely resemble those of the classical radial pattern. The sheets are fixed at the centre and are held in a taut position by rotation at 300-1000 r.p.m. The developing solvents are fed to the paper in a continuous stream at a point slightly away from the centre of the rotation. The sample solution is applied in the form of spots on a ring marked round the centre of rotation or alternatively it can be introduced as segments or whole rings. The use of centrifugal force speeds up chromatographic separations quite markedly.

For electrophoresis, a suitable chamber is obtained by clamping together a bakelite (lower) and perspex (upper) tray. Platinum strip electrodes are clamped along the full length of the two long edges of the paper strip. When the paper is correctly positioned it makes contact with neither the upper nor lower plates. The short ends of the paper are serrated and the nine teeth at either end dip into compartmented troughs which are positioned in such a way that they swing out into the plane of the paper when the unit rotates. The sample is applied at two points symmetrically distributed about the centre of rotation along the central longitudinal axis of the paper. As the sheet rotates more liquid is introduced at a point near the centre of rotation to prevent drying out of the paper.

In this way the developing solution is applied as a ring and moves out uniformly under the influence of capillary and centrifugal motion as a circular front till it reaches the platinum strip electrodes. It then streams along the edges of the electrodes till it passes into the four corner collecting compartments of the two troughs. This ensures continuous removal of electrolysis products from the electrodes.

The patterns obtained by this method are such that the one developed on one half of the paper is the mirror image of that on the other half. Consequently an authentic sample of a substance can be applied on one side and a mixture for analysis on the other. When the separation has proceeded to the necessary extent, the sheet can be folded in half and the presence or absence of the given substance can be determined by observing congruence of the 'known' and 'unknown' zones [*Chem. Age*, **81** (1959), 937].

Boron measurement in liquid streams

AN INSTRUMENT FOR MEASURING boron in liquid streams continuously to meet large-scale production control needs is described. It is based on the large capacity of boron for neutron absorption.

Slow neutrons (0·035 electron volts) from a radium-beryllium source are allowed to pass through a concentrically arranged stainless steel sample cell and into a proportional tube filled with boron trifluoride gas containing 96 per cent of the isotope B^{10}, which captures the neutrons. Each captured neutron causes a pulse on a wire (carrying about 2000 volts) in the proportional tube. The pulses are amplified and counted. A time-measuring device tied to the counter gives a rate measurement of the pulses. The rate of pulse generation is inversely proportional to boron concentration in the stream.

A pneumatic integrator, adjustable for the range of boron content in the plant streams, is used for measurement. Components of the instrument can be located almost as desired. No thermosetting is needed, since a change in ambient temperature from 70° to 120°F. has no noticeable effect on the reading [*Chem. Engng News*, **37** (23) (1959), 52].

Direct mass-flow meter

A TRUE MASS-FLOW METER — ONE that measures fluid flow directly in pounds — has been developed by the General Electric Co. Since its operation does not depend on volume it can bypass such variables as pressure, temperature and density. The meter, made up of three major components — flow rate sensor, gyroscopic integrator, and six-digit cyclometer register — can be used with many industrial fluids, such as naphtha, gasoline and other hydrocarbon liquids, refinery and natural gas, oxygen, nitrogen, and liquefied hydrocarbon gases, such as butane and propane. The device may also prove useful for light gases such as hydrogen and helium, as well as high temperature, corrosive, and cryogenic fluids.

The unit does not depend on a regulated power supply; it will measure flow rates of gases up to 40,000 lb. per hour and liquids up to 240,000 lb. per hour. The meter operates at pressures up to 1500 p.s.i.g., and at ambient temperatures from −20° to 125°F., and fluid temperatures from 0° to 165°F. It is explosion-proof [*Chem. Engng News*, **37** (21) (1959), 88].

Screening of anti-ozonants

AN EFFECTIVE TEST WHICH screens organic compounds to determine their potential as anti-ozonants in rubber has been reported. A model olefin, cyclohexene, is dissolved in an inert solvent, carbon tetrachloride; a small amount of the compound to be tested is also dissolved in the solvent. The solution is cooled to 0°C. and a stream of air containing ozone (2 per cent by volume) is passed through the solution.

The effluent is then scrubbed with potassium iodide, dried and

analysed for oxygen with a Beckman oxygen analyser. This oxygen content is recorded at 10 min. intervals for about 40 min., plotted and extrapolated to zero time. The extent to which the inhibitor is able to suppress the three-atom reaction is expressed in per cent by volume of oxygen. This value is then compared with that of a reference standard, *N*, *N'*-dioctyl-*p*-phenylenediamine, which is arbitrarily set at 100 [*Chem. Engng News*, **37** (23) (1959), 38].

Microbiological oxidation of steroids

A NEW METHOD FOR THE MICRObiological oxidation of steroids has been developed at the Research Institute of the Pharmaceutical Industry, Budapest. The method is simpler and gives a purer product than the conventional fermentation process and can be used for all microbiological conversions where the organism performing the transformation can be grown in pellet form and the polarity of the substrate molecule to be converted is not such as to make it soluble in the aqueous fermentation broth. The method gives a product which can be continuously extracted from the system and is thus not subjected to further oxidation; the product can be easily separated from the mycelial tissues and no loss occurs since the small quantity of untransformed steroid can be totally recovered.

R. nigricans is grown as a voluminous mucous mass and the inoculum (400 ml.) consisting of 10^5 spores/litre in the pellet form are placed in a chromatographic column of 4 cm. diameter fitted with a sintered glass plate. The fluid rises through the lower four-way joint into the glass tube placed alongside the column. Air is blown through a capillary and thus the broth is continuously forced from the tube into the column and saturated with air at the same time. To the fluid thus kept in constant circulation, 160 mg. of progesterone dissolved in 4 ml. of acetone are added. The speed of circulation of the broth was 250 ml./min. After the addition of progesterone, the fermentation broth (250 ml.) is drained off at different intervals and the same quantity of fresh broth added. The broth samples are shaken with twice their volume of dichloroethane, the mycelium globules retained in the column are extracted twice with 10 ml. of acetone and three times with dichloroethane, using in all 100 ml. of the solvent. The extracts are washed with a 2 per cent solution of sodium bicarbonate, then with water, dried with sodium sulphate and, finally, examined by paper chromatography. The conversion yield of progesterone was 86 per cent [*Nature, Lond.*, **183** (1959), 1279].

Synthetic penicillins

A NEW CHEAPER AND SHORTER route to biologically active synthetic penicillins, starting from commercially available penicillin G, has been worked out. The new series of penicillins can act on organisms which are resistant to the natural penicillins.

The first step in the new synthesis is the removal of phenylacetic acid side chain from penicillin G, which is done by treating the potassium salt of penicillin G with methanol containing triethylamine as catalyst. The resulting potassium α-methyl-D-α-benzyl penicilloate is then directly converted with methanolic hydrogen chloride to methyl-D-α-4-carbmethoxy-5, 5-dimethyl-α-amino-2-thiozolidine-acetate hydrochloride. This is the starting compound upon which the whole new synthetic series is based. The new intermediate also completes a transition between a natural penicillin and a biologically active synthetic penicillin series which is not directly available by fermentation [*Chem. Engng News*, **37** (24) (1959), 43].

Isolation of anti-protein bodies

A CONVENIENT, REPRODUCIBLE AND gentle method for the isolation of antibodies (Ab) directed against protein antigens (Ag) is reported. The method has been used successfully to isolate pure rabbit Ab to hen ovalbumin (OA), bovine serum albumin (BSA), and bovine ribonuclease (RNase).

A protein Ag is treated with N-acetyl D, L-homocysteine thiolactone (AHT), which places a number of SH groups on its surface without seriously affecting its capacity to precipitate with Ab directed to the original protein. A specific precipitate is then prepared with the thiolated protein (T-Ag) and the Ab. After the precipitate is freed from non-specific proteins, it is dissolved in a glycine sulphate buffer at *p*H 2·4, in which the Ag-Ab bonds are largely dissociated and the appropriate amount of the bifunctional organic mercurial 3,6-bis-(acetoxymercurimethyl)-dioxane (MMD) is added. The T-Ag is cross-linked by –S–Hg– bonds and precipitates, leaving much of the Ab in solution [*J. Amer. chem. Soc.*, **81** (1959), 2277].

Enzymatic synthesis of carbon-chlorine bond

THE FIRST ENZYMATIC SYNTHESIS of carbon-chlorine bond catalysed by an enzyme (or enzyme system) has been reported. The enzyme used is obtained from *Caldariomyces fumago* which excretes caldariomycin as the major chlorine-containing metabolite. Acetone-dried mycelial powders of this would catalyse the conversion of chloride ion into an ether-extractable organic form when supplemented with β-ketoadipic acid; a small amount (5 mg.) of the radioactive enzymatically synthesized compound has been isolated. The behaviour of this unknown compound on a Dowex-1 column (formate phase) and labile action towards 1*N* NaOH indicate it to be a weaker acid than β-ketoadipic acid and it was concluded that the chlorine atom is situated on a carbon alpha to the ketone. Assuming a β-decarboxylation, these considerations limit the possible constitution of enzymatically synthesized acid to either δ-chlorolevulinic acid or β-chlorolevulinic acid. The enzymatically synthesized acid has been found to be identical with β-chlorolevulinic acid [*J. Amer. chem. Soc.*, **81** (1959), 1011].

Duplication of virus in animal cells

A MAJOR STEP TOWARDS THE understanding of viruses comes from a recent discovery that an animal cell can manufacture a complete virus from the naked nucleic acid of a virus inserted into it. This clearly establishes that the animal cell has the machinery

within it to duplicate a virus. Apparently there is a specific attachment between the surface of a cell and the protein coat of a virus that determines whether the virus attacks the cell or not. A cell resistant to polio virus, for example, does not have the kind of protein on its surface that will combine with the polio virus protein.

In an experimental study, protein coat from polio virus was removed by chemical treatment and the nucleic acid released was then introduced into naturally resistant cells. The cells produced polio virus from the nucleic acid that was identical with the original polio virus. It has been found that susceptible human and monkey cells could be infected by the new polio virus but resistant cells from rabbits, mice, hamsters, chickens and guinea-pigs are immune. These studies shed some light on the possible mode of evolution of viruses; they may also lead to the development of new kinds of viruses and vaccines [*Sci. Newslett. Wash.*, **75** (1959), 275].

Single-strand DNA

THE ISOLATION OF A SINGLE-stranded deoxyribonucleic acid (DNA) is expected to lead to a better understanding of the behaviour and properties of many nucleic acids including how ribonucleic acid replicates.

While searching for a low molecular weight DNA with which to study biological activity as a function of chemical structure of DNA molecule, it has been observed that ϕXDNA, isolated from the virus X174, does not act the same way as DNA. Its radius of gyration is smaller than predicted for two-stranded DNA of the same molecular weight. Also its radius of gyration is a function of ionic strength of the solution, in contrast to two-stranded DNA. The ultraviolet absorption of ϕXDNA is temperature dependent between 20° and 60°C., a phenomenon which is not observed in two-stranded DNA. Its average molecular weight decreases upon enzyme degradation according to a function expected for a single-stranded molecule different from a function for a two-stranded molecule. It reacts with formaldehyde at 37°C. and is precipitated by Pb^{++} ions. This shows that the purine and pyrimidine rings are not tied up in a hydrogen-bonded complementary structure but are available for reaction. It does not have a complementary nucleotide composition. Adenine and thymine contents and guanine and cytosine contents are not equal. The simplest explanation for all these observations is that ϕXDNA is a single-stranded molecule [*Chem. Engng News*, **37** (22) (1959), 40].

Cholesterol-lowering activity of wheat gluten lipid

THE SUBSTITUTION OF WHEAT gluten for casein as the dietary protein has been reported to cause a marked reduction in the serum cholesterol concentration of rats fed a hypercholesteremic diet. It has been recently observed that the cholesterol-lowering activity of wheat gluten is associated with lipid material which is resistant to extraction with an ether-petroleum ether-acetone mixture. A major portion of the lipid material could be removed by continuous extraction with hot absolute ethyl alcohol for several days. Also, continuous extraction with hot *n*-butyl alcohol for 24 hr led to recovery of 80-90 per cent of this lipid material. The lipid has been separated into two fractions, one fraction soluble in acetone which comprises 90 per cent of the total lipids and another fraction insoluble in acetone, which forms approximately 10 per cent of the total lipids. Both these fractions possess cholesterol-lowering activity. Wheat gluten extracted in this manner not only lost its cholesterol-lowering activity, but actually enhanced hypercholesteremia when it was substituted for casein in the hypercholesteremic diet [*Federation Proceedings, U.S.A.*, **18** (1959), 539].

Symposium on Inhaled Particles and Vapours

AN INTERNATIONAL SYMPOSIUM ON Inhaled Particles and Vapours, organized by the British Occupational Hygiene Society, will be held in Oxford, London, from 29 March to 1 April 1960. The symposium, besides concerning itself with the physical, chemical and physiological factors governing the entry of harmful substances into the body via the respiratory system, will cover the following subjects: (1) Anatomy and physiology of the respiratory tract; (2) Distribution and retention of particles and vapours in the respiratory tract; (3) Elimination of material from the respiratory tract; (4) Reactions with the respiratory tract arising from the presence of particles and vapours; and (5) Sampling techniques simulating respiratory retention. The symposium will have bearing on many problems of industrial hygiene including silicosis, asbestosis and the other pneumoconioses, and on the damage to health produced by smog, tobacco smoke, radioactive gases and dusts, air-borne bacteria and toxic vapours.

Further details can be had from Dr J. S. McLintock, Medical Service, National Coal Board, Hobart House, London S.W.1.

Indian Institute of Technology, Madras

THE INDIAN INSTITUTE OF TECHNOlogy, Madras, the third in the chain of four regional higher technological institutions being established by the Government of India, was inaugurated by the Minister for Scientific Research and Cultural Affairs on 31 July 1959. The other two institutions, already functioning, are located at Kharagpur and Bombay. The fourth, to be established at Kanpur (U.P.), is to start functioning next year.

The Institute, which is being built on a 600-acre site at Guindy, Madras, with the technical assistance of West Germany, is the first to have a five-year integrated course, which will set the pattern of engineering education in the country. The institute will have a total strength of 1500 students for the degree courses and about 500 students for postgraduate courses. In addition, research work will be carried out on a wide variety of engineering and technological subjects. The Institute is expected to partially reduce the existing imbalance between the number of graduate engineers and those engaged in postgraduate research and diploma holders. The course at the institute will include instruction in human and social sciences also.

During the first year, the Institute proposes to admit 120 students and will offer facilities for advanced studies and research in a wide range of subjects such as machine tool technology, production engineering, mechanical handling of materials, metallurgy of iron and steel, foundry engineering, chemical engineering, plant design and fabrication, instrument technology, structural engineering and electronics.

The Institute represents another example of international co-operation and co-ordination in the scientific and technological field, and is assisted by 20 experienced German professors who will serve the institution for 5 years in training Indian engineers. Besides making available the services of the technical experts, the West German Government has provided equipment and a fully equipped library, worth over Rs 1 crore.

Physico-chemical data on antibiotics

AS AN AID TO THE IDENTIFICATION and study of antibiotics, the research staff of the Hindustan Antibiotics Ltd, Pimpri, Poona, have prepared tables in which the known antibiotics have been classified by their physical, chemical and biological properties. These are being published in the *Bulletin* issued by the Hindustan Antibiotics Ltd. The first set in the series of such tables published in a recent issue of the *Bulletin* [**2** (1959),13] presents data on the melting points, ultraviolet absorption maxima and empirical formulae for 235 antibiotics produced by fungi, bacteria and lichens. In the table, in which the antibiotics are arranged by their empirical formulae, the data provided include the name of the organism producing the antibiotic, crystal form and colour, nature, melting point, ultraviolet absorption maxima, optical rotation, antibiotic activity and structural formula.

Proceedings of the Symposium on Chemotherapy

THE *Proceedings of the Symposium on Chemotherapy* held at the Central Drug Research Institute, Lucknow, during 2-4 November 1958 have been published. The 172-page volume contains 44 technical papers presented at the symposium along with the discussions on each paper. A report of the symposium has already been published in this *Journal* [**18A** (1959), 89].

Copies of the publication (price Rs 12.00) are available from the Director, Central Drug Research Institute, Lucknow.

Solid State Electronics

THE PERGAMON PRESS LTD, London, has undertaken the publication, under a distinguished international board of editors, of a new bimonthly, *Solid State Electronics*, beginning with the autumn of 1959. The journal will cover broadly the following subjects: Transistor technology in all its aspects, crystal growing and handling; application of contacts, crystal detectors and power rectifiers; preparation of intermetallic and other binary and tertiary semiconductors; design and performance of galvanomagnetic devices; thermo-electric properties and their applications; electroluminescence; photoconductors and photovoltaic cells, and solid state batteries; and problems concerning encapsulation and working life. Papers on circuitry will also be included if they have a direct bearing on new technological aspects of the semiconductor devices concerned. The subscription for the journal is £ 7 or $ 20.00 per volume to libraries, and £ 5 or $ 14.00 per volume to certified private subscribers.

Journal of Research, National Bureau of Standards

THE NATIONAL BUREAU OF STANDARDS, Washington, is now issuing the *Journal of Research* in four separate sections to permit more effective dissemination of the Bureau's contributions to science and industry, and meet more effectively the specialized needs of scientists, engineers and mathematicians.

Section A: *Physics and Chemistry*, will cover a broad range of physical and chemical research, with major emphasis on standards of physical measurement, fundamental constants and properties of matter. This section will be issued six times a year (annual subscription $ 4.00, postage extra). Section B: *Mathematics and Mathematical Physics*, will present studies and compilation designed for the mathematician and theoretical physicist. It will include topics in mathematical statistics, theory of experiment design, numerical analysis, theoretical physics and chemistry, and logical design and programming of computers. It will be issued quarterly (annual subscription $ 2.25). Section C: *Engineering and Instrumentation*, will report results of interest chiefly to the engineer and the applied scientist. It will also cover some of the work in applied mechanics, properties of engineering materials, building research and cryogenic engineering. It will also be issued quarterly (annual subscription $ 2.25). Section D: *Radio Propagation*, will report research in radio propagation, communications, and upper atmospheric physics. It will be issued six times in a year (annual subscription $ 4.00).

In addition to research reports the new journal will contain review articles.

Announcements

▪ Dr F. W. G. White has been appointed Chairman, Council of Scientific & Industrial Research Organization (C.S.I.R.O.), Australia. Dr White was Professor of Physics at the Canterbury University College, New Zealand, before coming to Australia in 1941 at the invitation of the Australian Government to work on radar research. When the C.S.I.R.O. was formed in 1949 he became the Chief Executive Officer and in 1957 the Deputy Chairman. He played an important role in building up the laboratories of the C.S.I.R.O. He has been particularly active in the development of the C.S.I.R.O. Wool Research Laboratories and was the Chairman of the First International Wool Textile Research Conference which met in Australia in 1955.

▪ *Award of Doctorate Degrees* — Shri Sunil Priya Das Gupta and Shri Hakam Singh have been awarded the Ph.D. degree of the Delhi University for their respective theses entitled *Dielectric absorption of long-chain aliphatic esters* and *Some aspects of the structural chemistry of clay minerals.*

Shri Khodu Sorab Irani has been awarded the Ph.D. degree of the Poona University for his thesis entitled *Structural transformations in spinels.*

INSTRUMENTS AND APPLIANCES

Electronic microbalance

AN ELECTRONIC MICROBALANCE which can automatically measure and record small variations of weight or energy for which the conventional mechanical balances are either inadequate or their use involves lengthy and elaborate operations, has been designed. The instrument offers a number of basic advantages not obtainable in other presently available ones, like precise control of the weighing time and maximum immunity to mechanical vibration. The accuracy of measurement is unaffected by impacts. The recordings need not be in chronological event sequence.

In the electronic microbalance, the movement produced by the weight or energy to be measured is entirely self-compensated by a counteracting electric current. A small deflecting magnet attached to the quartz lever and moving within the field of an h.f. coil and permanent magnet, indicates the position of the lever and produces the counteracting moment. By suitable arrangement of the electronic circuits, other quantities, derived from weight differential curves for the determination of sedimentation weight variations gauged or recorded by the balance can be used independently for monitoring or controlling other processes. The specifications of the balance are: maximum measurable load, 1 kg.; overall measuring range, 0·1-5 mg. full-scale deflection in 4 sensitivity ranges; and error, 0·5 per cent of full-scale deflection [*Europ. tech. Dig.*, **4** (6) (1959), 37].

Gamma ray-insensitive fast-neutron counter

A FAST-NEUTRON COUNTER, SIMPLE in construction and comparable in efficiency to other similar devices in use, is described. Available devices to detect neutrons employing organic phosphors suffer from high gamma ray sensitivity, and this counter is free from this defect.

The counter consists of a number of thin rectangular lucite sheets coated with zinc sulphide over their large faces and then sandwiched together to form a rectangular block which is mounted on a RCA 6342 photomultiplier. Zinc sulphide powder of thickness less than 10 mg./sq. cm. gives a satisfactory neutron response. Several lucite sheet thicknesses have been tried and it has been found that for radium-beryllium neutrons the efficiency decreased for thicknesses greater than 0·125 in. Neutron detection efficiency has been found, within the limits of experimental error, independent of the direction of entrance.

The pulse height spectra and absolute efficiencies of the counter measured in the energy range 225 keV. to 4·4 MeV. using neutrons from the $T(p, n)He^3$ and $D(d, n)He^3$ reactions and for 17-MeV. neutrons from the $T(d, n)$ He^4 reaction, showed that the detection efficiency is dependent on the neutron energy. The curves for absolute efficiencies for Co^{60} 6-MeV. gamma rays indicate that a suitable bias can be chosen without seriously impairing neutron detection efficiency to give a gamma ray efficiency of 10^{-6} to 10^{-10} of the neutron detection efficiency at that bias [*Canad. J. Phys.*, **37** (1959), 858].

Semiconductor tetrode

A NEW FOUR-TERMINAL SEMICONductor device, which can perform a number of electronic functions, has been developed at the Bell Telephone Laboratories, New York. The device, called the field effect tetrode, can be made to function as a transformer, gyrator, isolator, non-distorting modulator, or a short-circuit stable negative resistance. The new device has been the outcome of the theoretical work done on the earlier field effect current limiter. Functionally the device has no analogue, either in electron tubes or in previous transistors. As a transformer, it has a very decided advantage of considerable reduction in size for low frequency use, although it does not afford d.c. isolation. As a gyrator, it should be of considerable circuit interest, e.g. for effecting impedance conversion. One such application may be to use the new device to convert the reactance of a miniature capacitor into that of a high-Q inductor. If the device is biased properly, it will function as an isolator, allowing passage of alternating current in one direction only. A chief application of the new device may be as a distortionless modulator, or electronically controlled resistor for large signals. If a direct connection is made between the inner lead on one face and the outer lead on the other, the device will function as a two-terminal a.c. short-circuit stable negative resistance. In the experimental models, this performance has been achieved over a range of about 30 to 250 V., at 0·1-0·6 ma., in a boron-doped silicon crystal with a phosphorus diffused junction [*J. Franklin Inst.*, **267** (1959), 547].

Progress Reports

TOBACCO RESEARCH IN INDIA

STATISTICS REGARDING THE ACREAGE UNDER TOBACCO and the production during 1957-58 and the significant results of researches carried out on different aspects of tobacco cultivation at the various research stations under the Indian Central Tobacco Committee are presented in the committee's thirteenth annual report. A slight fall was recorded both in area under cultivation and the total production from 1029 thousand acres and 658·5 million lb. in 1956-57 to 926 thousand acres and 564·5 million lb. respectively in 1957-58. The area under Virginia tobacco was 176,000 acres, of which 167,000 acres were in Andhra Pradesh alone, yielding about 101 million lb. Virginia tobacco out of the total of 114 million lb. produced in India. During the year, 93·7 million lb. of tobacco worth Rs 15·8 crores were exported against 99·9 million lb. worth Rs 13·8 crores during 1956-57. Imports of manufactured tobacco fell from 3·5 million lb., worth Rs 1·31 crores, in 1956-57 to 2·8 million lb., worth Rs 1·27 crores, during 1957-58.

Agronomy — Application of farmyard manure as a layer, at the rate of 50 tons/acre, supplemented with groundnut cake has been found to be beneficial for nursery plants of cigarette tobacco. The beneficial effect is, however, not marked when farmyard manure is mixed with the top soil. The number of transplants is minimum when groundnut cake alone is applied to supply about 80 lb. nitrogen/acre. In the case of cigar tobacco, the best results are obtained from a combination treatment with 100-200 lb. nitrogen per acre in the form of farmyard manure and 200 lb. nitrogen/acre as night soil compost or 100 lb. nitrogen as groundnut cake. For *bidi* tobacco, a combination of 80 lb. nitrogen from castor cake, 40 lb. from farmyard manure and 40 lb. from ammonium sulphate was found to be the best. Composting of the cake for one or two weeks before application proves advantageous.

A seed rate of 3 lb./acre has been found to be optimum for raising nursery plants. Rabbing of seed beds helps in increasing the number of transplants, more so when ash is mixed with the top soil. Cultural experiments on cigarette tobacco have led to the following general conclusions: (1) Deep ploughing increases the yield of bright grades and total bright leaf equivalent by as much as 28 and 23 per cent respectively over normal ploughing; (2) application of 20 lb. nitrogen per acre increases the green leaf yield significantly under deep tillage. Addition of P_2O_5, K_2O and Mg to the nitrogenous manure does not appreciably increase the yield under deep ploughing, but under normal ploughing their addition is beneficial; (3) artificial mulching with paddy straw at the rate of 3 cartloads/acre, immediately after the first interculturing, significantly increases the yield of the bright grade leaf and the total bright leaf equivalent over that of normal interculturing. Application of well-decomposed organic matter, whether farmyard manure or composted tobacco stalks, improves the response of the crop to fertilizers, while the application of undecomposed chaffed tobacco stalks has an adverse effect in this respect; and (4) among different chemical fertilizers, calcium ammonium nitrate appeared to be most promising in producing more bright grades and total bright leaf equivalent.

In the case of cigar tobacco, highest yields are obtained by manuring with 20 cartloads of farmyard manure plus 50-100 lb. nitrogen per acre, half as groundnut cake and half as ammonium sulphate.

The spacing 48 × 24 in. has been found to be more convenient from the points of view of interculturing and inspection of leaf at harvest than the prevalent 33 × 33 in. spacing. In the case of Natu tobacco, the farm method of topping at flower head and harvesting from bottom to top as in flue-cured Virginia tobacco, instead of topping, as in the conventional method, at about 14 leaves and harvesting from top to bottom has been found to give 27 per cent increase in cured leaf yield.

Chemistry — Application of nitrogen, phosphorus and potassium, singly or in combination, does not influence the nitrogen content of the leaf. In the varieties Chatham and Harrison Special, the nicotine content of the leaf increases with increasing amounts of nitrogenous fertilizers used. Application of P_2O_5 gives significant increase in the yield of bright grades and total bright leaf equivalent. The chemical composition of cured leaf is independent of the method of cultivation; the total nitrogen and nicotine contents increase while the total sugar content of the leaf decreases with the application of nitrogen.

Plant physiology — Seeds subjected to low temperature treatment have been found to germinate better and to give higher number of transplants than untreated seeds. The application of coconut oil and spraying of M.H. 30 considerably improves the cured leaf weight per plant. The total bright leaf equivalent is more in Harrison Special and Delcrest when coconut oil or M.H. 30 is applied two weeks before topping. Application of mustard oil to top eight buds has been found to be most effective in eliminating the suckers in *N. tabacum*. Maleic anhydride was not only effective in controlling suckers, but also gave maximum yield of cured leaf as well as first grade leaf.

Plant breeding — Delcrest variety, among the cigarette tobaccos, has proved superior to other varieties in its response to topping and giving a uniform and high proportion of bright grades in all pickings. Among the varieties of wrapper tobacco, a new variety, ' Dixie Shade ', introduced recently was found to be best both from the point of yield and first grade leaf.

Plant pathology — Shell Copper, Coppesan, Blitox and Cupravit have been found to reduce the growth of the fungus *Pythium aphanidermalum*. Application of 40 lb. sulphur/acre completely controls the

incidence of powdery mildew. Spraying Dithane Z-78 and priming of the spotted and sand leaves control incidence of spot disease better than either of them independently. In the case of *bidi* tobacco, a seed rate of 1-1½ lb./acre was found to give less damping off and produced larger number of transplants.

Entomology — DDT, Rhothane and Endrin are more or less equally effective in preventing damage to seedlings. Two applications appear to give better results in the case of DDT and Endrin than one application. For cigarette beetle, the vertical suction light trap with two baffle plates and a fan and with one bulb gave the highest average catch (533 per day). Hydrocyanic acid gave more than 90 per cent kill of all the stages of cigarette beetle excepting eggs in which case the mortality was 100 per cent.

Endrin (10·01 per cent), Aldrin (0·05 per cent), DDT (10·2 per cent), Dieldrin (0·05 per cent) and Folidol (0·03 per cent), in order of preference, could be used effectively to control tobacco stem borer. Aldrin (0·05 per cent), Dieldrin (0·05 per cent), DDT (0·2 per cent), Endrin (0·05 per cent) and Folidol, when sprayed at the rate of 2·5 gal. per bed of 12 × 4 ft before the seeds germinate, have been found to be quite effective in controlling soil-borne pests of tobacco nursery. The addition of Aldrex emulsion in transplanting water at the rate of 0·5 lb./acre effectively controls the cutworms.

DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH, NEW ZEALAND

THE ANNUAL REPORT OF THE DEPARTMENT OF Scientific & Industrial Research, New Zealand, for the year ended 31 March 1958, shows that the budget of the Department during the period under review rose to £ 1,535,000, an increase of £ 130,000 over the previous year. Three new research journals, the *New Zealand Journal of Agricultural Research* (bimonthly), *New Zealand Journal of Geology and Geophysics* (quarterly), and the *New Zealand Journal of Science* (quarterly) started publication during the year; these replace the *New Zealand Journal of Science and Technology*.

During the year, the Department continued to devote much attention to the work in connection with the International Geophysical Year Programme and collected valuable data on the topography and geology of the Ross Dependency Area, and on seismological, ionospheric, geomagnetic and auroral phenomena at Scott Base and Hallett Station. Radar experiments have shown that the reflections of the radar beam come from a layer only a few km. (110 km.) thick above the earth, which indicates that in this region the atmosphere is ionized along tracks parallel to the direction of the earth's magnetic field. These tracks are probably left by protons arriving from the sun. The regions that reflect the radar beam are not the same as those that glow visibly during auroral displays and the two do not necessarily occur simultaneously. These experiments give a better understanding and control of the transmission of radio signals past the Poles. From observations on ' whistlers ' it appears that the state of the ionosphere fluctuates with the sun's activity but shows a delay of about 6 weeks, whereas the corona (much nearer the sun) is reported to show a delay of about 3 weeks.

A number of new or improved medical instruments have been designed and constructed: (1) An automatic isodose recorder for use with the 4 MeV. linear accelerator. This instrument eliminates the tedium in the plotting of individual curves in the earlier method and takes only 15 min. for plotting a 15 × 15 cm. field; (2) a repeating pistol for the implantation of radon seeds which facilitates accurate control of the implantation and minimizes radiation hazard. Special casettes loaded in protective containers can be simply transferred to the pistol, which delivers one seed at the tip of a hypodermic needle for each operation of the trigger; and (3) an improved cardiotachometer which, by means of an automatic pulse amplitude control and a rate recording circuit, allows an accurate record to be made of the short-term effects of certain modern drugs.

Comprehensive work on the evaluation of indigenous materials for their pozzolanic properties have led to the selection of two suitable types of pozzolans, diatomite and pumicite, for use in mass concrete in hydro construction. Diatomite has been found to possess greater reactivity than pumicite. Measurements have conclusively shown that pumicite replacement in optimum proportions has decided advantages. Fine grinding of pumicite imparted greater strength to the concrete and the drying shrinkage can be controlled satisfactorily. Early heat generation has also been reduced.

A technique developed, involving the use of paper chromatography, has made possible the separation and identification, in human organs, of barbiturates. Another useful technique for studying metabolic paths of hydrogen in photosynthesis or of oxygen in respiration has been developed. The difficulty of making radio-autographs with tritium has been overcome by converting the beta particle energy to light quanta and photographing the light on a film. Such radio-autographs should prove valuable in many fields of biochemical research.

The Auckland Industrial Development Laboratories have developed a method of measuring sap flow in plants (pines) by means of heat transport. An instantaneous line pulse of heat is released in the sap-wood by passing electric current through a resistance wire (perpendicular to the sap stream) and the resulting temperature changes at a point *c.* 0·5 in. downstream are measured by means of a thermistor probe. Experimental values confirm the theoretical predictions showing the usefulness of the instrument in sap flow measurement.

Based on the finding that cell size has a correlation with the storage quality of apples, the Fruit Research Division has devised an improved method by which the time of measuring of cell size in apples is considerably reduced and the section cutting is eliminated. In this method the apple cells are separated without altering their size or shape by dissolving away the material that holds the cells together; once separated, the cells are easily measured. With this increased speed in testing, commercial forecasting of apple storage quality becomes a possibility.

Supplement

ABSTRACTS

of Published Research Papers from National Laboratories and Sponsored Research Projects of C.S.I.R.

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Journal of Scientific & Industrial Research
1959, Vol. 18, No. 4

INDEX TO CONTENTS

ABSTRACTS

[For the classification of abstracts both the Colon and the U.D.C. systems have been adopted. The numbers on the left-hand side of the subject titles refer to Colon Classification while those on the right-hand side refer to the U.D.C.]

C PHYSICS 53

C216 Crystallography 53 : 548.0

273. DESHPANDE, V. T., SIRDESHMUKH, D. B. & MUDHOLKER, V. M.: The lattice constant of strontium nitrate, *Acta cryst., Copenhagen*, **12** (1959), 257

The value reported in literature for the lattice constant of strontium nitrate being too high, an accurate determination of the lattice constant has been made. The mean value at 20°C. has been obtained as 7·7798 $\pm$0·0002 A. The density of the crystal, calculated from this value, is in good agreement with that given in the *International Critical Tables.*

C216e *Apparatus* 53.07 : 548.0

274. CHIDAMBARAM, R.: A magnetic storage system for a double Fourier series synthesizer, *J. sci. industr. Res.*, **18B** (1959), 177

A magnetic storage system for an analogue computer for the summation of double Fourier series in X-ray crystal structure analysis has been described. The system uses a synchronous magnetic recorder to store the structure amplitudes and phases in the form of sinusoidal harmonic waves. These harmonics are generated photoelectrically by a chopper system, processed and then recorded with appropriate amplitudes and phases on two magnetic drums. The phase shifting is done by a modified RC phase shifter. Long pickup heads perform the summations over one of the running indices. Two new methods have been described for indicating that the phase relations between the reproduced voltages are correct. The transfer characteristics for normal and synchronous magnetic recording have been compared and it has been shown that, in the latter, the ' supersonic ' bias frequency may be much lower than the signal frequency. It has been suggested that the pickup head can be used as a low pass filter to eliminate part of the distortion in the recorded remanent induction. The effect of amplitude modulation of the reproduced waveforms at a sub-harmonic of the fundamental frequency on the final contour map of electron density has been investigated. The performance of the storage system has been evaluated and some possible improvements in the design have been indicated.

C5 : 1 Optical Systems 535.31

275. SEN GUPTA, M. K.: Calculation of last radius of an optical system for the correction of zonal chromatic aberration, *J. sci. industr. Res.*, **18B** (1959), 221

In calculating the last radius of an optical system for the correction of chromatic aberration, for a particular zone, the last glass thickness is in general ignored, and set almost arbitrarily. This makes the equations inexact and the chromatic correction imperfect. An exact equation suitable for computing with desk calculating machines has been derived by which the two coloured rays can be brought to exact reunion. The method has been illustrated by a numerical example.

C5 : 3 Spectroscopy 535.33

276. GARG, S. N. & SINGH, I. S.: On the emission spectrum of benzaldehyde, *J. sci. Res., Banaras Hindu Univ.*, **9** (1) (1958), 61

The emission spectrum of benzaldehyde, obtained by transformer discharge through flowing vapour of benzaldehyde (vapour pressure, *c.* 1 mm.), has been studied. The spectrum covers the region 3679-5983 A. A comparatively large number of vibrations has been observed to be excited. The main frequency is 1733 $cm.^{-1}$, which is identified as C=O

stretching frequency. Over this frequency and its multiples, other totally symmetrical as well as non-totally symmetrical vibrations are superposed. A detailed analysis of a large number of bands observed has been made.

277. PADDI REDDY, S.: New band systems of FeBr in the visible region, *J. sci. industr. Res.*, **18B** (1959), 188

Four band systems attributed to the FeBr molecule have been observed in the region 5720-6410 A. in the spectrum when excited both in a high frequency discharge and in a heavy current discharge from a generator. Starting from the shorter wavelength side these have been designated as systems I, II, III and IV. In each of the first three band systems, only two sequences have been identified while in the fourth, three sequences have been observed. The vibrational analyses of the four systems indicate that systems I, II and IV have a common lower state which may probably be the ground state of the FeBr molecule. Systems I and II, which consist of single headed bands, may belong to a transition of the type Σ-Σ with multiplicity 2 or 4. The bands of systems III and IV show P and Q heads. In the O, O band of system IV, the O ' form ' head has been identified in addition to the P and Q heads. Each of the systems III and IV may probably belong to a transition of the type π-Σ with multiplicity 2 or 4.

C5 : 73 Fluorescence 535.37

278. PANT, D. D. & KHANDELWAL, D. P.: Fluorescence spectrum of uranyl perchlorate solutions at room temperature, *J. sci. industr. Res.*, **18B** (1959), 126

The fluorescence spectrum of uranyl perchlorate solutions at room temperature has been found to consist of a single series of α-bands which are unaffected by dilution, the solution being acidic. The spectrum shows no noticeable change on adding excess of perchloric acid. On increasing the *p*H of the solution, weak bands develop in between the α-bands and finally these appear to the entire exclusion of α-bands. On further increase of *p*H the spectrum becomes continuous due to the formation of higher hydrolysed species.

C6 : 141 Dielectrics 537.226

279. ARVIND VYAS & SRIVASTAVA, H. N.: Relaxation times of some simple alkyl amines, *J. sci. industr. Res.*, **18B** (1959), 195

Relaxation times of some simple alkyl amines have been determined using a modified Debye equation given by Gopal Krishna [*Trans. Faraday Soc.*, **53** (1957), 767]. It has been shown that for primary, secondary and tertiary amines the relaxation time increases with the length of the carbon chain. Also, the relaxation time for the amines increases from primary to secondary and from secondary to tertiary.

280. NARASIMHA RAO, D. V. G. L.: A method for obtaining dipole moment and relaxation time from solution measurements, *J. sci. industr. Res.*, **18B** (1959), 133

A method has been described for the determination of dipole moment and relaxation time from measurements of the dielectric constant and dielectric loss of dilute solutions at two frequencies, on either side of the peak of the absorption curve. The method has been applied to four molecules — chloro-, bromo- and nitrobenzenes and benzophenone — and the derived values of dipole moment and relaxation time have been found to agree with previous literature values; the actual values of tan δ also compare well with previous measurements. It has been possible to obtain approximate estimates of the distortion polarization and hence the atom polarization from the same data.

281. RAJAN, R.: Variation of relaxation time with viscosity — Benzyl alcohol and nitrobenzene, *Curr. Sci.*, **28** (1959), 238

Results of a study of the variation of dielectric relaxation time with viscosity of the solvent in the case of two molecules, benzyl alcohol and nitrobenzene, have been reported. Measurements of dielectric constant and loss factor have been made on a wave guide set up at 3·20 cm. using the standing wave method of Roberts and von Hippel.

282. SRIVASTAVA, S. C. & CHARANDAS: Simple equation for estimating the dipole moment of a molecule from solution data, *J. chem. Phys.*, **30** (1959), 816

A simple empirical equation for estimating the dipole moment of a molecule from dielectric constant measurements in solution without any density or refraction data has been suggested.

D ENGINEERING 62

D34-66 Mica : Electrical Properties 691.27 : 621.31

283. DHAR, R. N., MANDAL, S. S. & ROY, S. B.: Electrical properties of Indian mica — D.C. resistivity,

Bull. cent. Glass Ceram. Res. Inst., **6** (1) (1959), 29

The d.c. resistivity of various classes of Bihar and Madras mica has been studied. No correlation is observed between volume resistivity and the visual properties on the basis of which the micas are generally classified. The resistivity of green mica is much lower than that of ruby mica.

D36 : 81 Concrete : Testing 691.32 : 620.179.1

284. CHATTERJEE, P. N. & SEN, B.: Use of resonant frequency method as a standard for non-destructive testing of concrete, *J. Instn Engrs India*, **39** (Pt 1) (1959), 985

Studies on the use of resonant frequency of longitudinal and flexural vibrations for non-destructive testing of concrete have shown that the flexural method is preferable from the point of view of excitation and detection of resonant frequencies while the longitudinal method is more satisfactory from the theoretical point of view, the equations involved being exact. Correlations between the compressive strength of concrete specimens of different ages and mixes with their corresponding modulus of elasticity have been indicated and the possibility of using the modulus of elasticity of concrete as a measure of its strength has been discussed.

D6, 9(D85) Pumps 621.65

285. LAHIRI, A. K. & BANERJEE, T.: Cavitation erosion, a case of conjoint action, *NML tech. J.*, **1** (2) (1959), 38

Cavitation erosion has been attributed to a conjointed action of chemical and mechanical factors giving rise to a serious type of erosion. A case of serious failure of cast iron pump impeller by cavitation erosion investigated has shown that the hammering effect of collapsing cavities and corrosion by chlorites and chlorine are the root causes of attack. Preventive measures suggested include control of water pressure head at the pump inlet, choice of metal, perfection in design, etc.

D64e Heating Devices 697.35

286. MATHUR, K. N., KHANNA, M. L., DAVEY, T. N. & SURI, S. P.: Domestic solar water heater, *J. sci. industr. Res.*, **18A** (1959), 51

An arrangement for heating water with solar energy for supplying the domestic needs of a small family at Delhi, using easily available and inexpensive construction materials (galvanized iron sheets), has been described. The heat collector unit consists of a wooden box, insulated at the bottom, in which are formed the flow channels for water by one corrugated and one plane galvanized iron sheet. The upper side of the box is glazed with one or more layers of $\frac{1}{8}$ in. thick window glass sheets to reduce heat losses, keeping a 2 in. gap between the glass sheets and the water flow channels.

As the length of the day is short and hot water requirements large during winter, the heating unit is set up at an angle of 45° to the horizontal to make the best use of sunlight. Flow rates of water, through the collector unit, in the range 4-21 gal./hr, have been used and a rate of 7-10 gal./hr has been found to be optimum under the experimental conditions employed. The efficiency of heat transfer on a clear day is about 70 per cent which is more than that for the usual types of heat collector units using copper pipes soldered to flat copper sheets.

D65 Electronics 621.38

287. KRISHNAN, S.: Cathode-follower for a d.c. reference level, *Electron. Radio Engr*, **36** (1959), 192

The equivalent circuit for the cathode-follower as a source for clipping circuits requiring variable clipping level is given. Better performance is obtained with clipping at negative voltages. On the positive side, the height of the input pulses is limited by the cut-off; the probable maximum height of the pulses to be clipped has to be taken into account while designing the circuit.

288. KRISHNAN, S.: Diode phase detectors: Characteristics of simple and balanced push-pull circuits, *Electron. Radio Engr*, **36** (1959), 45

A theory common to diode phase-meters and phase-sensitive detectors has been worked out for two types of detectors (the simple push-pull and the balanced push-pull detectors). The general case of unequal sinusoidal voltages being compared for phase has been discussed and it has been shown that equality of the two comparison voltages, assumed by previous workers to be the most suitable for phase-meter use, is inconvenient in certain cases. An alternative operating condition has been suggested in which the signal is considerably larger than the reference voltage. A study of the effect of the output time constant indicates that, if the output capacitor is dispensed with, the output of the balanced push-pull arrangement becomes strictly proportional to the signal.

E CHEMISTRY 54

E : 213 Chemical Kinetics 541.12

289. PALIT, SANTI R. & GUHA, TILAK: Some observations on the effect of the physical nature of the separating phase on the rate of heterogeneous polymerization, *J. Polym. Sci.*, **34** (1959), 243

Study of the polymerization of methyl methacrylate and acrylonitrile in aqueous solution in a redox-initiated system consisting of $Na_2S_2O_4$-$K_2S_2O_8$ has revealed that the initial rate of polymerization increases with increase in concentration of the catalyst or activator, and this is followed by a fall in rate with a further increase in concentration of either of the two, and finally the rate increases again with higher concentration of the catalyst or activator. This peculiarity has been linked with the physical state of the separating phase. In the region where the rate is increasing with increasing catalyst concentration, the insoluble phase is in the form of a fine sol. In the region where the rate falls with increased catalyst or activator concentration, the separating phase is in the form of a coarser, less stable sol (milky sol or latex). In the region where the rate again increases, the insoluble phase is in the form of a coarse precipitate or coagulum.

290. RASTOGI, R. P. & SRIVASTAVA, R. C.: Generalized theory of thermal transpiration and thermal diffusion based on the thermodynamics of irreversible processes, *Physica, 'sGrav.*, **25** (1959), 391

A generalized theory of thermal transpiration and thermal diffusion based on the thermodynamics of irreversible processes has been developed for a mixture involving a single chemical reaction. The theory is valid even when a non-linear relation between chemical reaction rate and affinity exists but the range of validity of the theory cannot exceed the range of validity of the Gibbs formula for entropy production.

A quantitative estimate of the difference in the values of thermal diffusion factors with and without chemical reaction for *ortho*- and *para*-hydrogen mixture has been made.

291. TEWARI, K. K. & KRISHNAN, P. S.: Further studies on the metachromatic reaction of metaphosphate, *Arch. Biochem. Biophys.*, **82** (1959), 99

A quantitative study has been made of the metachromatic reaction of polymetaphosphates (weight-average molecular weights ranging from 690 to 20,600) with toluidine blue by the spectrophotometric technique. The lower members of the series give only a weak reaction; the higher members are strongly metachromatic. The latter yield the same metachromatic intensity for a given weight of the polymer, irrespective of the molecular weight. Slight alterations in the molecule of the polymer brought about by storage of solutions or subjection to ultrasonic vibrations do not result in significant changes in the metachromatic response.

E : 232 Surface Chemistry 541.83

292. PURI, B. R., KHANNA, S. N. & MYER, Y. P.: Studies in properties of capillary-held liquids: Part VI — Hysteresis effect in adsorption by porous bodies, *J. sci. industr. Res.*, **18B** (1959), 67

Hysteresis in the sorption-desorption isotherms of benzene, toluene and *m*-xylene on silica and alumina gels has been found to be reversible. The relationship between adsorption and desorption pressure at different points on the respective isotherms has been found to be fairly in accordance with Cohan's quantitative treatment of the open-pore theory of hysteresis [*J. Amer. chem. Soc.*, **60** (1938), 433].

E : 33051 Paper Chromatographic Analysis 544 : 545.844

E : 33051 (95) *Staining Reagents* 544 : 545.844 : 667.21

293. CHANAN SINGH: New staining reagents for the detection of condensed phosphates, *J. sci. industr. Res.*, **18B** (1959), 249

Fifty-eight basic dyes have been examined for their suitability as reagents for paper chromatographic detection of condensed phosphates. Of these dyes, toluidine blue has been found to be the reagent of choice because of its sensitivity and relative specificity. Another advantage of the use of toluidine blue is that it permits the recovery of the detected compound (free from the reagent) by a simple and mild procedure. The reaction between this dye and the polyanions on filter paper is adversely influenced by a large number of organic and inorganic cations.

E10 : 228 Rare Gases : Diffusion 546.29 : 533.15

294. SRIVASTAVA, B. N. & SRIVASTAVA, K. P.: Mutual diffusion of pairs of rare gases at different temperatures, *J. chem. Phys.*, **30** (1959), 984

The coefficient of mutual diffusion of the binary gas mixtures Ne-A, A-Kr and Ne-Kr has been determined

at 0°, 15°, 30° and 45°C. From the experimentally determined values of the diffusion coefficient at different temperatures the unlike interaction parameters for the above gas pairs have been calculated by two different methods on the Lennard-Jones 12: 6 model. These values of the force parameters are in good agreement with those obtained from the usual combination rules and also from thermal diffusion data. The values are found to reproduce the experimental data on mutual diffusion quite satisfactorily. The data have also been utilized to calculate the self-diffusion coefficient of neon, argon and krypton.

E5-38 : 26 Polymeric Acids : Electrochemistry 541.13 : 678-1

295. PAL, MADINI KANTA: On the electrochemistry of polymeric acids: Part I — Vinyl acetate-maleic acid copolymer, *J. sci. industr. Res.*, **18B** (1959), 109

During the potentiometric titration of a copolymer of vinyl acetate and maleic anhydride in the ratio of 1 : 1·4, the polymeric acid has been found to behave as a monobasic acid. Consideration of the relation between *p*H and percentage neutralization from the point of view of Katchalsky and Gills [*Rec. Trav. chim. Pays-Bas*, **68** (1949), 879] has shown that the intrinsic *pK* of the carboxyl group is higher in this case than those of the polymeric acids with random distribution of carboxyl groups. This has been attributed to the inductive effect of the carboxyl groups at the adjacent positions.

E5 : 4 Organic Synthesis 547 : 542.91

296. BANERJEE, D. K. & DAS GUPTA, S. K.: Synthesis of 4-keto-7-methoxy-1 : 2 : 3 : 4 : 4a : 9 : 10 : 10a-octahydrophenanthrene, *J. Indian chem. Soc.*, **36** (1959), 223

4-Keto-7-methoxy-1 : 2 : 3 : 4 : 4a : 9 : 10 : 10a-octahydrophenanthrene has been prepared as a model for the synthesis of aromatic analogues of 11-keto-steroids.

297. DHAR, M. M.: Some tuberculostatic derivatives of isonicotinic acid hydrazide, *J. sci. industr. Res.*, **18C** (1959), 117

The condensation of isopropylidene isonicotinic acid hydrazone with 30 per cent hot formaldehyde has been found to give a compound of the formula $C_{21}H_{23}O_4N_9$. The condensation of cyclohexylidene isonicotinic acid hydrazone or INH with formaldehyde also gives the same compound. The condensation of crotonaldehyde with INH in water or alcohol gives a compound of the formula $C_{10}H_{11}ON_3$.

298. GUPTA, A. S. & AGGARWAL, J. S.: Some derivatives of hexadecane-1 : 16-dicarboxylic acid — α, α'-Diaryl diketones, *J. sci. industr. Res.*, **18B** (1959), 205

Hexadecane-1 : 16-dicarboxylic acid has been esterified with a number of mono- and dihydric phenols using sulphonic acid catalysts and the phenolic esters formed have been changed through Fries transformation to the corresponding *o*- and *p*-diaryl diketones which are high melting waxy substances. The diaryl diketones have been further reduced by Clemmensen's method to the corresponding diaryl octadecanes as possible antioxidants. During the esterification of the dicarboxylic acid by α-naphthol Fries transformation also seems to take place.

299. NEELAKANTAN, S., RAJAGOPALAN, T. R. & SESHADRI, T. R.: A new synthesis of islandicin and cynodontin, *Proc. Indian Acad. Sci.*, **49A** (1959), 234

2-Methylanthraquinones with the 1 : 4-dihydroxy system are conveniently prepared by the persulphate oxidation of the intermediate benzoylbenzoic acids and subsequent ring closure. 2-Methylquinizarin, islandicin and cynodontin have been prepared by this method as typical examples.

300. PAUL, R., POPLI, S. P. & DHAR, M. L.: Studies in possible oral hypoglycemic agents: Part I — Synthesis of some hydantoins, hydantoic esters and related compounds, *J. sci. industr. Res.*, **18C** (1959), 21

Based on the fact that most of the synthetic oral anti-diabetic agents are built round a guanidine, a urea or a potential thiourea moiety, a number of δ-substituted hydantoic esters, 3- or 5-substituted hydantoins and some of the corresponding thiohydantoins have been prepared with a view to testing them for their hypoglycemic activity.

301. SEN GUPTA, S. K. & BHATTACHARYYA, B. K.: Studies in Michael condensation: Part IV — Condensation of 8-methylbicyclo-[4 : 3 : 0]-nonanone-4 with 1-methyl-2-acetylcyclohexene, *J. Indian chem. Soc.*, **36** (1959), 273

The condensation of 1-methyl-2-acetylcyclohexene with 8-methylbicyclo-[4 : 3 : 0]-nonanone-4 in presence of a base furnishes a mixture of two products; the presence of two double bonds in both the products has been established by hydrogenation. Treatment of the mixture with $LiAlH_4$ and acid affords either a mixture of 2,4b-dimethyl-1,2-cyclopentano-1,

2,3,4,4a,4b,5,6,7,8-decahydrophenanthrene and 2,4b-dimethyl-1,2-cyclopentano-2,3,4,4a,4b,5,6,7,8,8a-decahydrophenanthrene or 2,4b-dimethyl-1,2-cyclopent-$\Delta^{1,1'}$-eno-1,2,3,4,4a,4b,5,6,7,8,8a,9-dodecahydrophenanthrene, depending on the condition and the acidic reagent. The former mixture of the aforementioned dienes reacts with maleic anhydride to yield an adduct and the mixture of the three dienes furnishes, on dehydrogenation, Diels' hydrocarbon. 9-Keto-2-methyl-1,2-cyclopentano-1,2,3,4,4a,4b,5,6,7,8,8a,9-dodecahydrophenanthrene on catalytic hydrogenation affords 9-keto-2-methyl-1,2-cyclopentano-1,2,3,4,4a,4b,5,6,7,8,8a,9,10,10a-tetradecahydrophenanthrene, indicating that the β-side is less hindered, and on treatment with $LiAlH_4$ followed by acid, affords a diene which is heteroannular.

302. SESHADRI, T. R. & VENKATASUBRAMANIAN, G. B.: A new synthesis of diploschistesic acid, *J. chem. Soc.*, (1959), 1658

Experimental support has been provided for the biogenetic view that diploschistesic acid arises from lecanoric acid by a Gattermann reaction of the latter which gives the 3-aldehyde whence Dakin oxidation affords diploschistesic acid.

E92 : 34 Alkaloids : Estimation 547.94 : 545

303. KANNAN, L. V., SRIVASTAVA, S. K. & RAY, G. K.: Estimation of vasicine in *Adhatoda vasica* Nees, *Indian J. Pharm.*, **21** (1959), 108

A method for the estimation of the alkaloid vasicine in the leaves of *Adhatoda vasica* Nees has been worked out, the variation in four estimations for each sample being ±0·02 per cent. The loss on drying, ash, acid-insoluble ash and alcohol-soluble extractive have been determined for a number of authentic samples collected from different parts of India.

E92Z2 Proteins 547.96

304. JOSEPH, K. THOMAS & BOSE, S. M.: Studies on the reactive groups of collagen: III — Methylation and guanidination, *Bull. cent. Leath. Res. Inst.*, **5** (1959), 399

Full esterification of collagen has been achieved with methanolic hydrochloric acid, methanol and thionyl chloride and methanol and ethylchloroformate. The esterification of collagen with methanol and ethyl chloroformate is accompanied by an increase in the amino nitrogen content.

E94972 Essential Oils 547.913

305. CHAUDHARY, S. S., VISHWA PAUL & HANDA, K. L.: Chemical composition of essential oil from *Angelica glauca* roots growing in Jammu and Kashmir, *Indian Soap J.*, **25** (1959), 288

Angelica glauca root oil has been found to contain lactones and sesquiterpenes as major components and DL-pinene, DL-phellandrene, selinene, DL-cadinene, umbelliprenin and some terpene alcohols.

306. GURMIT SINGH, TEJ SINGH & HANDA, K. L.: Composition of *Artemisia absenthium* oil from plants growing wild in Jammu and Kashmir, *Indian Soap J.*, **25** (1959), 305

The worm wood oil obtained from *Artemisia absenthium* growing in Jammu and Kashmir has been found to consist mostly of esters of thujyl alcohol, thujane, cadinene and S-guaiazulene.

307. GURMIT SINGH, VISHWA PAUL & HANDA, K. L.: Composition of *Origanum vulgare* oil from plants growing in Jammu and Kashmir, *J. sci. industr. Res.*, **18B** (1959), 128

The oil from *Origanum vulgare* growing in Jammu and Kashmir has been found to contain palmitic acid, DL-pinene, dipentene, linalool and some bicyclic and tricyclic sesquiterpenes.

308. NIGAM, S. K., SHARMA, V. N. & KAUL, K. N.: The possibilities of growing *Cymbopogon winterianus* Jowitt in India, *J. sci. industr. Res.*, **18B** (1959), 132

The growth and the essential oil content of *Cymbopogon winterianus* have been studied. The yield of the oil is *c.* 0·38 per cent on the weight of the air-dried leaves.

E95 Pigments 547.97

309. KRISHNA MURTY, T. & SANKARA SUBRAMANIAN, S.: Isolation of carotene from *Roccella montagnei*, *J. sci. industr. Res.*, **18B** (1959), 162

A convenient method for the isolation of carotene from *Roccella montagnei* has been described. Besides β-carotene, which is the major carotene pigment, the presence of γ-carotene is also reported.

310. SESHACHAR, B. R. & PRABHAKARA RAO, A. V. S.: Observations on the pigment from an Indian species of *Blepharisma* (Ciliata: Protozoa), *J. sci. industr. Res.*, **18C** (1959), 76

The properties of the pigment from an Indian species of *Blepharisma* have been studied. Ethyl alcohol

has been found to be the best solvent for extracting the pigment, and the extraction is easier and more complete when the animals are wet. The pigment gets bleached more quickly when the living animals are exposed to sunlight than when the alcoholic extract is exposed to sunlight. The pigment loses its colour intensity to a certain extent in the cold and in the dark; the loss in intensity is more rapid at room temperature and when the extract is left uncovered. The pigment shows absorption maxima at 340, 480, 540 and 580 mμ. The pigment is purple in acid or neutral medium and turns green in alkaline medium.

311. SESHADRI, T. R. & VENKATARAMANI, B., Leucocyanidin from mangroves, *J. sci. industr. Res.*, **18B** (1959), 261

The barks of *Bruguiera gymnorrhiza* and *B. parviflora* have been found to yield leucocyanidins which have the flavan-diol structure. The leucocyanidin from *B. gymnorrhiza* has a low rotation and that from *B. parviflora* has a higher rotation.

E9G BIOCHEMISTRY 577.1

E9G : 11 Preparation 577.1 : 542

312. RAGHAVENDRA RAO, M. R.: Preparation of glucose-6-phosphate, *J. sci. industr. Res.*, **18C** (1959), 87

A method for preparing glucose-6-phosphate using a phosphoglucoisomerase-free phosphoglucomutase preparation has been described. The product is free from fructose-6-phosphate but contains small quantities of inorganic phosphate.

E9(G : 33) Metabolism 577.12

313. NATH, M. C. & BELKHODE, M. L.: Glucose cycloacetoacetate as a precursor to ascorbic acid in germinating green gram — Its confirmation by paper chromatography, *Nature, Lond.*, **183** (1959), 1258

It has been confirmed by paper chromatography that ascorbic acid is formed from glucose cycloacetoacetate (GCA) during germination of *mung* (*Phaseolus radiatus*) beans. Chromatograms with standard ascorbic acid solution and deproteinized extracts of the same weight of seeds germinated in (a) water, and (b) aqueous solutions of GCA show bands with the same R_f value. The intensity of the colour of the bands with extracts of seeds germinated along with GCA is much higher than that obtained with extracts of seeds germinated in water alone, showing thereby that the reducing substance formed from GCA is ascorbic acid, and its biosynthesis varies directly with the amount of GCA added in the germinating medium.

E9G982 Enzymes 577.15

314. ARORA, K. L., KRISHNA MURTI, C. R. & SHRIVASTAVA, D. L.: Studies in the enzyme make-up of *Vibrio cholerae*: Part XIII — Tryptophanase activity of vibrios, *J. sci. industr. Res.*, **18C** (1959), 65

The distribution of tryptophanase in various cholerigenic and non-cholerigenic strains of vibrios, and the optimum conditions for the extraction of the enzyme in cell-free state have been described. The properties of the enzyme and the action of enzyme inhibitors and coenzymes on it have also been studied.

Incorporation of sodium and potassium chlorides in the growth medium has been found to stimulate the production of the enzyme by the cells, and potassium chloride solution has been found to be relatively specific for the extraction of the enzyme from viable cells.

Indole-3-acetic acid, indole-3-propionic acid, indole-3-butyric acid and acetyl DL-tryptophane are not decomposed by the enzyme and they do not affect the normal course of tryptophane breakdown by the enzyme. Cyanide, hydrazine and hydroxylamine, copper and mercury salts in very small concentrations inhibit the activity of the enzyme completely. Compounds having sulphydryl groups also strongly inhibit the activity of the enzyme; glutathione is more powerful than cysteine. Pyridoxal phosphate activates tryptophanase of *V. cholerae*, whereas diphosphopyridine nucleotide and riboflavin have no effect.

315. ARORA, K. L., KRISHNA MURTI, C. R. & SHRIVASTAVA, D. L.: Studies in the enzyme make-up of *Vibrio cholerae*: Part XIV — Organic nitroreductase, *J. sci. industr. Res.*, **18C** (1959), 105

Vibrio cholerae and related vibrios reduce aromatic nitro compounds, including chloramphenicol, producing the corresponding arylamines. An active cell-free preparation of this enzyme has been made and factors affecting its activity have been studied. Chlorotetracycline, which has been shown to inhibit the *E. coli* enzyme, has no action on the *V. cholerae* extract. Isonicotinic acid hydrazide, however, is found to be inhibitory.

316. JOSHI, A. P. & RAMAKRISHNAN, C. V.: Detection of oxalacetic hydrolase in citric acid producing strain of *Aspergillus niger*, *J. sci. industr. Res.*, **18C** (1959), 62

Results of investigations on the presence of oxalacetic hydrolase in *Aspergillus niger* in the initial stage of fermentation have been reported.

317. SADANA, J. C. & MOREY, A. V.: The purification of hydrogenase of *Desulfovibrio desulfuricans*, *Biochim. biophys. Acta*, **32** (1959), 592

Hydrogenase from *D. desulfuricans* has been purified by ion exchange and cellulose chromatography to a specific activity of $11{\cdot}40 \times 10^6$ µl. H_2 absorbed per mg. N per hour. The purified enzyme is free from cytochrome impurities and is completely inactive without added iron. The enzyme shows no activity when Fe is replaced by equivalent amounts of Mn^{++}, Cu^{++}, Ni^{++}, Zn^{++}, Pb^{++}, molybdate, vanadate, tungstate, chromate and borate. These substances also have no stimulatory effect on enzyme activity in the presence of optimum amounts of iron. The observations indicate that iron is required for hydrogenase activity with methylene blue as hydrogen acceptor.

318. SOHONIE, KAMALA, HUPRIKAR, S. V. & JOSHI, M. R.: Trypsin inhibitors in Indian foodstuffs: Part VI — Purification and properties of the double bean trypsin inhibitor, *J. sci. industr. Res.*, **18C** (1959), 95

The physical and chemical properties of a purified preparation of double bean (*Faba vulgaris* M.) trypsin inhibitor have been examined. The elementary composition of double bean trypsin inhibitor has been found to be similar to that of trypsin inhibitors from other sources and it has a molecular weight of 23,000. It is soluble and stable in 2·5 per cent solution of trichloroacetic acid and is stable to heat and to acid and alkaline *p*H. The ultraviolet absorption spectrum of the inhibitor is typical of proteins showing maxima at 280 mµ and minima at 252 mµ. Of the known trypsin inhibitors, the double bean trypsin inhibitor appears to exhibit the least inhibitory activity towards trypsin. It is, however, active against other proteolytic enzymes.

E9G (F56) Antibiotics 577.1 : 615.779

319. SHETE, (Mrs) K. & VORA, V. C.: Antibiotic X-1285: Part I — Isolation from a *Streptomyces* species, *J. sci. industr. Res.*, **18C** (1959), 48

An apparent mixture of antibiotic substances, designated X-1285, has been isolated from a *Streptomyces* species, whose cultural characteristics have been described. X-1285 is active against both gram-positive and gram-negative bacteria and is effective against *Entamoeba histolytica* infection in rats.

E9G(F594) Antifungal Agents 577.1 : 615.77

320. SRIVASTAVA, O. P.: Antifungal activity of some sulphur-containing compounds against dermatophytes and yeast-like fungi, *J. sci. industr. Res.*, **18C** (1959), 25

The antifungal activities of a copper chelate of a sulphone hydrazide, two sulphoxides (*p*-methylamino-*p'*-aminodiphenyl and *p*-amylamino-*p'*-aminodiphenyl), three sulphides (diaminodiphenyl, *p*-methylamino-*p'*-aminodiphenyl and *p*-ethylamino-*p'*-aminodiphenyl) and a potassium salt of benzyl isothiocyanate sulphonic acid have been tested against five dermatophytes (*Trichophyton rubrum*, *T. sulfureum*, *T. mentagrophytes*, *Microsporum audouini* and *M. gypseum*) and three yeast-like fungi (*Candida albicans*, *Geotrichum* sp. and *Trichosporon cutaneum*) using undecylenic acid as the standard. The potassium salt of benzyl isothiocyanate sulphonic acid completely inhibits the growth of all the fungi except *M. audouini*. It appears to be superior to undecylenic acid against seven fungi but not against *M. audouini*. *p*-Methylamino-*p'*-aminodiphenyl and *p*-ethylamino-*p'*-aminodiphenyl sulphides completely inhibit the growth of *T. rubrum*, *T. sulfureum*, *T. mentagrophytes*, *Geotrichum* sp. and *Trichosporon cutaneum* at certain concentrations but have little or no effect on *M. audouini*, *M. gypseum* and *C. albicans*. Diaminodiphenyl sulphide and the two sulphoxides are able to stop the growth of *T. rubrum*, *T. sulfureum* and *T. mentagrophytes* only at the highest concentration used. Copper chelate of the sulphone hydrazide does not show much activity.

E(I) PLANT CHEMISTRY 54: 58

E(I) : 3 Chemical Analysis 543 : 581

321. AGARWAL, K. P. & DHAR, M. M.: Chemical examination of *Ophiorrhiza mungos* Linn., *J. sci. industr. Res.*, **18B** (1959), 114

The chemical examination of *Ophiorrhiza mungos*, reported to be useful in the treatment of cancer, has been carried out. β-Sitosterol, 5α-ergost-7-en-3β-ol and 5α-ergost-8-(14)-en-3β-ol (as an ester) have been identified in the extracts of the roots of the plant.

322. CHATTERJEE, S. K., NITYA ANAND & DHAR, M. L.: Chemical examination of *Melodinus monogynus* Roxb.: Part II — Identification of monogynol A and monogynol B, *J. sci. industr. Res.*, **18B** (1959), 262

Monogynol A and monogynol B isolated from *Melodinus monogynus* Roxb. have been shown to be

triterpenes. Monogynol A possesses a lupeol skeleton and may be designated as lupan-32 : 0-diol. Monogynol B has been found to be identical with lupeol.

323. DHAR, M. L., NEELAKANTAN, S., RAMANUJAM, S. & SESHADRI, T. R.: Chemical investigation of Indian lichens: Part XXII, *J. sci. industr. Res.*, **18B** (1959), 111

Four lichens of the *Usnea* species and five of the *Parmelia* species, collected from different parts of India, have been analysed. Among them, two varieties of *U. orientalis* differ in the depsidone component. *U. longissima* is found to be a very good source of usnic acid which is well known as an antibiotic. The chemical components of six other lichens belonging to different genera have been recorded.

324. GROVER, P. K. & SESHADRI, T. R.: Chemical investigation of Indian lichens: Part XXIII — Imperfect lichens, *J. sci. industr. Res.*, **18B** (1959), 238

Four Indian species of imperfect lichens have been analysed. These contain closely related compounds having the C_{18} skeleton and exhibit progressive methylation of the system.

325. NAZIR, B. N. & HANDA, K. L.: Chemical investigation of *Lochnera rosea*, *J. sci. industr. Res.*, **18B** (1959), 175

Chemical investigation of the roots of *Lochnera rosea* procured from Travancore and the roots of the plant raised locally has shown that the roots contain 1·22 and 1·18 per cent total alkaloids and 0·0195 and 0·029 per cent reserpine respectively.

326. RASTOGI, R. P. & DHAR, M. L.: Chemical examination of *Picrorhiza kurrooa* Benth.: Part IV — Identification of kurrin as D-mannitol, *J. sci. industr. Res.*, **18B** (1959), 219

Kurrin, isolated from *Picrorhiza kurrooa*, has been identified as D-mannitol by molecular weight determination using the X-ray method, by infrared spectrum analysis, by comparison of melting points and by mixed melting point determinations.

327. SARKAR, B. & KHANNA, N. M.: Chemical examination of *Grewia populifolia* Vahl., *J. sci. industr. Res.*, **18C** (1959), 20

Results of chemical investigation of *Grewia populifolia* Vahl. have been reported. A pale yellow oil, β-sitosterol, α-amyrin, β-amyrin, faradiol, glucose, arabinose, proline, serine, glutamic acid, phenylalanine, isoleucine and lysine have been obtained from the air-dried stems.

F TECHNOLOGY 66

F : 6 Industrial Electrochemistry 66.087

328. KRISHNASWAMY, N.: Electrodialysis: Part I — Desalting of aqueous salt solutions, *J. sci. industr. Res.*, **18A** (1959), 218

The construction and the performance characteristics of a five-compartment electrodialysis cell using cation and anion 'Permaplex' membranes have been described. It has been shown, in the case of feed solutions containing sodium or a mixture of sodium chloride and calcium chloride, that the feed rate, under a constant applied potential, governs the extent of desalting, and that by recycling the salt content of the effluent can be reduced to any desired extent.

F5 : (E81) Organic Chemical Processes 661.7 : 66.094.3

329. TREHAN, B. S., SURI, I. K. & THAMPY, R. T.: Maleic anhydride by vapour phase oxidation of benzene using fluid bed catalyst, *J. sci. industr. Res.*, **18B** (1959), 147

Optimum conditions have been determined for the vapour phase oxidation of benzene to maleic anhydride by the fluid bed technique using a mixture of vanadium and molybdenum oxides as the catalyst. Catalysts containing equal proportions of vanadium and molybdenum oxides have been found to give the best performance. Addition of P_2O_5 to the catalysts prolongs their useful life and permits the reduction of the ratio of air to benzene to the minimum without appreciably affecting the yields of maleic anhydride. Catalyst carriers with medium porosity (alundum) are best suited for use in the fluid bed. Yields of maleic anhydride varying from 70 to 76 per cent are obtained at reaction temperatures varying between 440° and 455°C. and with a contact period of 0·35 sec. The ratio of benzene to air (by volume) can be varied from 162 : 1 to 218 : 1, depending on the composition of the catalyst, without appreciably affecting the yield of maleic anhydride.

F : (E881) Catalysts 66.097.3

330. BOSE, S. K., BASAK, N. G. & LAHIRI, A.: Hydrogenation of Assam coal: Part II — Development of indigenous catalysts, *J. sci. industr. Res.*, **18B** (1959), 255

The results of studies on the development of indigenous catalysts for the hydrogenation of high sulphur coals have been reported. Haematite, magnetite and mill-scale yield results comparable with those

of stannous sulphide and ammonium chloride mixture, and can, therefore, replace tin salts as catalysts.

Impregnation of coal with ferrous sulphate before hydrogenation results in increased liquefaction. Iron pyrites have been found to favour conversion of coal to oil with increased formation of tar acids and neutral oil.

331. SATTUR, N. B., RAMALINGAM, K. V., RAO, E. S., MASARGUPPI, J. A. & CHIPALKATTI, V. B.: Improved catalysis of urea-formaldehyde precondensates for textile applications, *Indian Text. J.*, **69** (1959), 502

Two new catalysts (Stabaca-101 and Stabaca-102) for use in urea-formaldehyde treatment baths developed are particularly suited to Indian conditions. They confer improved stability to the urea-formaldehyde treatment baths, and produce less loss in tensile and tear strength, compared to ammonium salt catalyst, at approximately equivalent crease-recoveries.

F : (E881-3053) *X-ray Analysis* 66.097.3 : 544.64

332. BANERJEE, B. K., BASAK, N. G. & LAHIRI, A.: Studies on a synthetic iron oxide hydrate for desulphurization of industrial gases, *J. sci. industr. Res.*, **18B** (1959), 70

Crystal phase composition of a hydrated iron oxide catalyst developed for use in the desulphurization of industrial gases has been presented. The width and the diffuseness of the lines in the X-ray diffraction pattern due to the hydrated iron oxide suggest its colloidal state, a prerequisite for pronounced catalytic activity.

The superiority of the prepared catalyst over bog iron has also been shown.

333. BANERJEE, B. K., BASU, A. N., SAHA, J. & LAHIRI, A.: X-ray study of vanadium oxide catalyst, *J. sci. industr. Res.*, **18B** (1959), 97

The X-ray method of analysis has been applied to the investigation of a number of vanadium oxide catalysts employed in the oxidation of naphthalene oils to phthalic anhydride.

It has been observed that the method of preparation of the catalyst has a great influence on the particle size of the catalyst, the dispersion of the particles and its catalytic properties. Both the physical and chemical nature of the catalyst are affected by the duration for which it is used in the oxidation reaction. Prolonged use of the catalyst has a remarkable effect on its structure and the catalyst starts sintering at temperatures as low as 450°C. Both amorphous and crystalline phases are observed in the regenerated catalyst and the crystalline phase is predominant, contrary to the case of the active catalyst.

F140 Carbon & Graphite 661.666

F140 : (C) *Physical Properties* 661.666 : 53

334. JOGLEKAR, G. D. & GOPALASWAMY, T. R.: Smearing property of graphite, *J. sci. industr. Res.*, **18B** (1959), 127

A method for the quantitative assessment of the smearing property of graphite powders has been described. The smearing property is estimated from the reflectance of a white filter paper after it has been used as a lining in a hollow cylinder in which the graphite powder is made to rotate, a roller being placed in the cylinder to exert pressure on the particles. The loose particles of graphite sticking to the paper must be removed before measuring the reflectance.

F140 : (C6 : 3) *Electrical Properties* 661.666 : 537.7

335. GOPALASWAMY, T. R., SUBRAMANIAN, N. R. & JOGLEKAR, G. D.: Measurement of the electrical resistance of sized powders at different bulk densities: Part II — Graphite powders, *J. sci. industr. Res.*, **18A** (1959), 60

Bulk electrical resistivity and bulk density of graphite powders from different sources have been determined with a view to establishing criteria for identifying the source of the graphite samples and for determining their suitability for specific industrial purposes. Measurements carried out with 20 samples have shown that bulk electrical resistivity and bulk density of the graphites decrease progressively as the particle becomes more and more flaky. Electrical resistivity increases with increase in the fineness and the ash content of the powders; surface films on the graphite particles also increase the resistivity. Bulk density decreases with increase in the fineness of the powders and increases with increase in ash content.

336. JOGLEKAR, G. D., SEN, D. & GOPALASWAMY, T. R.: Measurement of electrical resistance of sized powders at different bulk densities: Part I — Petroleum coke and retort carbon powders, *J. sci. industr. Res.*, **18A** (1959), 21

The electrical resistances of sized powders of petroleum coke and retort carbon at different bulk densities have been measured and the factors which affect such measurements have been discussed. The resistivity

of the powders has been found to increase with their fineness and for a given size and bulk density, the resistivity of petroleum coke is much lower than that of retort carbon. The resistivity of the powders is also an index of their graphitizability; petroleum coke, which has a lower resistivity than retort carbon, is more easily graphitizable.

F191 METALLURGY 669

F191 : (η2) Ore Processing 669.051

337. BANERJEE, S. K. & NARAYANAN, P. I. A.: Processing of magnetite ores with particular reference to Salem magnetite, *NML tech. J.*, **1** (2) (1959), 23

The results of studies on the beneficiation of low grade Salem magnetite, assaying 36·5 per cent Fe and 44·2 per cent SiO_2 and containing principally magnetite, quartz, haematite and goethite, have been presented. Using the same feed size of −48 mesh, tabling and magnetic separation yield the same grade of concentrate assaying 62·5 per cent Fe with a recovery of about 87·0 per cent. The results of sintering studies on the magnetic concentrate have also been presented.

F191 : (E21-895) (D81) Corrosion Protection : Testing 669 : 620.197

338. RAJAGOPALAN, K. S. & ANNAMALAI, P. L.: Chromate treatment of zinc and other metals: Part I — Accelerated testing of chromate coatings, *J. sci. industr. Res.*, **18A** (1959), 171

The protection afforded by chromate coatings to zinc under different atmospheric conditions has been studied and a new method of testing chromate coatings has been proposed. Studies on temperature and humidity conditions under which the chromate coating formed by Cronak process gives protection show that in the presence of salt spray the temperature at which the test is carried out is an important variable in determining the efficiency of protection of chromate coating.

F191-193 Alloys 669.018

F191-193 (C2 : 8) *Structure* 669.018 : 539

339. BANERJEE, T.: Structure of electrolytic alloys, *NML tech. J.*, **1** (2) (1959), 15

Electrolytic deposition of alloys at constant current density and constant cathode potential has indicated that the composition of the deposited alloys remains unaffected during the period of electrolysis carried out at c.p. Atomic structure of electrolytic alloys, such as, Cu-Zn, Ag-Cd, deposited at constant c.p., has been compared with that of their thermal counterparts and the mechanism of phase transformation in these alloys has been explained on the basis of the discharge of ions in an amorphous unordered condition and in a state of high energy.

F191-193 : (D81) *Testing* 669.018 : 66.017

340. VED PRAKASH & ENTWISTLE, K. M.: The effect of specimen size on the quench-ageing of an aluminium-3·8 per cent copper alloy, *J. Inst. Met.*, **87** (1959), 262

Massive specimens of a high-purity aluminium-3·8 per cent copper alloy show a much lower hardening rate during the first stage of quench-ageing than thin specimens. Experiments lead to the conclusion that the low hardening rate is due to the failure to retain vacancies in the large specimens.

F3 Salt Technology 664.4

341. BHAVNAGARY, H. M. & GADRE, G. T.: Potassium sulphate from sea bittern, *Res. & Ind.*, **4** (1959), 84

A process for the recovery of potassium, as sulphate, from sea bittern has been reported. Sea bittern is subjected to solar concentration and the mixed salt separating in the density range 36-8° Bé. is collected. A saturated solution of the mixed salt on cooling from 110°C. yields schoenite, the double sulphate of magnesium and potassium, from which potassium sulphate is obtained by treatment with potassium chloride or lime, followed by crystallization. Pilot plant scale trials have indicated the feasibility of obtaining potassium sulphate of 98 per cent purity.

342. SESHADRI, K. & BUCH, (Late) S. D.: Exploitation of Sambhar Lake bitterns, *J. sci. industr. Res.*, **18A** (1959), 132

A process for recovering sodium sulphate, sodium chloride and sodium carbonate from liquid and solid bitterns and sub-standard salt, worked out on the basis of phase rule studies, has been described. It consists of the following steps: (1) elimination of algae from the liquid bittern or aqueous extracts of solid bitterns by chlorine treatment; (2) adjustment of the composition of the solution and chilling it to 0°C.; (3) separation of $Na_2SO_4.10H_2O$ by centrifuging; (4) dehydration and purification of sodium sulphate

by solar heat; (5) recovery of sodium chloride by solar evaporation of desulphated liquor until the liquid reaches 10 per cent sodium carbonate strength; and (6) carbonation of the desalted liquor for the recovery of sodium carbonate as bicarbonate.

Improvements in recoveries are effected by simple recycling of the residual liquors. The overall recoveries are: sodium sulphate, 90 per cent (technical grades of I.S.S.); sodium chloride (99 per cent purity), 55 per cent; and sodium carbonate (98 per cent purity), 73 per cent.

343. SESHADRI, K. & BUCH, (Late) S. D.: Exploitation of Sambhar pan crust, *J. sci. industr. Res.*, **18A** (1959), 224

Three methods based on solubility data have been worked out for the recovery of sodium sulphate from the Sambhar Lake pan crust. Ninety per cent of sodium sulphate present in the crust is recovered as technical grade quality sodium sulphate by the chilling process, 65-73 per cent by precipitation by the addition of solid sodium chloride at 50°C. to the solution prepared from the crust and 75-80 per cent from the upgraded crust obtained by digesting it with water.

F4414 Refractory Materials 666.76

344. MINHAS, G. S. & BHASKAR RAO, H. V.: Evaluation of quartzite for the manufacture of silica bricks, *NML tech. J.*, **1** (2) (1959), 32

Chemical, physical and inversion characteristics of quartzites from different sources have been studied to evaluate their suitability for the conventional as well as superduty type of silica refractories. Results of small-scale trials carried out on quartzite samples with addition of lime and iron oxide and physical properties of the specimens after firing to 1450°C. have been presented and the suitability of indigenous quartzites has been assessed.

345. NOMAN KHAN, M. & BALABHEEM RAO: Indigenous sources of ball clays, *Res. & Ind.*, **4** (1959), 127

Four samples of Kerala ball clays from Pedappakkara, Cherumuthuseri, Cherukulam and Changanacherri have been studied for the following properties: plasticity, shrinkage, strength, particle size, colour and porosity. The first three of the above properties compare well with those of a sample of English Dorset ball clay. The fired colour of Pedappakkara clay is whiter than that of the English ball clay. Differential thermal analyses of the four clays have shown that these essentially belong to the kaolinite group. Pedappakkara and Cherumuthuseri ball clays can be used satisfactorily in the production of porcelain.

F53 Food Technology 664

346. ANANTHARAMAN, K., SUBRAMANIAN, N., BHATIA, D. S. & SUBRAHMANYAN, V.: Nutritional studies on isolated groundnut protein, *Indian Oilseeds J.*, **3** (1959), 100

Nutritional studies on isolated groundnut protein as well as the parent cake material have shown that the protein has higher digestibility coefficient, but lower biological value. Supplementation of the protein or the cake with methionine or casein does not increase its biological value to that of casein indicating that the protein is deficient both in methionine and lysine.

347. ANANTHARAMAN, K., SUBRAMANIAN, N., BHATIA, D. S. & SUBRAHMANYAN, V.: Processing of groundnut cake for edible protein, *Indian Oilseeds J.*, **3** (1959), 85

A method has been standardized for the preparation of edible quality proteins from expeller cakes of groundnut containing 8-10 per cent fat. The removal of fat from protein solution is effected by centrifugal force. Bench-scale trials using 10 kg. of cake per batch have yielded a protein having moisture 4·1, fat 1·0, ash 0·53 and nitrogen (on moisture, ash and fat-free basis) 15·36 per cent. The protein has a solubility of about 80·5 per cent in water at *p*H 7·5. The yield of protein based on the weight of the cake is 34 per cent.

348. NARAYANAN, K. M., KAPUR, N. S. & BHATIA, D. S.: Effect of baking on the stability of B-vitamins in biscuits enriched with proteins and vitamins, *Food Sci.*, **8** (1959), 79

The effect of baking on the stability of B-vitamins in 'nutro' biscuits has been studied. There is no loss of B-vitamins during dough making. During baking, riboflavin and nicotinic acid are stable. The loss of thiamine depends upon the *p*H and the level of fortification of the biscuit. The higher the *p*H and/or level of fortification, the greater is the percentage loss of thiamine.

349. PRUTHI, J. S.: Physico-chemical changes in lemon concentrate during commercial-scale vacuum concentration, *Food Sci.*, **8** (1959), 39

Changes in refractometric solids (°Brix), viscosity, spectral reflectance (colour), *p*H, acidity, °Brix/acid ratio and true ascorbic acid during commercial-scale vacuum concentration of lemon juice in forced circulation, single-pass falling-film evaporator have been

discussed. With increasing concentration, the °Brix, acidity, viscosity and ascorbic acid of the juice gradually decrease; the °Brix/acid ratio does not change but the *p*H falls slightly. Up to four-fold concentration of the juice, viscosity increases slightly, but after five-fold concentration the rise in viscosity is rapid. The losses in ascorbic acid during concentration up to seven-fold are within 5 per cent. The use of mid-season lemons at optimum maturity for juice extraction and vacuum concentration of the flash-pasteurized juice up to five-fold concentration have been suggested.

350. SAMUEL, D. M. & SRINIVASAN, M.: Removal of saponins and bitter taste in the juice of agave stem by treatment with carbon, *J. sci. industr. Res.*, **18B** (1959), 264

It has been observed that carbon can remove saponins and the bitter principle from the agave juice, before or after hydrolysis. The observation is significant from the point of view of production of fructose syrup.

351. SASTRY, M. V. & SIDDAPPA, G. S.: Changes in ascorbic acid and tannin contents during the preparation of *amla* (*Phyllanthus emblica*) preserve, *Food Sci.*, **8** (1959), 12

Prolonged brine treatment of *amlas* has been found to have a highly destructive effect on the ascorbic acid content, the destruction being as much as 93 per cent. In the case of *amla* preserve made by the conventional method, using fruit not subjected to brining, the retention of ascorbic acid is comparatively low (15·9-39·9 per cent). The absolute values for ascorbic acid content are, however, high on account of the very high ascorbic acid content of the fresh fruit. The retention of tannin in the final preserve is high (45·5-57·8 per cent).

Of the three methods of making preserves, viz. conventional, vacuum and incubation, the last one has the most destructive effect on ascorbic acid and tannin contents, their retention being only 25·7 and 42·2 respectively. The retention in the vacuum method is 81·7 and 77·8 per cent respectively.

352. SIDDAPPA, G. S. & BHATIA, B. S.: Effect of variety, preliminary treatment and method of preparation on the quality of some Indian preserves — Physico-chemical studies, *Food Sci.*, **8** (1959), 47

Results of physico-chemical studies on the effect of variety, preliminary treatment and method of preparation on the quality of apple, carrot and *petha* (ash gourd, *Benincasa cerifera* Savi) preserves have been discussed.

F(J94) Sugar Technology 664.1

F(J94) (C4 : 55)e *Concentrators* 664.1.05 : 621-8

353. KHANNA, MOHAN LAL, GARDNER, A. L., DAVEY, T. N. & SURI, S. P.: Plane-glass mirror solar energy concentrators for concentrating sugarcane and palm juices, *J. sci. industr. Res.*, **18A** (1959), 212

The design, construction and working details of a plane-glass mirror (9 in. square) solar energy concentrator have been described. The results of experiments on the evaporation of water and cane juice, using reflectors with overall dimensions of 3×3 ft and 6×3 ft, have been presented. The advantages of this type of collector over the conventional concentrators, such as low cost, simplicity of construction, ease of handling and portability, have been pointed out and the probable economy in the sugarcane and palm *gur* manufacturing industries, by the use of this type of reflector, has been assessed.

F551 Coal Technology 662.66

354. AHUJA, L. D., KINI, K. A. & LAHIRI, A.: Effect of reduced ring structures on the coking power of coals, *J. sci. industr. Res.*, **18B** (1959), 216

Investigations on the effect of reduced ring structures on the coking power of coals have confirmed that addition of compounds containing such structures improves the coking quality of coals. The efficiency of pitch in improving the caking index of coal has also been studied.

355. BANDOPADHYAY, J., SARKAR, S. & DAS GUPTA, N. N.: A method for evaluating the plastic properties of highly swelling coals, *J. sci. industr. Res.*, **18B** (1959), 116

The plastic properties of highly swelling coals, determined experimentally by the present methods, are not accurate due to excessive frothing of the coals which leads to large increase in the volume of the test sample during testing. A new method, which enables the determination of the plastic properties of such coals accurately, has been reported. The procedure consists in (1) mixing the coal sample, stepwise, with increasing proportion of inert (electrode carbon), (2) testing the mixture in a Gieseler plastometer, (3) plotting the percentage inert against log maximum fluidity, and (4) extrapolating the straight line plot obtained at higher inert content to zero inert content to arrive at the correct maximum

fluidity and resolidification of mixtures, corresponding to the minimum inert content when an inflexion, noted in the plot, represents the correct characteristic values of the coal sample.

356. BHOWMIK, J. N., MUKHERJEE, P. N. & LAHIRI, A.: Studies on oxidation of coal at lower temperatures, *Fuel, Lond.*, **38** (1959), 211

The mechanism of oxidation of coal in air at 200°C. has been discussed. From an estimation of the oxygen-containing functional groups in oxidized coal as well as hydrolysed samples, it has been shown that there is a stoichiometric relation between —COOH and phenolic —OH groups that are formed on hydrolysis. The increase in these acid groups is accompanied by a decline in the =CO groups. The probable mechanisms of the reaction have been discussed.

357. DAS, S. B. & DAS GUPTA, N. N.: Studies on hygroscopic characteristics of cokes, *J. Min. Met. Fuels*, **7** (5) (1959), 1

The capacity moisture in cokes prepared from different coals carbonized at different temperatures has been determined. The values are maximum for cokes in the temperature range of 600-700°C. irrespective of the rank of the parent coals. The capacity moisture of cokes at 500°C. has a linear relationship with the rank of coals. A nearly linear relationship also exists between the capacity moisture of cokes and their strength.

358. IYENGAR, M. S. & LAHIRI, A.: Heat of wetting of coals, *BrennstChemie*, **18** (1959), 45

The interrelation between the briquettability, oxidizability, coking behaviour, inflammability, hydrating and sulphonating power as well as petrographic constituents of normal and abnormal coals on the one hand and the heats of wetting in polar liquids on the other has been studied. The heat of wetting is a measure of the extent of reactive oxygen groups present in the coal.

359. MAZUMDAR, B. K., CHAKRABARTTY, S. K. & LAHIRI, A.: Aromaticity of coal — An appraisal, *Fuel, Lond.*, **38** (1959), 115

A new method for the determination of aromaticity of coal has been suggested. After oxidizing coal in air in which the non-aromatic part of the coal can be selectively oxidized at low temperatures (below 200°C.), the unaffected aromatic skeleton or the aromatic carbon and hence the aromaticity of the coal can be determined. Dehydrogenation study with pitch has shown that this is not completely aromatic in nature.

360. MAZUMDAR, B. K., CHAKRABARTTY, S. K. & LAHIRI, A.: Dehydrogenation of coal and tar formation, *Fuel, Lond.*, **38** (1959), 112

Based on a study of dehydrogenation of coal by sulphur, a direct relationship between the alicyclic part of coal structure and tar formation has been derived. Alicyclicities have been found to be nearly equal and proportional to the yields of tar for all ranks of coal. Dehydrogenation leads to inhibition of tar formation by modification of the coal structure.

361. NANDI, S. P., KINI, K. A. & LAHIRI, A.: Reactivity of low temperature cokes and chars, *BrennstChemie*, **18** (1959), 85

Active oxygen groups, surface area and heat of wetting in methanol of samples of a low and a high rank coal, carbonized at different temperatures in vacuum, have been determined. The active groups exhibit a maximum in the region 400-500°C. for both the coals, the increase being more pronounced for the high rank coal than for the low rank coal. Surface area is a maximum at about 800°C. for the high rank coal and at 600°C. for the low rank coal. The heat of wetting has been found to be the resultant of contributions from the surface area and the active groups. In the region of low temperature coke formation (500-600°C.), where the surface area starts increasing, the concentration of active groups is high.

362. RAO, H. S., KAISER, F. & LAHIRI, A.: Active hydrogens in coal, *Fuel, Lond.*, **38** (1959), 254

Active hydrogen in coal has been determined by the deuterium exchange method and the results of studies on a sample of coal from the Raniganj field employing this method have been presented.

363. SINHA, A. K., SARKAR, G. G. & LAHIRI, A.: Beneficiation of coal slurries of difficult cleaning and high ash middlings for metallurgical use, *J. Min. Met. Fuels*, **7** (3) (1959), 1

The possibilities of upgrading high ash coal fines produced on crushing lower seam coals and washery middlings have been investigated. Flotation tests have shown that better results are obtained by using combined reagents (e.g. kerosene, cresylic acid and methyl amyl alcohol) in optimum proportions. Studies on the effect of conditioning prior to flotation have shown that the efficiency decreases with increasing conditioning time.

F58 Dyes 667.62

364. SIVASANKARAN, K., SARDESAI, K. S. & SUNTHANKAR, S. V.: Cellulose acetate dyes: Part I —

Synthesis of aminoanthraquinonyl acrylates and pyridinoanthraquinones, *J. sci. industr. Res.*, **18B** (1959), 164

A series of aminoanthraquinones has been condensed with diethyl ethoxymethylenemalonate and the resulting acrylates have been cyclized to the respective pyridinoanthraquinones. Both the acrylates and the pyridinoanthraquinones have been tested as cellulose acetate dyes. The dyeing and fastness properties of the dyes synthesized have been explained on theoretical considerations. The acrylate of 1-aminoanthraquinone and the cyclized compound, 4'-hydroxy-3'-carbethoxy- 1(N) : 2 -pyridinoanthraquinone, possess good dyeing and fastness properties. The fastness to sublimation and gas fading of all the dyes is satisfactory. The improvement in the gas fading fastness property of the dyes has been achieved by lowering the basicity of the amino group while the improvement in light fastness property has been brought about by curbing the electron mobility in the compound by locking up the basic nitrogen.

F5895 Paints 667.6

365. MENON, M. C. & AGGARWAL, J. S.: Anticorrosive paints for ship bottoms, *Paintindia*, **9** (1959), 77

Thirteen varnish media for anticorrosive paints have been prepared from mostly indigenous raw materials. Results of pigmentation studies with 33 pigment compositions using 12 different pigments and their mixtures have been presented. The characteristics of the compositions have been evaluated according to I.S. specifications, and their water permeability has been determined by radioactive tracer technique. The stability of the compositions during storage has been investigated.

F594 Insecticides 615.777

366. KULKARNI, S. B., GHARPUREY, M. K. & BISWAS, A. B.: Water dispersible DDT formulations: An analysis of the problem, *J. sci. industr. Res.*, **18A** (1959), 178

An analysis of the relative merits of the various types of DDT (dichloro diphenyl trichloroethane) formulations used for insect control has been made on the basis of physico-chemical considerations. The desirable properties of a formulation have been discussed on the basis of the following factors: (1) suspensibility, (2) covering power, (3) lethal dose in minimum time, (4) residual toxicity and (5) technological aspects. It is concluded that some type of paste formulation incorporating a non-volatile lipoid dissolving oil and containing thin needle-shaped DDT particles may prove to be the best.

F596 Spices & Condiments 664.5

F596 (J67) *Pepper & Chillies* 664.51

367. ANANDASWAMY, B., MURTHY, H. B. N. & IYENGAR, N. V. R.: Prepackaging studies on fresh produce: *Capsicum grossum* Sendt. & *Capsicum acuminatum* Fingh., *J. sci. industr. Res.*, **18A** (1959), 274

Prepackaging studies of *Capsicum grossum* Sendt. (sweet pepper) and *Capsicum acuminatum* Fingh. (green chillies) in bags made of different packaging films such as (1) polyethylene, (2) plain transparent cellulose, and (3) moisture-proof heat-sealable transparent cellulose (M.S.T.), with and without aeration vents, have been carried out at different temperatures and relative humidities. These studies have indicated that the shelf life of sweet pepper can be nearly doubled by prepackaging it in 150 gauge polyethylene film with adequate respiration vents and also in M.S.T. bags at (i) 100°F. and 90 per cent R.H., (ii) 76-80°F. and 65-75 per cent R.H., and (iii) 47-50°F. and 80-90 per cent R.H. The beneficial effect of prepackaging green chillies is seen only when they are packed in polyethylene bags at (i) 76-80°F. and 65-75 per cent R.H., and (ii) at low temperature in all the three types of bags. The ascorbic acid content of both sweet pepper and green chillies is not affected by prepackaging.

F94 Fats & Oils 665.3

368. RAJAGOPAL, N. S. & ACHAYA, K. T.: Fat tropicalization phenomenon in sunflower seed oil, *J. sci. industr. Res.*, **18C** (1959), 117

Results of studies on the fat tropicalization phenomenon (relative saturation of fats obtained from animals and vegetables raised in the tropics over those derived from the same species in cooler climates) in sunflower seed oil have been presented. The low acid value of the oils from the seeds of crops raised in Hyderabad, kept in glass stoppered bottles for 1 to 3 years, shows that sunflower seeds store well without deterioration of oil. Figures for the individual component fatty acids in relation to the iod. val. of the mixed fatty acids for Indian, African, Australian and English samples indicate that, both in gross iod. val. and in fatty acid composition, the tropicalization occurs to a varying degree.

F(J91) Adhesives 668.3

369. GHOSH, A. G.: Gelation time studies of some resorcinol adhesives, *J. sci. industr. Res.*, **18A** (1959), 58

The effect of *p*H, temperature and initial resorcinol-furfural ratio on the gelation time of some resorcinol-furfural adhesives, when hardened in the normal manner with paraform, has been investigated. The gelling time of the adhesives decreases when part of the resorcinol in them is replaced by phenol.

F(M6) Glass Technology 666.1

370. ATMA RAM, BHATYE, S. V. & SHARMA, K. D.: Influence of TiO_2 on the viscosity and surface tension of soda-lime-silica glasses, *Bull. cent. Glass Ceram. Res. Inst.*, **6** (1) (1959), 3

Studies on the influence of TiO_2 on the viscosity and surface tension of soda-lime-silica glasses have shown that in an ordinary soda-lime-silica glass, substitution of SiO_2 by TiO_2 or substitution by TiO_2 on an overall basis lowers the high temperature viscosity of glass progressively, the effect being greater in glasses where SiO_2 is substituted by TiO_2. With the addition of TiO_2, the extent of decrease in viscosity generally diminishes below 1050° and ultimately, at a temperature near 800°, becomes negligible and a reversal of the effect sets in after which the viscosity increases. This increases the 'setting rate' of glass with increasing TiO_2 content. Substitution of SiO_2 by TiO_2 lowers the surface tension of glass, but the effect is very little. The temperature coefficient for titania containing glasses is negative and their behaviour is similar to that of the base glass.

371. KUMAR, S.: Glasses in the systems containing lead oxide, boric oxide, alumina and phosphorus pentoxide, *Bull. cent. Glass Ceram. Res. Inst.*, **6** (1) (1959), 12

The systems B_2O_3-P_2O_5, B_2O_3-$AlPO_4$, PbO-B_2O_3-P_2O_5 and PbO-B_2O_3-$AlPO_4$ have been studied. Glasses are obtained only in the last two systems. Measurement of liquidus and deformation temperature has shown that these two temperatures for lead borophosphate glasses are higher than those for lead borate or lead phosphate glasses.

Glasses containing PbO and B_2O_3 generally show increase in the coefficient of thermal expansion and power factor with increasing lead content while electrical resistivity and to some extent chemical durability decrease. For lead phosphate glasses, however, the effects of increasing lead content on power factor, electrical resistivity and chemical durability are reversed. On replacing B_2O_3 by P_2O_5 in lead borophosphate glass, the power factor and the coefficient of thermal expansion increase, while the spectrophotometric absorption edge due to the amber colour of iron progressively shifts towards the shorter wavelength. On replacing B_2O_3 by $AlPO_4$ in lead boroaluminophosphate glasses, the power factor, thermal expansion, the deformation temperature, chemical durability and electrical resistivity increase. The lead phosphate glass 1·0 PbO, 1·0 P_2O_5 shows excellent chemical durability, low deformation temperature and very little visible absorption due to iron compared to the other glasses.

F(M7) Textile Technology 677

372. TANEJA, K., RAMALINGAM, K. V., SATTUR, N. B., MASARGUPPI, J. A., RAO, E. S. & CHIPALKATTI, V. B.: Srifirset compounds in textile finishing, *16th All-India Textile Conference Souvenir* (Textile Association of India, Bangalore), 1959, 1

Five Srifirset compounds for various textile finishes and two stable bath catalysts, Stabaca-101 and Stabaca-102, for use in the urea-formaldehyde resin treatment bath have been developed. The uses, advantages and applications of the compounds have been discussed and results of large-scale mill finishing trials have been presented.

F(M97) Leather Technology 675

373. MADHAVAKRISHNA, W. & BOSE, S. M.: Studies on enzymic unhairing and degreasing for production of leather, *Bull. cent. Leath. Res. Inst.*, **5** (1959), 351

Comparative chemical, physical and microscopical assessments of the quality of the leathers produced by the traditional liming process and by the two enzymic unhairing processes utilizing a protease and an amylase have been made. The optimum conditions for the hydrolysis of skin lipids by castor seed lipase have been studied with respect to the effects of *p*H, period of digestion, temperature and enzyme concentration and degreasing experiments with lipase on sheep skins before and after enzymic unhairing.

374. RANGANATHAN, S., BOSE, S. M. & NAYUDAMMA, Y.: Studies on the formation of Mannich linkages involving phenolic compounds with reference to the interaction of collagen with certain

tanning agents, *Bull. cent. Leath. Res. Inst.*, **5** (1959), 447

Resorcinol has been shown to be capable of forming tris Mannich bases. Evidence for the hypothesis that Mannich linkages are formed on retannage of vegetable tanned leather with formaldehyde has been presented.

G BIOLOGY 57

G91 Bacteriology 576.8

375. BHASKARAN, K.: Observations on the nature of genetic recombination in *Vibrio cholerae*, *Indian J. med. Res.*, **47** (1959), 253

The occurrence of genetic recombination between *V. cholerae* strains has been found to be dependent on the lysogenic state (phage 129) of either of the two mating strains. The lysogenic cultures give rise to plaques on sensitive strains, but the filtrates are free of phage particles. The genotype of the recombinants isolated from certain crosses between *V. cholerae* corresponds generally to one of the parents in the cross. Certain unstable recombinant prototroph colonies, which appear to be segregating diploids, have been identified.

K ZOOLOGY 59

K615 Cestoda 595.121

376. SINGAL, DHARAM PARKASH: Two new Anoplocephalid Cestodes belonging to the genus *Oochoristica* Lühe, 1898 from *Varanus monitor* (Linnaeus, 1758), *J. sci. industr. Res.*, **18C** (1959), 99

Two new Anoplocephalid Cestodes belonging to the genus *Oochoristica* Lühe, 1898 from *Varanus monitor* (Linnaeus, 1758) have been reported. The two species, *O. longivittata* n.sp. and *O. musculocirrosa* n.sp., are clearly distinguishable from other species under the genus *Oochoristica* Lühe, 1898 and present certain distinctive characters with respect to disposition and number of testes, size of eggs and onchospheres, shape of ovary and vitelline gland, to justify the creation of new species.

K81 Crustacea 595.3

377. SRINIVASAN, T. K.: On a new species of wood boring isopod, *Exosphaeroma madrasensis* from Madras, *J. Timb. Dr. Pres. Ass. India*, **5** (1959), 20

A new species of the wood boring crustacean *Exosphaeroma madrasensis* has been described. The diagnostic features are: two tubercles at the base of the terminal abdominal segment, abdomen posteriorly ending in a trilobed structure with the middle lobe broader, 'W' shaped, on either side of which there is a small tooth, with the outer ramus of the uropoda ovatolanceolate having an acute apex, both rami of equal length extending a little beyond the telson.

K (G9555) Marine Biology 59 : 57(26)

378. SEBASTIAN, V. O.: Notes on the occurrence of *Herdmania ennurensis* Das, a fouling Ascidian at Kerala coast of India, *J. Timb. Dr. Pres. Ass. India*, **5** (1959), 19

The occurrence of *Herdmania ennurensis* in the brackish water region of Neendakara, Quilon, has been reported. They are found in the summer months of December-May when salinity of the waters is 25-30 per cent and they disappear during the rainy season when salinity is 7 per cent.

L MEDICINE 61

L : 474 Peptic Ulcer 616-002.4

379. SINGH, G. B. & SHUKLA, R. C.: Effect of gonadectomy on experimental peptic ulceration, *Indian J. med. Res.*, **47** (1959), 287

Ovariectomized rats show increased gastric secretion and significantly higher peptic activity than non-ovariectomized rats. Neither gastric secretion nor the degree of ulceration is influenced by orchidectomy. Gonadectomy alone, without ligation, has no ulcerogenic effect on the gastric mucosa.

380. ZAIDI, S. H., BALKRISHNA & SINGH, G. B.: Experimental peptic ulceration: Part V — Adrenal function in histamine-induced ulceration, *Indian J. med. Res.*, **47** (1959), 280

Adrenals play an insignificant role in the production of ulceration in guinea-pigs. Electroshock produces congestion and tiny haemorrhages without any peptic ulceration. Involvement of adrenals is indicated by depletion of ascorbic acid with hypertrophy of the cells of *Zona fasciculata*. Guinea-pigs, protected against acute histamine-induced ulceration by oxyphenonium bromide, show marked depletion of adrenal ascorbic acid and hypertrophy of cortical cells of *Zona fasciculata*. Administration of oxyphenonium bromide to normal fasted animals shows similar adrenal changes.

L: 6 Pharmacognosy 615.43

381. MADAN, C. L. & NAYAR, S. L.: Pharmacognostic study of the leaf and root of *Vitex negundo* Linn., *J. sci. industr. Res.*, **18C** (1959), 10

The macroscopic and microscopic characters of the leaf and root of *Vitex negundo* Linn., a commercial drug used in indigenous medicine in India, have been described.

382. NAYAR, S. L. & BISHT, B. S.: The pharmacognosy of the bark of *Ficus glomerata* Roxb., *J. sci. industr. Res.*, **18C** (1959), 15

The macroscopic and microscopic characters of the bark of *Ficus glomerata* Roxb. have been described.

L: 63 Pharmacology 615.1

383. BALKRISHNA, CHAKRAVARTI, R. N. & ZAIDI, S. H.: Effect of α-tocopherol on serum lipids and lipoproteins in experimental cholesterol atherosclerosis, *J. sci. industr. Res.*, **18C** (1959), 57

Parenteral administration of DL, α-tocopherol acetate during the development of experimental atherosclerosis produced progressive hypercholesterolaemia and β-lipoproteinaemia with a marked rise of C/P ratio and β-cholesterol. In the untreated animals fed with cholesterol in olive oil, the peak of hypercholesterolaemia was noted at six weeks which was maintained up to twelve weeks. Feeding of olive oil alone did not give rise to an increase of serum cholesterol level but produced relative increase of serum β-lipoproteins.

384. CHATTERJEE, K. P., SINHA, K. K. & BANERJEE, S.: Effect of penicillin on blood glucose and lipide contents of tissues, *J. sci. industr. Res.*, **18C** (1959), 110

The effects of penicillin on blood glucose of normal rabbits and on lipide contents of normal rats have been investigated. Prolonged administration of penicillin increases blood glucose level and diminishes glucose tolerance. Glucose tolerance has been found to return to normal in seven days, after the withdrawal of penicillin. Total and ester cholesterol of whole body and only ester cholesterol of intestine increase and ester cholesterol of brain diminishes in rats treated with penicillin. Phospholipide content of kidney of penicillin-treated rats increases.

385. CHOPRA, I. C. & CHOPRA, C. L.: *In vitro* anti-tubercular activity of pristimerin, *J. sci. industr. Res.*, **18C** (1959), 85

Studies on the *in vitro* anti-tubercular activity of pristimerin have shown that pristimerin completely inhibits the growth of H37Rv (human) strain of *Mycobacterium tuberculosis* in a concentration of 5·0 μg./ml., H52RS (streptomycin-resistant) and B19-3 (bovine) strains in a concentration of 6·0 μg./ml. and B19-1 (avian) strain in a concentration of 8·0 μg./ml.

386. GUPTA, S. K., MATHUR, I. S. & MUKERJI, B.: The therapeutic activity of some sulphides, quinazolones and pyrimidines in experimental tuberculosis of guinea-pigs, *J. sci. industr. Res.*, **18C** (1959), 1

A series of sulphides, pyrimidines and quinazolones has been screened against experimental tuberculosis in guinea-pigs. Only *p,p'*-diaminodiphenyl sulphide (D.D. sulphide) has been found comparable to Dapsone (DDS), isoniazid (INH) and dihydrostreptomycin sulphate (DHS). A high correlation between the spleen weight and pathological scores has been established.

387. KHOSLA, M. C., KOHLI, J. D. & NITYA ANAND: Studies in metabolism, absorption, distribution and the mode of excretion of 4: 4'-diaminodiphenyl sulphide, *J. sci. industr. Res.*, **18C** (1959), 51

Conditions have been standardized for the estimation of 4: 4'-diaminodiphenyl sulphide in the presence of biological materials and its metabolism has been studied. The drug is absorbed gradually over a long period and is distributed fairly uniformly in all the tissues, except the brain, and it does not seem to be able to cross the blood-brain barrier. The main route of excretion is the kidney. The drug circulates in the blood mainly in the form of a polar conjugate of 4: 4'-diaminodiphenyl sulphide. The major metabolites in the rabbit and human urine are 4: 4'-diaminodiphenyl sulphide, the corresponding sulphoxide, sulphone and a polar unidentified compound.

A method has been standardized for the salting out chromatography of 4: 4'-diaminodiphenyl sulphide, sulphoxide and sulphone; the method is particularly suitable for sulphides, since these give rather high and unpredictable R_f values by conventional paper partition chromatography.

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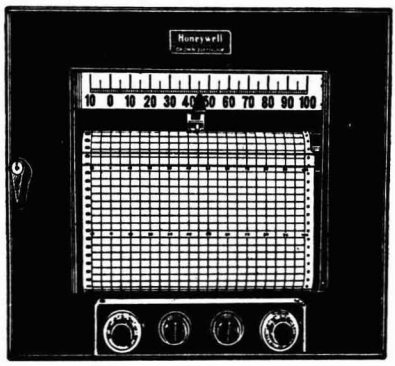

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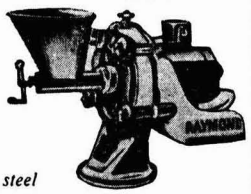

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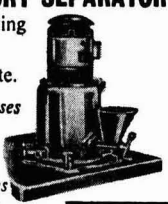

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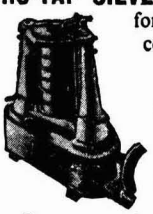

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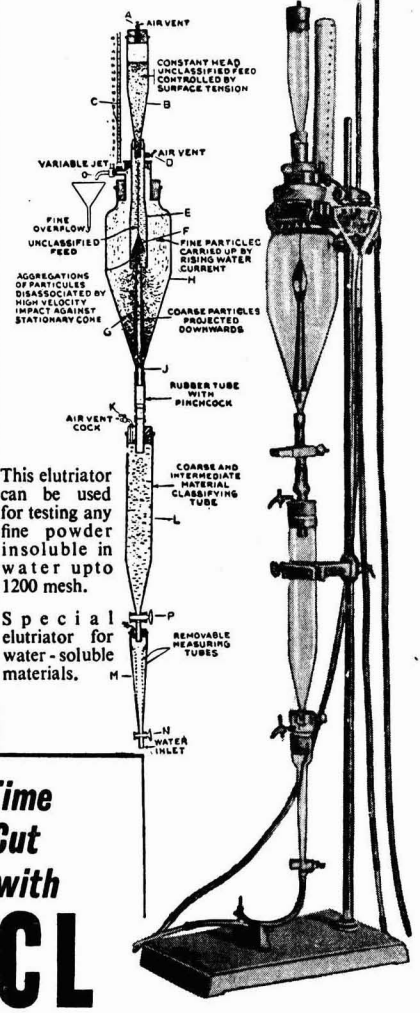

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